IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MARYLAND

ERIC HAMILTON, Plaintiff, v. COMWEB TECHNOLOGY GROUP, INC. PLACEWARE, INC. WEBEX COMMUNICATIONS, INC. FIRST VIRTUAL COMMUNICATIONS, INC. SMART TECHNOLOGIES, INC. TERAGLOBAL COMMUNICATIONS CORP. WEBWISDOM.COM, INC. Defendants.	Civil Action No. MJG 02-CV-2438

APPENDIX TO DEFENDANTS TERAGLOBAL AND WAVE THREE SOFTWARE'S JOINT RESPONSE TO PLAINTIFF'S OPENING BRIEF ON CLAIM CONSTRUCTION

TABLE OF EXHIBITS

TAB	TITLE OR DESCRIPTION	PAGES
Exhibit A	Hamilton, U.S. Patent No. 5,176,520 (issued 5,176,520).	1 – 34
Exhibit B	Amendment A, (Aug. 5, 1991).	1 – 26
Exhibit C	The American Heritage Dictionary (2d ed. 1985).	1 – 13
Exhibit D	Computer Dictionary & Handbook (3d ed. 1980).	1 – 5
Exhibit E	Amendment B, (May 20, 1992).	1 – 68
Exhibit F	IBM Dictionary of Computing: Information Processing, Personal Computing, Telecommunications, Office System, IBM-specific Terms	1 – 6
Exhibit G	Notice of Allowability, (Aug. 24, 1992).	1 – 17

EXHIBIT A

US005176520A

United States Patent [19]

Hamilton

[11] Patent Number: 5,176,520

[45] Date of Patent: Jan. 5, 1993

[54] **COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM AND METHOD**

[76] Inventor: Eric R. Hamilton, 1427 Madison, Evanston, Ill. 60602

[21] Appl. No.: 510,141

[22] Filed: Apr. 17, 1990

[51] Int. Cl.[5] G09B 3/00

[52] U.S. Cl. 434/350; 434/307; 434/323; 434/365; 273/434; 358/85; 379/96; 395/927; 364/419

[58] Field of Search 434/307, 350, 336, 365, 434/323, 108, 162; 379/96; 273/629–431, 433, 434; 358/85; 395/927; 364/410, 419

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4,538,995	9/1985	Fryer	434/432
4,609,358	9/1986	Sangster	434/350
4,659,876	4/1987	Sullivan et al.	379/96
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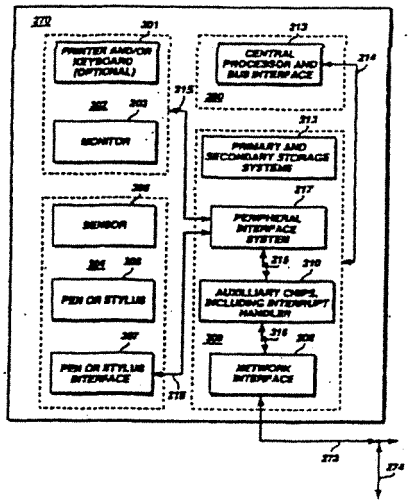
"Audiographic Terminal" by M. Laube, Electrical Communication, vol. 60, No. 1, pp. 45–50, 1986.

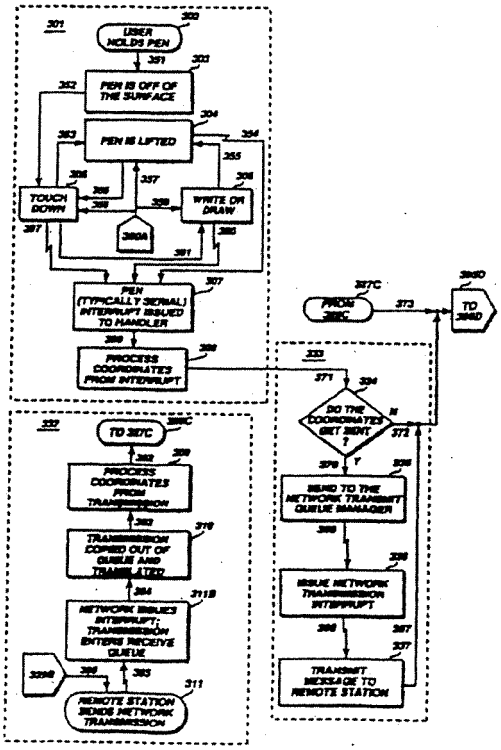
Primary Examiner—Richard J. Apley
Assistant Examiner—Joe H. Cheng
Attorney, Agent, or Firm—Welsh & Katz, Ltd.

[57] **ABSTRACT**

A computer assisted instructional information delivery system having at least two stations. One station for an instructor and one or more stations for students. An interactive monitor is positioned in each station. Each interactive monitor displays instructional information in visual form as inputted by a stylus or light pen on the interactive monitor. A network communication system operated by a central processing unit and corresponding software, communicates the instructional information from the stylus as inputted on one of the interactive monitors and selectively displays the instructional information simultaneously and concurrently onto any or all of the interactive monitors of the stations.

39 Claims, 16 Drawing Sheets





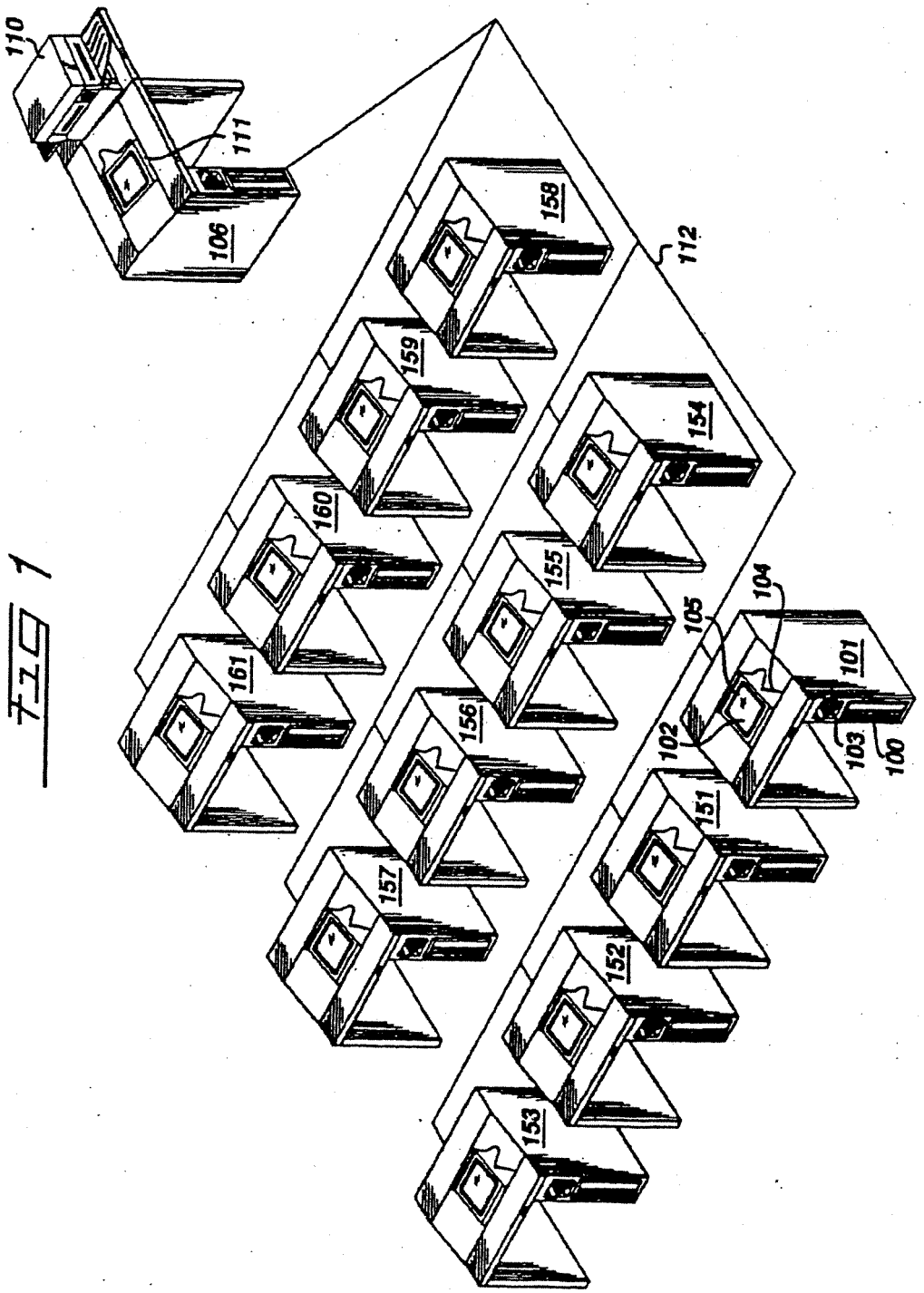

110
111
106
159
112
159
154
160
155
104
105
101
161
156
102
103
100
151
157
152
153

FIG 1

fig 2a

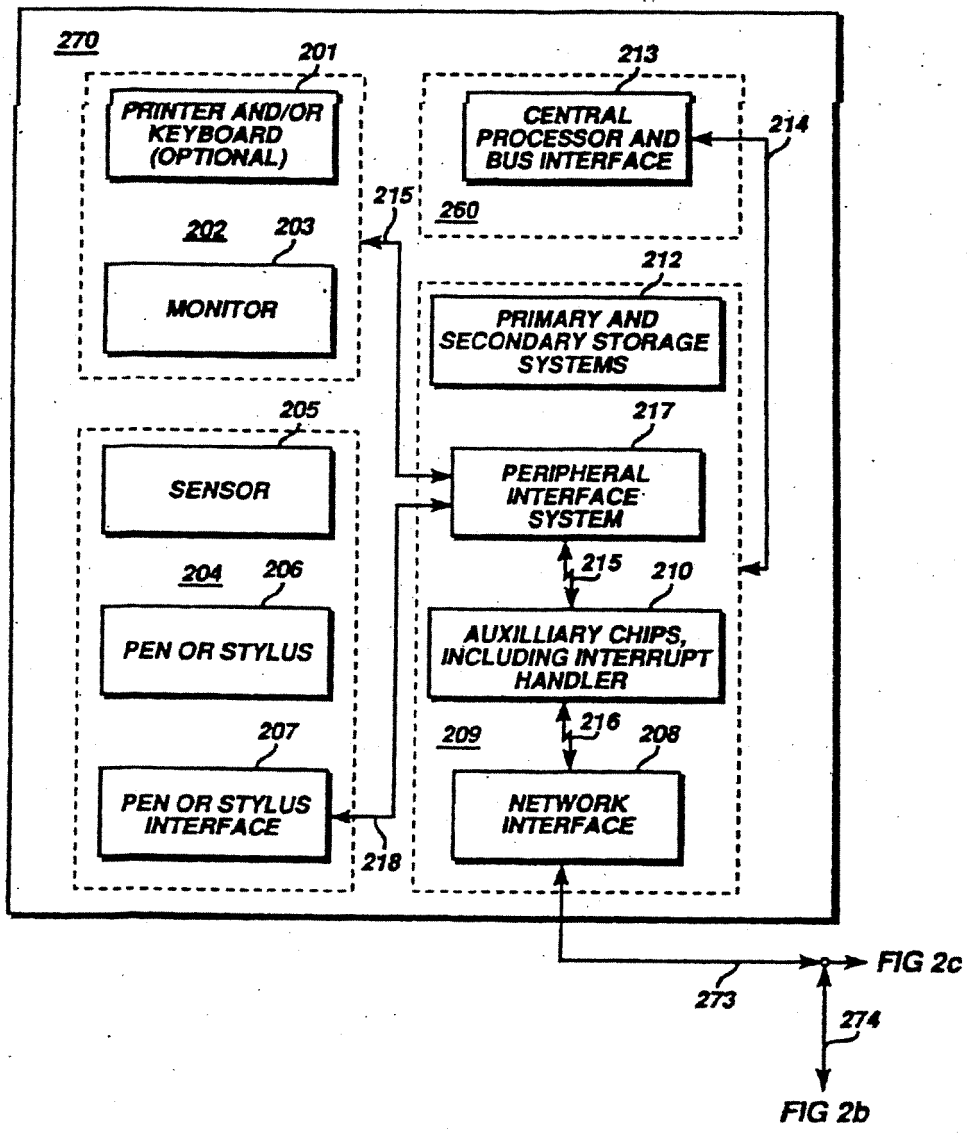

270
201
PRINTER AND/OR KEYBOARD (OPTIONAL)
202
203
MONITOR
205
SENSOR
204
206
PEN OR STYLUS
207
PEN OR STYLUS INTERFACE
218
215
213
CENTRAL PROCESSOR AND BUS INTERFACE
214
260
212
PRIMARY AND SECONDARY STORAGE SYSTEMS
217
PERIPHERAL INTERFACE SYSTEM
215
210
AUXILLIARY CHIPS, INCLUDING INTERRUPT HANDLER
209
216
208
NETWORK INTERFACE
FIG 2c
273
274
FIG 2b

FIG 2b

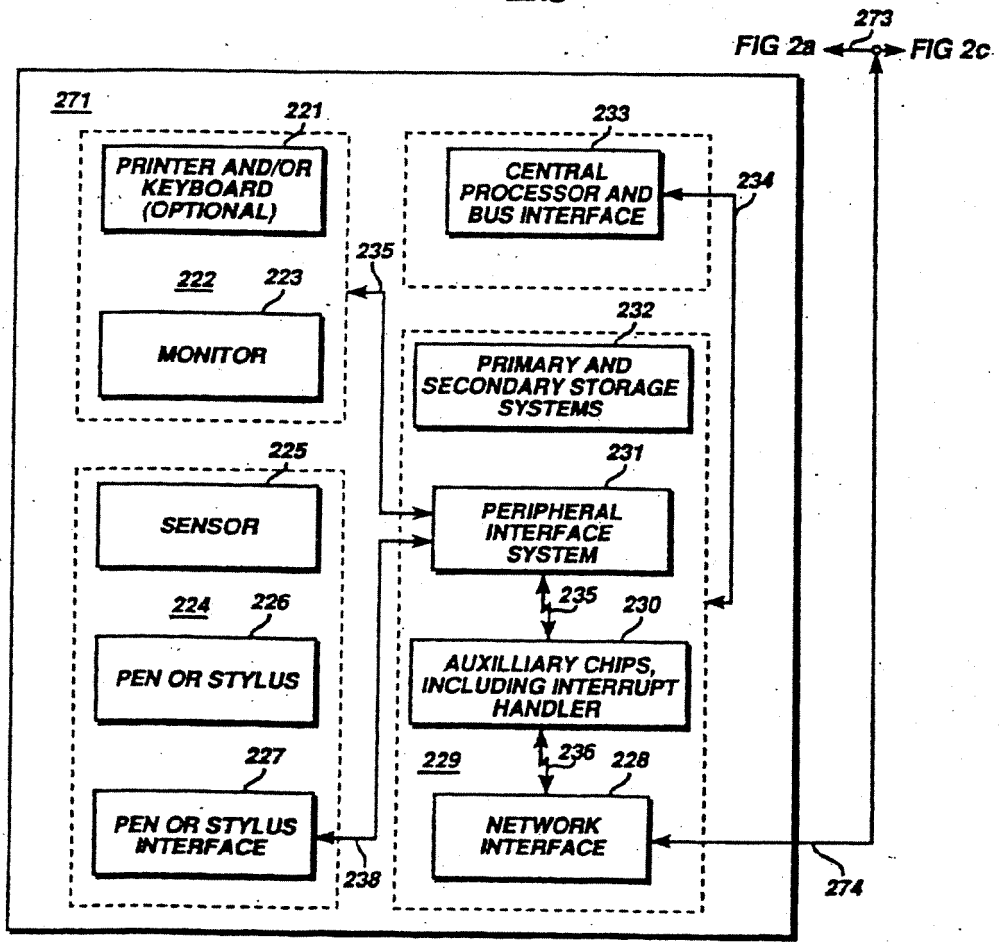

273
FIG 2a
FIG 2c
271
221
PRINTER AND/OR KEYBOARD (OPTIONAL)
222
223
MONITOR
225
SENSOR
224
226
PEN OR STYLUS
227
PEN OR STYLUS INTERFACE
238
233
CENTRAL PROCESSOR AND BUS INTERFACE
234
235
232
PRIMARY AND SECONDARY STORAGE SYSTEMS
231
PERIPHERAL INTERFACE SYSTEM
235
230
AUXILLIARY CHIPS, INCLUDING INTERRUPT HANDLER
229
236
228
NETWORK INTERFACE
274

Fig 2c

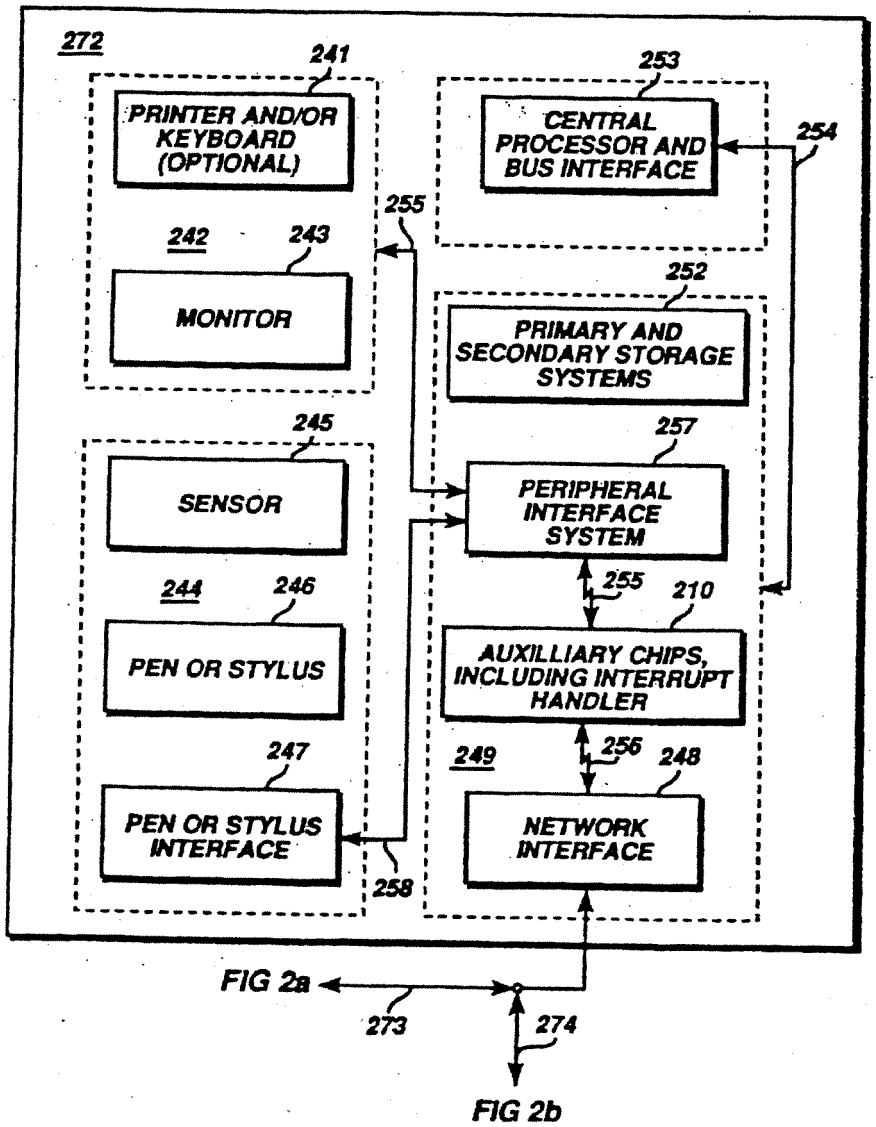

272
241
PRINTER AND/OR KEYBOARD (OPTIONAL)
242
243
MONITOR
253
CENTRAL PROCESSOR AND BUS INTERFACE
254
255
252
PRIMARY AND SECONDARY STORAGE SYSTEMS
245
SENSOR
257
PERIPHERAL INTERFACE SYSTEM
244
246
PEN OR STYLUS
255
210
AUXILLIARY CHIPS, INCLUDING INTERRUPT HANDLER
247
249
256
248
PEN OR STYLUS INTERFACE
NETWORK INTERFACE
258
FIG 2a
273
274
FIG 2b

Fig 3a

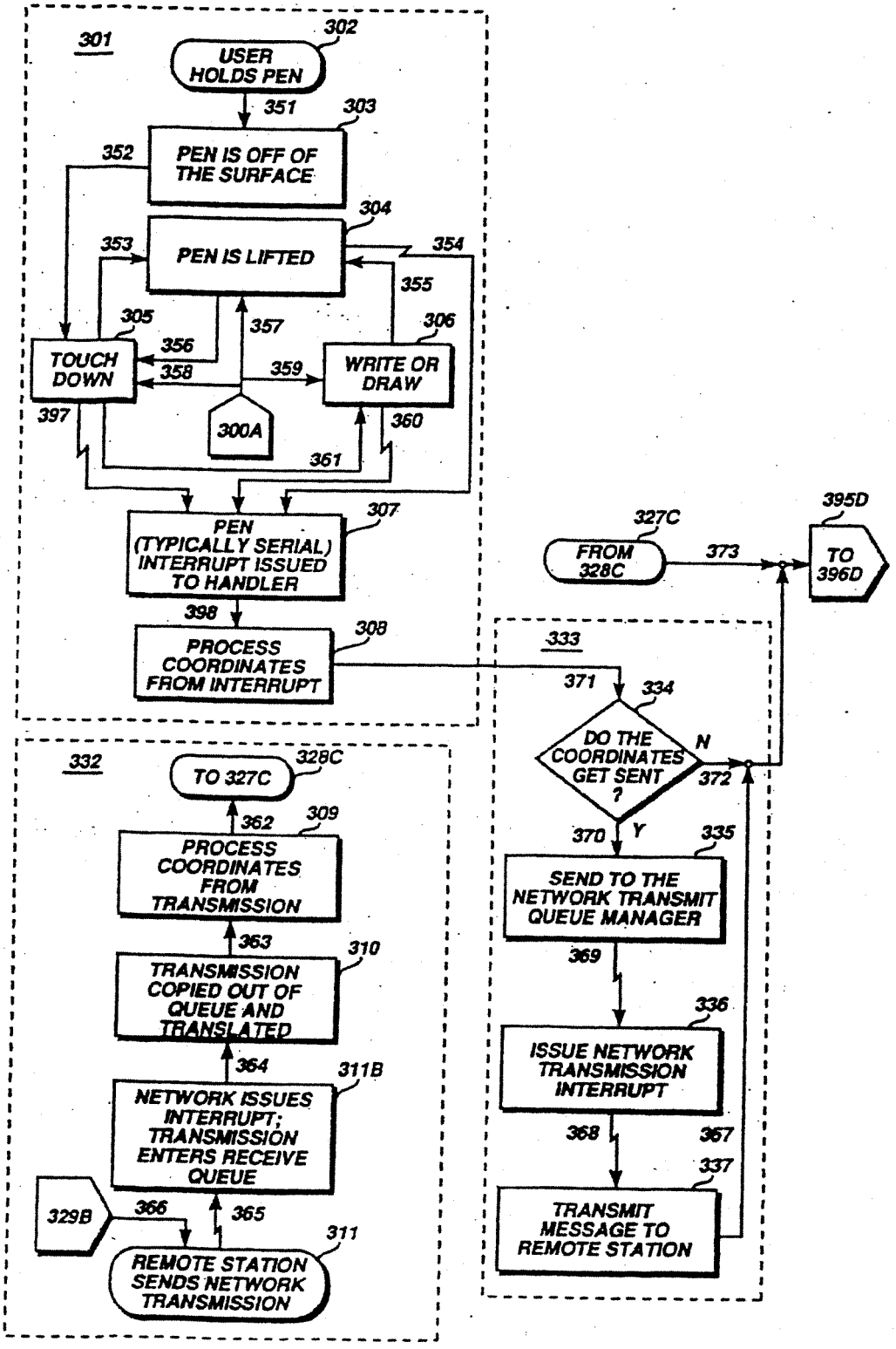

301
302
USER HOLDS PEN
351
303
PEN IS OFF OF THE SURFACE
352
304
PEN IS LIFTED
353
354
355
305
306
357
TOUCH DOWN
356
358
359
WRITE OR DRAW
397
300A
360
361
307
PEN (TYPICALLY SERIAL) INTERRUPT ISSUED TO HANDLER
398
308
PROCESS COORDINATES FROM INTERRUPT
327C
FROM 328C
373
395D
TO 396D
333
371
334
DO THE COORDINATES GET SENT ?
N
372
Y
370
335
SEND TO THE NETWORK TRANSMIT QUEUE MANAGER
369
336
ISSUE NETWORK TRANSMISSION INTERRUPT
368
367
337
TRANSMIT MESSAGE TO REMOTE STATION
332
328C
TO 327C
362
309
PROCESS COORDINATES FROM TRANSMISSION
363
310
TRANSMISSION COPIED OUT OF QUEUE AND TRANSLATED
364
311B
NETWORK ISSUES INTERRUPT; TRANSMISSION ENTERS RECEIVE QUEUE
329B
366
365
311
REMOTE STATION SENDS NETWORK TRANSMISSION

FIG 3b

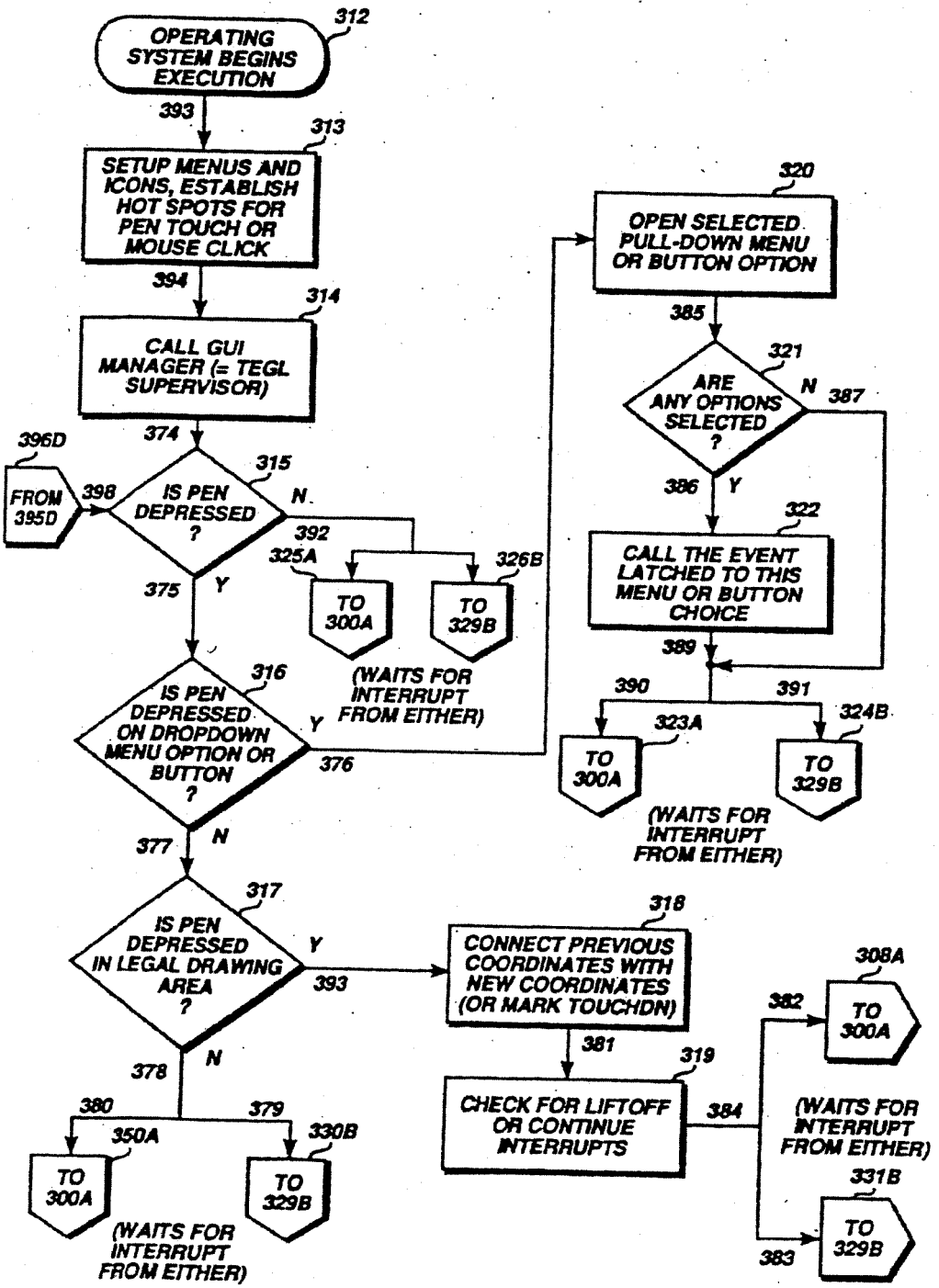

OPERATING SYSTEM BEGINS EXECUTION
312
393
SETUP MENUS AND ICONS, ESTABLISH HOT SPOTS FOR PEN TOUCH OR MOUSE CLICK
313
394
CALL GUI MANAGER (= TEGL SUPERVISOR)
314
374
396D
FROM 395D
398
IS PEN DEPRESSED ?
315
N
392
325A
TO 300A
326B
TO 329B
(WAITS FOR INTERRUPT FROM EITHER)
375
Y
IS PEN DEPRESSED ON DROPDOWN MENU OPTION OR BUTTON ?
316
Y
376
377
N
IS PEN DEPRESSED IN LEGAL DRAWING AREA ?
317
Y
393
CONNECT PREVIOUS COORDINATES WITH NEW COORDINATES (OR MARK TOUCHDN)
318
381
CHECK FOR LIFTOFF OR CONTINUE INTERRUPTS
319
384
382
308A
TO 300A
(WAITS FOR INTERRUPT FROM EITHER)
383
331B
TO 329B
378
N
380
350A
TO 300A
379
330B
TO 329B
(WAITS FOR INTERRUPT FROM EITHER)
OPEN SELECTED PULL-DOWN MENU OR BUTTON OPTION
320
385
ARE ANY OPTIONS SELECTED ?
321
N
387
386
Y
CALL THE EVENT LATCHED TO THIS MENU OR BUTTON CHOICE
322
389
390
391
323A
TO 300A
324B
TO 329B
(WAITS FOR INTERRUPT FROM EITHER)

Fig 4a

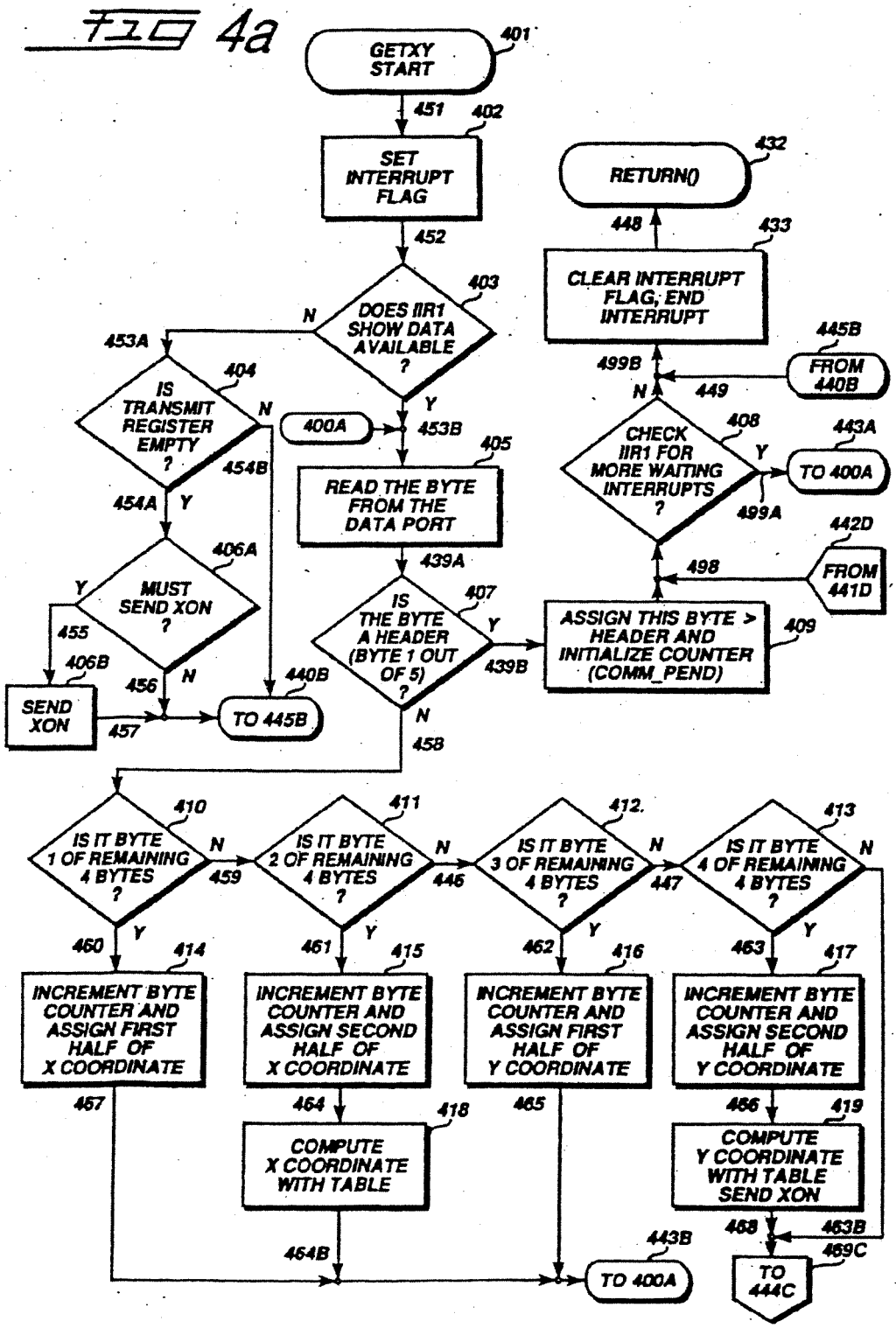

GETXY START
401
451
402
SET INTERRUPT FLAG
452
403
DOES IIR1 SHOW DATA AVAILABLE ?
N
453A
Y
404
IS TRANSMIT REGISTER EMPTY ?
N
454B
454A
Y
406A
MUST SEND XON ?
Y
455
406B
456
N
SEND XON
457
440B
TO 445B
400A
453B
405
READ THE BYTE FROM THE DATA PORT
439A
407
IS THE BYTE A HEADER (BYTE 1 OUT OF 5) ?
Y
439B
N
458
ASSIGN THIS BYTE > HEADER AND INITIALIZE COUNTER (COMM_PEND)
409
498
442D
FROM 441D
CHECK IIR1 FOR MORE WAITING INTERRUPTS ?
408
Y
499A
443A
TO 400A
N
449
499B
445B
FROM 440B
CLEAR INTERRUPT FLAG, END INTERRUPT
448
433
RETURN()
432
410
IS IT BYTE 1 OF REMAINING 4 BYTES ?
N
459
Y
460
411
IS IT BYTE 2 OF REMAINING 4 BYTES ?
N
446
Y
461
412
IS IT BYTE 3 OF REMAINING 4 BYTES ?
N
447
Y
462
413
IS IT BYTE 4 OF REMAINING 4 BYTES ?
N
Y
463
414
INCREMENT BYTE COUNTER AND ASSIGN FIRST HALF OF X COORDINATE
467
415
INCREMENT BYTE COUNTER AND ASSIGN SECOND HALF OF X COORDINATE
464
418
COMPUTE X COORDINATE WITH TABLE
464B
416
INCREMENT BYTE COUNTER AND ASSIGN FIRST HALF OF Y COORDINATE
465
417
INCREMENT BYTE COUNTER AND ASSIGN SECOND HALF OF Y COORDINATE
466
419
COMPUTE Y COORDINATE WITH TABLE SEND XON
468
463B
469C
TO 444C
443B
TO 400A

Fig 4b

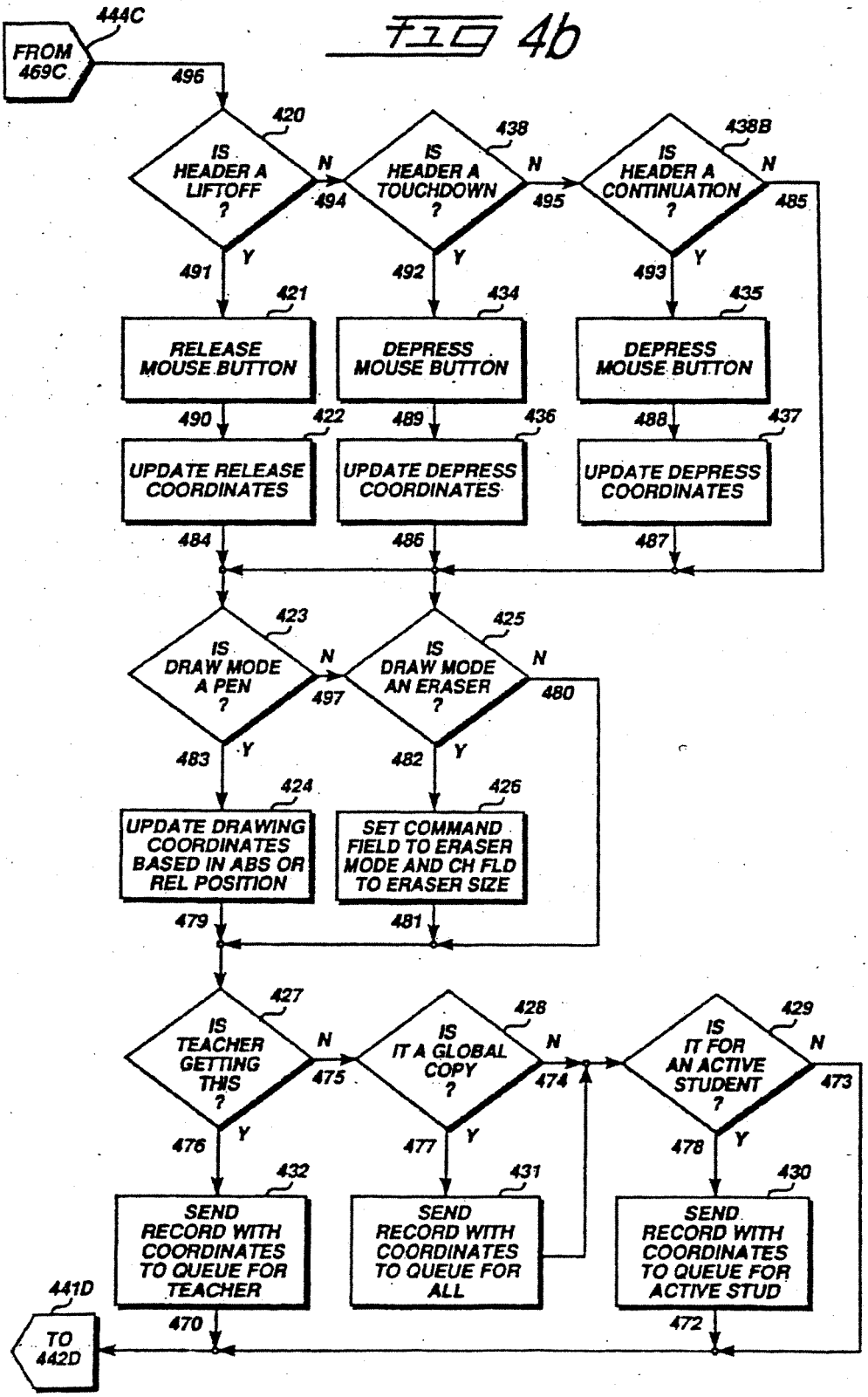

444C
FROM 469C
496
420
IS HEADER A LIFTOFF ?
N
494
438
IS HEADER A TOUCHDOWN ?
N
495
438B
IS HEADER A CONTINUATION ?
N
485
Y
491
Y
492
Y
493
421
RELEASE MOUSE BUTTON
434
DEPRESS MOUSE BUTTON
435
DEPRESS MOUSE BUTTON
490
422
UPDATE RELEASE COORDINATES
489
436
UPDATE DEPRESS COORDINATES
488
437
UPDATE DEPRESS COORDINATES
484
486
487
423
IS DRAW MODE A PEN ?
N
497
425
IS DRAW MODE AN ERASER ?
N
480
Y
483
Y
482
424
UPDATE DRAWING COORDINATES BASED IN ABS OR REL POSITION
426
SET COMMAND FIELD TO ERASER MODE AND CH FLD TO ERASER SIZE
479
481
427
IS TEACHER GETTING THIS ?
N
475
428
IS IT A GLOBAL COPY ?
N
474
429
IS IT FOR AN ACTIVE STUDENT ?
N
473
Y
476
Y
477
Y
478
432
SEND RECORD WITH COORDINATES TO QUEUE FOR TEACHER
431
SEND RECORD WITH COORDINATES TO QUEUE FOR ALL
430
SEND RECORD WITH COORDINATES TO QUEUE FOR ACTIVE STUD
441D
TO 442D
470
472

Fig 5a

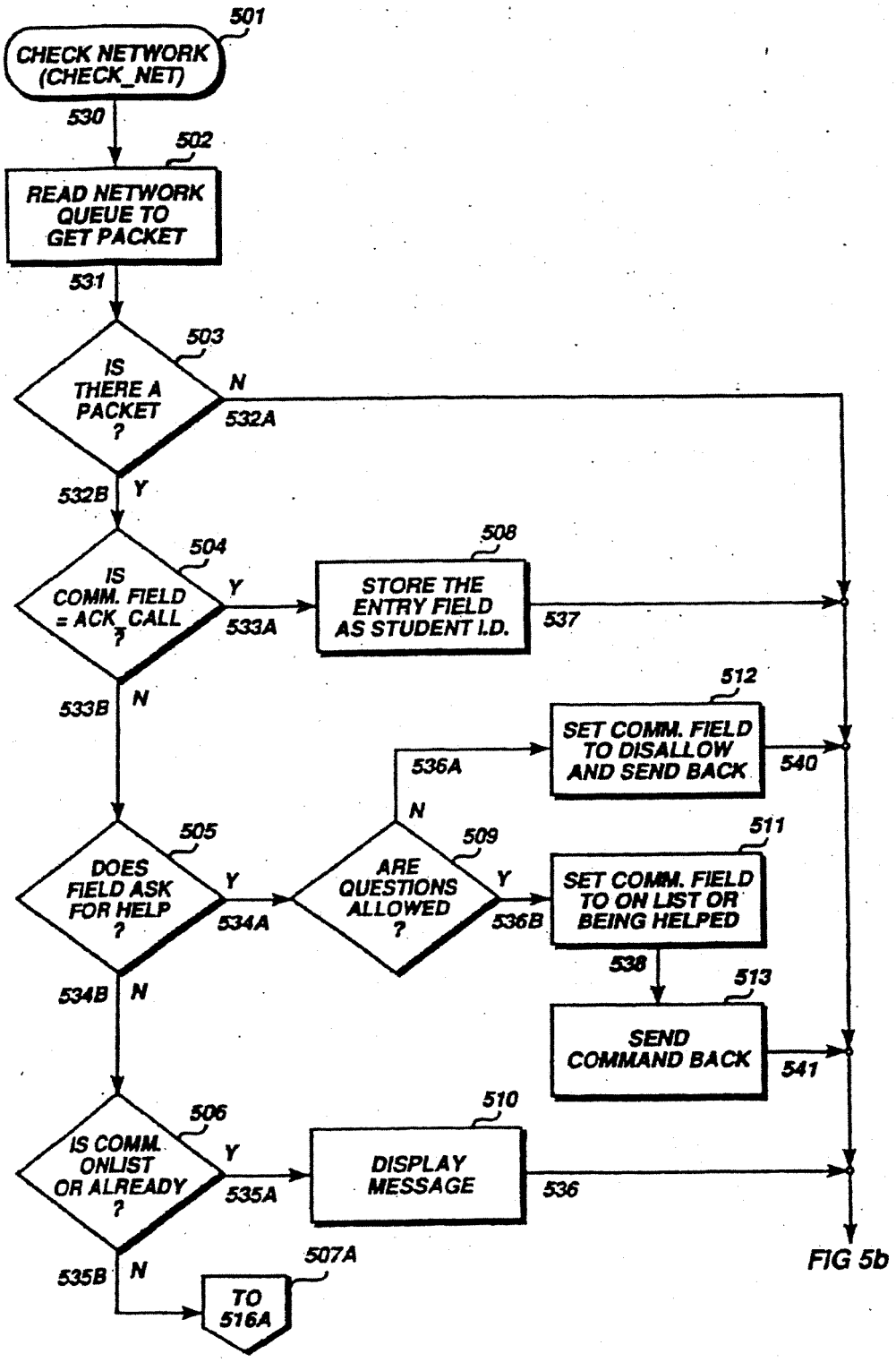

501
CHECK NETWORK (CHECK_NET)
530
502
READ NETWORK QUEUE TO GET PACKET
531
503
IS THERE A PACKET ?
N
532A
Y
532B
504
IS COMM. FIELD = ACK_CALL ?
Y
533A
508
STORE THE ENTRY FIELD AS STUDENT I.D.
537
N
533B
512
SET COMM. FIELD TO DISALLOW AND SEND BACK
540
536A
N
505
DOES FIELD ASK FOR HELP ?
Y
534A
509
ARE QUESTIONS ALLOWED ?
Y
536B
511
SET COMM. FIELD TO ON LIST OR BEING HELPED
538
513
SEND COMMAND BACK
541
N
534B
506
IS COMM. ONLIST OR ALREADY ?
Y
535A
510
DISPLAY MESSAGE
536
N
535B
507A
TO 516A

FIG 5b

FIG 5b

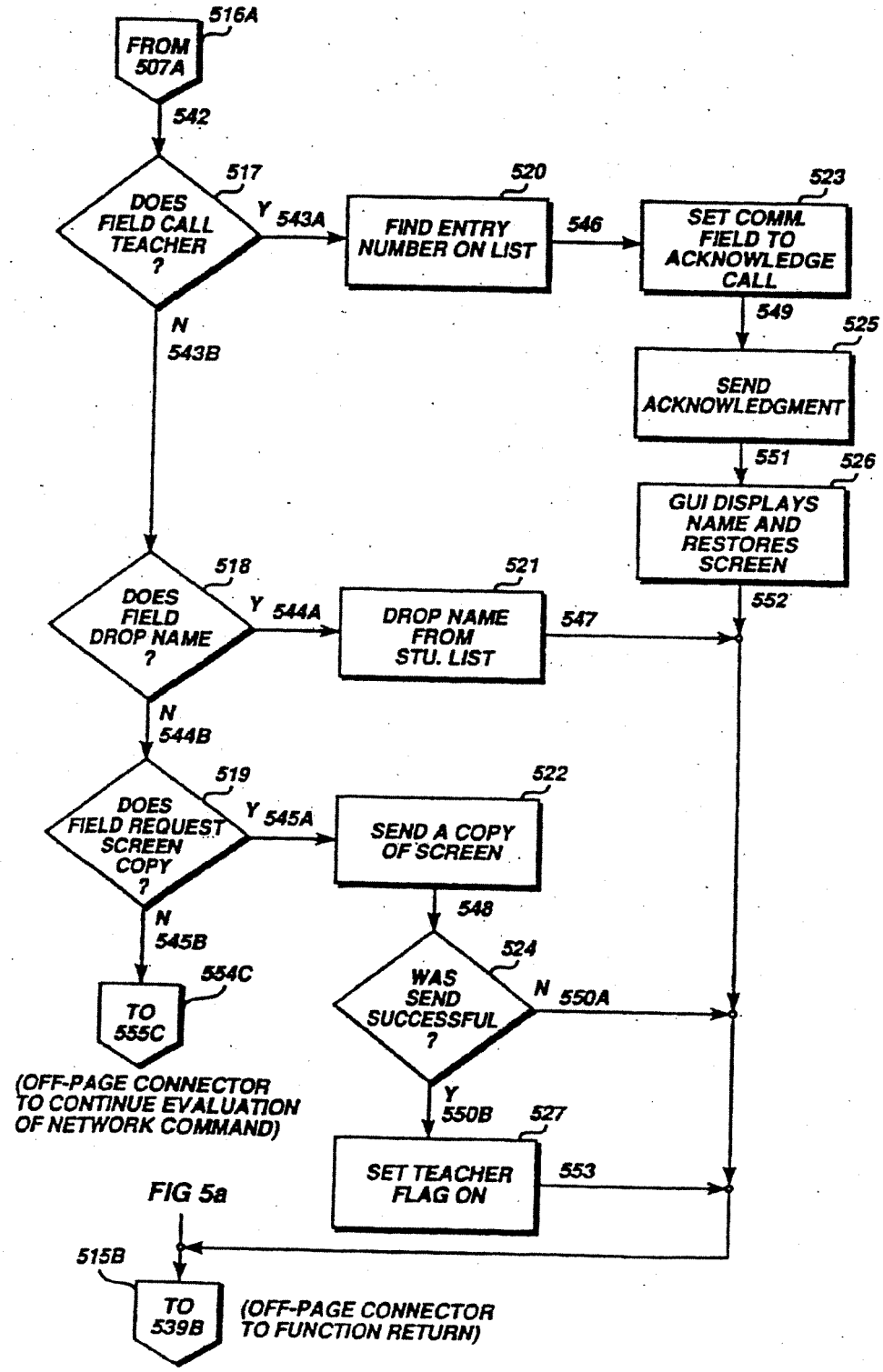

516A
FROM 507A
542
517
DOES FIELD CALL TEACHER ?
Y 543A
520
FIND ENTRY NUMBER ON LIST
546
523
SET COMM. FIELD TO ACKNOWLEDGE CALL
549
525
SEND ACKNOWLEDGMENT
551
526
GUI DISPLAYS NAME AND RESTORES SCREEN
552
N 543B
518
DOES FIELD DROP NAME ?
Y 544A
521
DROP NAME FROM STU. LIST
547
N 544B
519
DOES FIELD REQUEST SCREEN COPY ?
Y 545A
522
SEND A COPY OF SCREEN
548
N 545B
524
WAS SEND SUCCESSFUL ?
N 550A
554C
TO 555C
(OFF-PAGE CONNECTOR TO CONTINUE EVALUATION OF NETWORK COMMAND)
Y 550B
527
SET TEACHER FLAG ON
553
515B
TO 539B
(OFF-PAGE CONNECTOR TO FUNCTION RETURN)

FIG 5a

Fig 5c

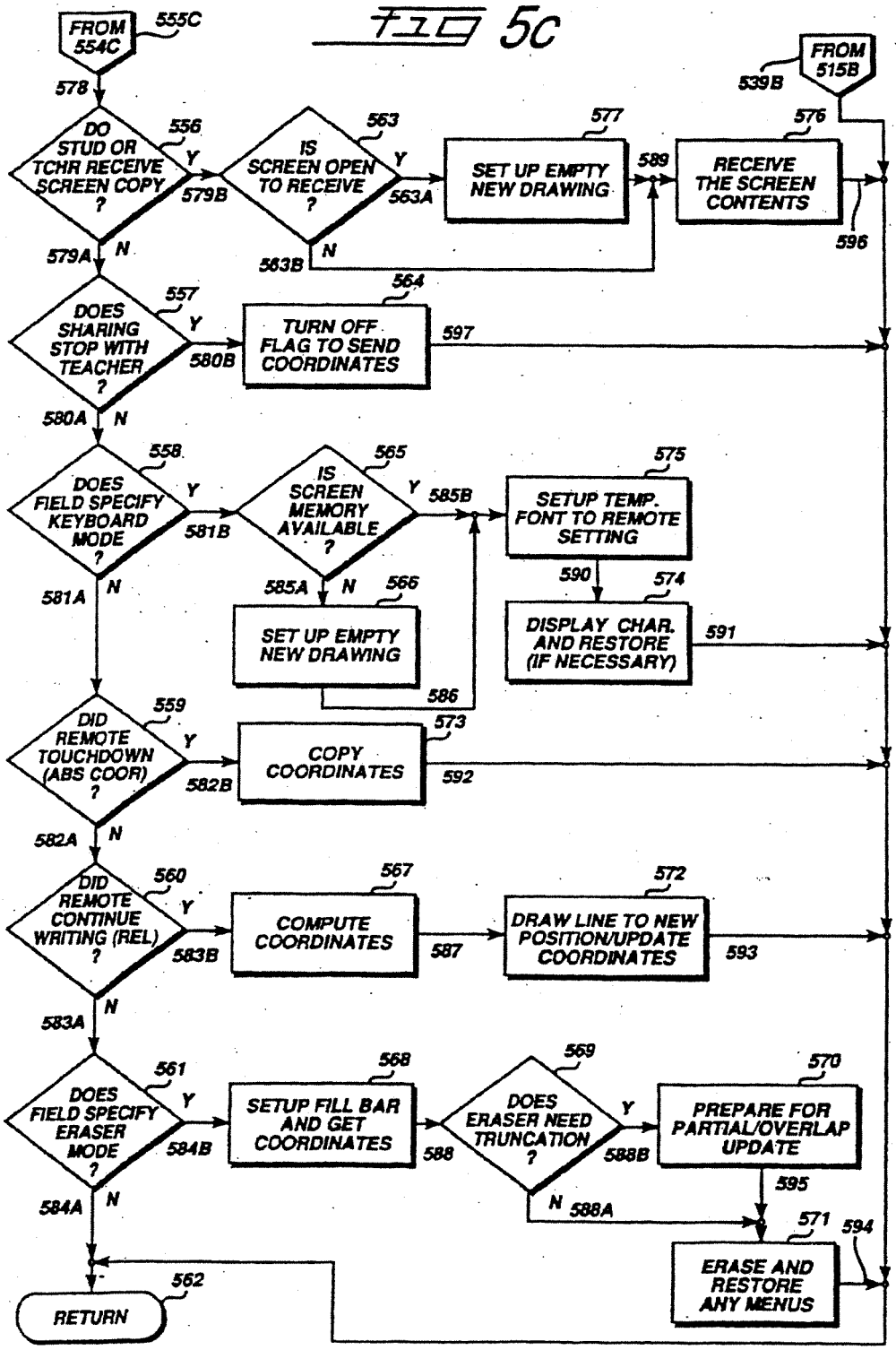

FROM 554C
555C
578
DO STUD OR TCHR RECEIVE SCREEN COPY ?
556
Y
579B
N
579A
IS SCREEN OPEN TO RECEIVE ?
563
Y
563A
N
563B
SET UP EMPTY NEW DRAWING
577
589
FROM 515B
539B
RECEIVE THE SCREEN CONTENTS
576
596
DOES SHARING STOP WITH TEACHER ?
557
Y
580B
N
580A
TURN OFF FLAG TO SEND COORDINATES
564
597
DOES FIELD SPECIFY KEYBOARD MODE ?
558
Y
581B
N
581A
IS SCREEN MEMORY AVAILABLE ?
565
Y
585B
N
585A
SETUP TEMP. FONT TO REMOTE SETTING
575
590
DISPLAY CHAR. AND RESTORE (IF NECESSARY)
574
591
SET UP EMPTY NEW DRAWING
566
586
DID REMOTE TOUCHDOWN (ABS COOR) ?
559
Y
582B
N
582A
COPY COORDINATES
573
592
DID REMOTE CONTINUE WRITING (REL) ?
560
Y
583B
N
583A
COMPUTE COORDINATES
567
587
DRAW LINE TO NEW POSITION/UPDATE COORDINATES
572
593
DOES FIELD SPECIFY ERASER MODE ?
561
Y
584B
N
584A
SETUP FILL BAR AND GET COORDINATES
568
588
DOES ERASER NEED TRUNCATION ?
569
Y
588B
N
588A
PREPARE FOR PARTIAL/OVERLAP UPDATE
570
595
ERASE AND RESTORE ANY MENUS
571
594
RETURN
562

FIG 6a

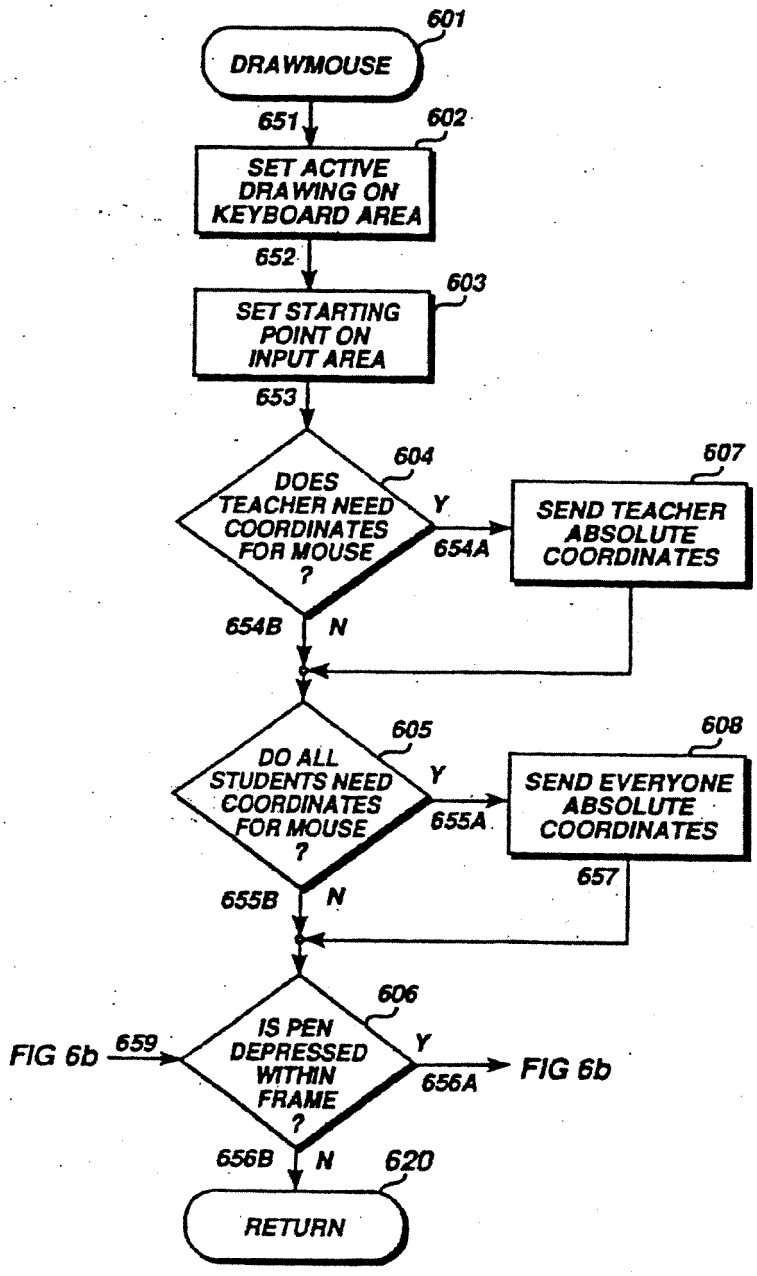

601
DRAWMOUSE
651
602
SET ACTIVE DRAWING ON KEYBOARD AREA
652
603
SET STARTING POINT ON INPUT AREA
653
604
DOES TEACHER NEED COORDINATES FOR MOUSE ?
Y
654A
607
SEND TEACHER ABSOLUTE COORDINATES
654B
N
605
DO ALL STUDENTS NEED COORDINATES FOR MOUSE ?
Y
655A
608
SEND EVERYONE ABSOLUTE COORDINATES
657
655B
N
606
FIG 6b
659
IS PEN DEPRESSED WITHIN FRAME ?
Y
656A
FIG 6b
656B
N
620
RETURN

FIG 6b

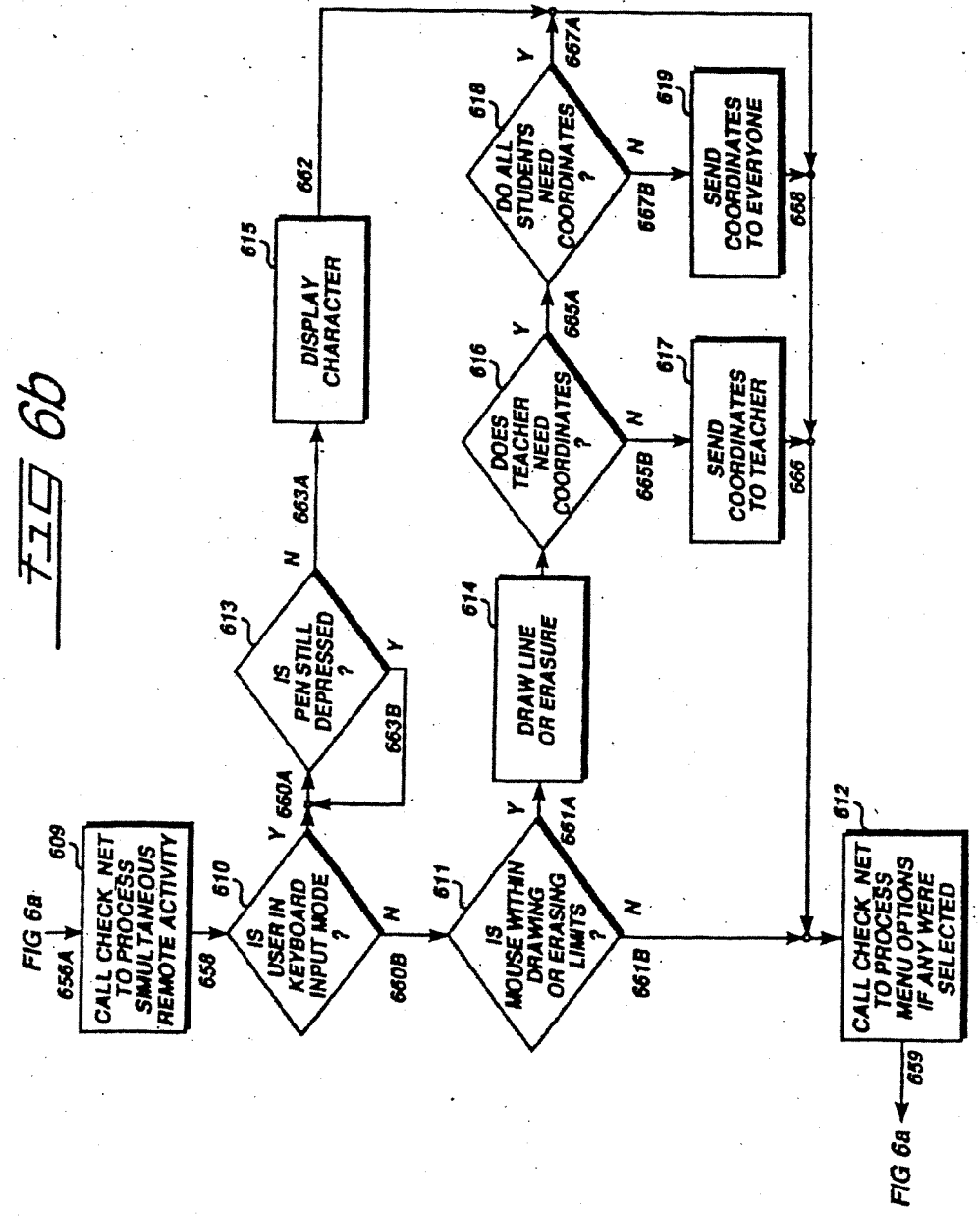


FIG 6a
656A
609
CALL CHECK NET TO PROCESS SIMULTANEOUS REMOTE ACTIVITY
658
610
IS USER IN KEYBOARD INPUT MODE ?
Y
660A
N
660B
611
IS MOUSE WITHIN DRAWING OR ERASING LIMITS ?
Y
661A
N
661B
613
IS PEN STILL DEPRESSED ?
Y
663B
N
663A
614
DRAW LINE OR ERASURE
615
DISPLAY CHARACTER
662
616
DOES TEACHER NEED COORDINATES ?
Y
665A
N
665B
617
SEND COORDINATES TO TEACHER
666
618
DO ALL STUDENTS NEED COORDINATES ?
Y
667A
N
667B
619
SEND COORDINATES TO EVERYONE
668
612
CALL CHECK NET TO PROCESS MENU OPTIONS IF ANY WERE SELECTED
659
FIG 6a

Fig 7

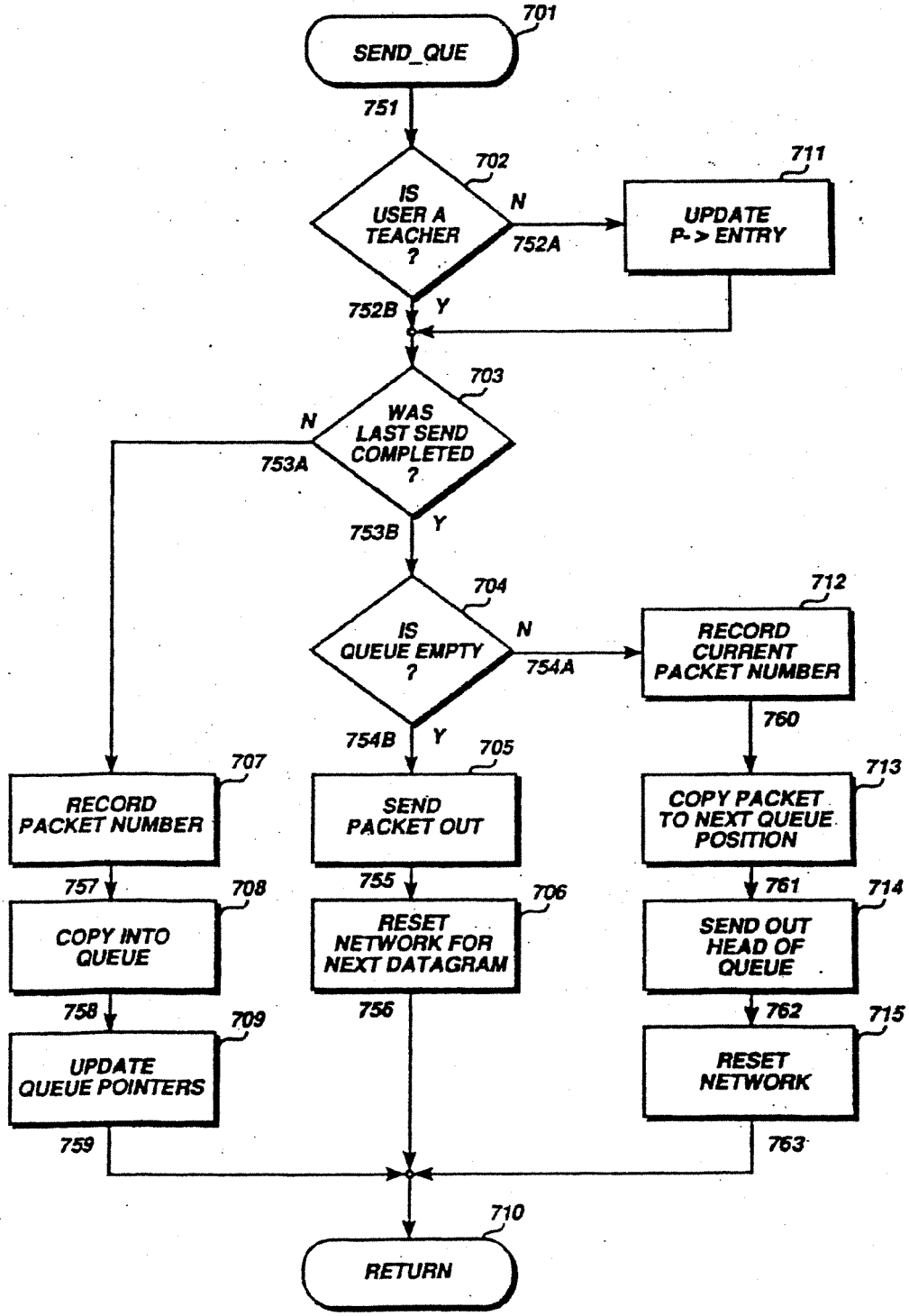

701
SEND_QUE
751
702
IS USER A TEACHER ?
N
752A
711
UPDATE P-> ENTRY
752B
Y
703
WAS LAST SEND COMPLETED ?
N
753A
753B
Y
704
IS QUEUE EMPTY ?
N
754A
712
RECORD CURRENT PACKET NUMBER
760
754B
Y
705
SEND PACKET OUT
707
RECORD PACKET NUMBER
713
COPY PACKET TO NEXT QUEUE POSITION
755
757
708
COPY INTO QUEUE
706
RESET NETWORK FOR NEXT DATAGRAM
761
714
SEND OUT HEAD OF QUEUE
758
709
UPDATE QUEUE POINTERS
756
762
715
RESET NETWORK
759
763
710
RETURN

Fig 8a

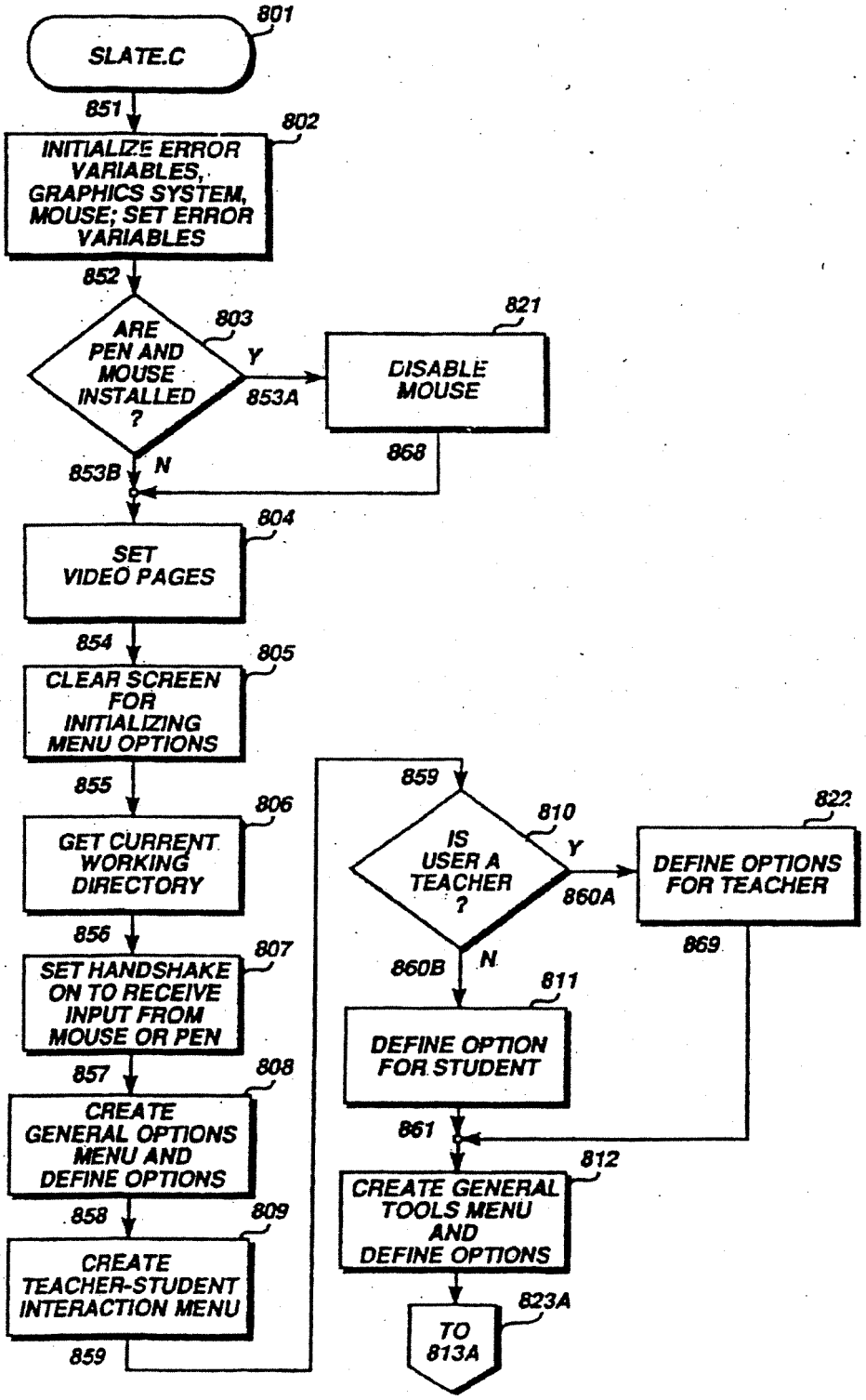
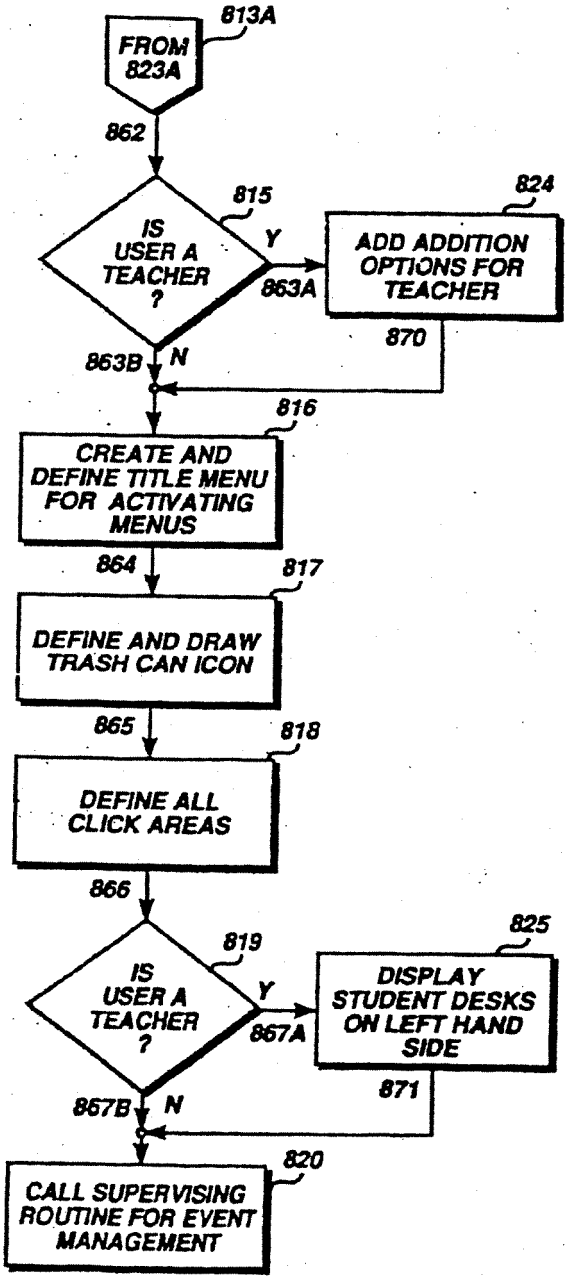

801
SLATE.C
851
802
INITIALIZE ERROR VARIABLES, GRAPHICS SYSTEM, MOUSE; SET ERROR VARIABLES
852
803
ARE PEN AND MOUSE INSTALLED ?
Y
853A
821
DISABLE MOUSE
868
853B
N
804
SET VIDEO PAGES
854
805
CLEAR SCREEN FOR INITIALIZING MENU OPTIONS
855
806
GET CURRENT WORKING DIRECTORY
856
807
SET HANDSHAKE ON TO RECEIVE INPUT FROM MOUSE OR PEN
857
808
CREATE GENERAL OPTIONS MENU AND DEFINE OPTIONS
858
809
CREATE TEACHER-STUDENT INTERACTION MENU
859
859
810
IS USER A TEACHER ?
Y
860A
822
DEFINE OPTIONS FOR TEACHER
869
860B
N
811
DEFINE OPTION FOR STUDENT
861
812
CREATE GENERAL TOOLS MENU AND DEFINE OPTIONS
823A
TO 813A

Fig 8b


813A
FROM 823A
862
815
IS USER A TEACHER ?
Y
863A
824
ADD ADDITION OPTIONS FOR TEACHER
870
863B
N
816
CREATE AND DEFINE TITLE MENU FOR ACTIVATING MENUS
864
817
DEFINE AND DRAW TRASH CAN ICON
865
818
DEFINE ALL CLICK AREAS
866
819
IS USER A TEACHER ?
Y
867A
825
DISPLAY STUDENT DESKS ON LEFT HAND SIDE
871
867B
N
820
CALL SUPERVISING ROUTINE FOR EVENT MANAGEMENT

COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM AND METHOD

As part of the specification hereto is a Microfilm Appendix as Computer-Output-Microfilm output affixed to 26 paper cards.

This invention relates to a computer-mediated communication system, the primary application of which is intended to be classrooms or other training or learning environments. More particularly, this invention relates to a configuration of computer hardware and software which enables two or more users (typically an instructor and student) at different stations to share what will be called electronic sheets of paper.

BACKGROUND OF THE INVENTION

A genre of training software that simulates simultaneous two-way communication has emerged in recent years. Such software typically involves an operator at one terminal taking control of an application at another station. Although control of the application reverts back and forth between operators at different stations, three critical differences distinguish such systems from the present invention. First, such prior systems always require a basic platform application, such as a word processor or spreadsheet. The present invention does not require such a platform application. Second, the present invention does not involve one operator taking control of an application. Two users may simultaneously control the application. Third, such applications do not contemplate free-hand writing or drawing to simulate paper and pencil writing and drawing as the principal means of effecting the shared communication.

Although some video instructional systems enable teachers to transmit images created by one student to appear at the stations of a full classroom in a single manner similar to this invention, these prior systems do not entail simultaneous and interactive communication between the teacher and student, either on a one to one or one to a selective group.

Prior instruction systems, such as that shown in U.S. Pat. No. 3,401,469 to Shaver and U.S. Pat. No. 4,486,180 to are severely limited in their flexibility and interaction capabilities. In Shaver, the interaction between student and a control center is over different channels in which the instructional material is prepared in advance, unlike the present invention in which the instructional material is constructed extemporaneously. The invention disclosed in Shaver is not interactive, in that the present invention affords the ability for the material being presented to the student to change on the basis of a teacher's response to the student's input. In Riley, no simultaneous and interactive communication is contemplated, because the system is intended for standardized tests. The present invention provides a medium of simultaneously written interactions between teacher and student.

Other known systems involve the use of predefined still video information such as U.S. Pat. No. 4,052,798 to Tomita, et al. The present invention disseminates information interactively by the teacher as the student works. There is no need to predefine information, and it is not "still" in that the video image seen by the student is always subject to change by the teacher.

Many prior systems are not applicable to written textual communication which is the most effective manner to teach grammar or mathematics, etc. U.S. Pat. No. 3,233,346 to Cornberg involves the use of a telephone system for the student to communicate to the teacher while the student views a video display of the teacher. The invention disclosed in Cornberg is severely limiting in that it does not allow one of the most fundamental means of communication, that being the writing mode, in which student and instructor can communicate.

Even currently known software products such as "Carbon Copy" made by Meridien Technology, a subsidiary of Microcom, Inc., do not allow interaction based on extemporaneous freehand input and rely on the use of preexisting application software rather than the application-free context that the present invention provides. Of all known computer assisted instructional systems, none provide interactive freehand input in an application-free context.

Numerous other advantages and features of the invention will become readily apparent from the detailed description of the preferred embodiment of the invention, from the claims, and from the accompanying drawings, in which like numerals are employed to designate like parts throughout the same.

SUMMARY OF THE INVENTION

The invention in its simplest form is a computer assisted instruction system for a classroom which allows a teacher to share an electronic sheet of paper with one or more students in the classroom, enabling both teacher and student to write on the same "sheet" virtually simultaneously from different parts of the room. At her choice and at her pace, the teacher can switch among students, observing and sharing their work space as their needs require.

The inventive concept consists in the preferred embodiment of the following. Each student's desk is equipped with a 14" monitor (i.e. "screen" or "display"). The monitor surface lies flat on the desk, flush with the desk's surface, and it is equipped with an attached stylus that looks much like a fiber-tipped pen, but with a hard tip. The teacher's station is equipped with a monitor as well (and may also be connected to a bank of small monitors). All of the student computers are linked to the teacher's station. As a student physically writes on the surface of his monitor with the stylus, the image that is written not only appears on that student's display, but is also transmitted simultaneously to the teacher's station. The teacher can passively observe the student's work, or actually interact with the student by writing on her own station at the front of the class, with the image moving back to the student on their display. In effect, the teacher and the student are sharing an electronic sheet of paper. Both can actually work with several electronic sheets of paper, and can "shuffle them" as one might shuffle loose pages taken from a notebook. The teacher can transmit the image from one student, to the whole class, or to a subset of the entire class. With a scanner, the teacher can send images from problem sheets, practice sheets, or even tests to all of the students, virtually copying them directly off of paper and onto the students' displays. Students can, when appropriate, get actual printed copies of their work, or save their work from one class to the next. The desk housing the student monitor will include a sliding cover, to protect the monitor when not in use.

If the teacher's station is equipped with a single monitor, she would be able to select which student's work to view just by touching an image (or "icon") on her monitor from the front. Because all student activity is trans-

mitted to the teacher's station as that activity occurs, the image of the newly selected student's work will immediately appear at the teacher's display.

In a mathematics classroom, for example, a teacher and a student may work together on the same problem from different locations within a classroom. The teacher, more particularly, can watch a student work, and jot down suggestions or comments on the student's sheet. The student may similarly pose questions to the teacher.

The teacher may also elect to transmit back to all students simultaneously. For example, if the teacher poses a geometry problem that she transmits to all of the students, she can wait for a few minutes, observing them and helping them as they work, and then send all of them some further information to help in the next step of the problem.

When equipped with a monitor of sufficient resolution, split screen capability, or when equipped with more than one monitor, the teacher may view the work of and communicate with several students simultaneously.

It is an object of this invention to enable a student and a teacher to share an electronic sheet of paper from remote locations, where the term "share" means that both teacher and student may write or draw on that electronic sheet of paper simultaneously from remote locations with the image produced by one appearing on screen of the other or both.

It is further an object of this invention to enable a student and a teacher to share an electronic sheet of paper from remote locations, where the term "share" also means that both teacher and student may type on that paper simultaneously from remote locations with the text produced by one appearing on screen of the other.

It is further an object of the invention that a teacher may monitor the written work of students by electronically selecting which student's paper will appear at the teacher's station. For example, by activating an icon (appearing in the teacher's monitor) corresponding to a particular student, the current image for that student then appears on the teachers monitor, and the teacher and the student may continue to work on the image together.

It is further the object of this invention that the teacher may transmit to a group of two or more individuals the same image, and the teacher would be able to write on his/her screen, with the result appearing simultaneously at all of the stations sharing that image. In fact, an entire group may work on the same electronic sheet simultaneously.

It is yet another object of the invention that students may discretely communicate with teachers by signaling to the teacher in a means that only the teacher and student can see that the student would like to pose a question. The student may jot down questions to the teacher on their display and the teacher's display without the rest of the class being privy to that communication.

The attainment of the foregoing and related objects, advantages, and features of the invention should be more readily apparent to those skilled in the art after review of the following more detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an external perspective view of a classroom system in accordance with the present invention.

FIGS. 2A–2C represent an overall schematic diagram identifying the hardware components and connections of the present invention.

FIGS. 3A and 3B provide flow diagrams identifying the general operation of the present invention in which FIG. 3A emphasizes the three communication systems (from the pen, from the network, and to the network), and FIG. 3B depicts the background operation, primarily of the graphical user interface (GUI).

FIGS. 4A and 4B depict in flow chart form the specific flow of operations of the first communication system (from the pen).

FIGS. 5A–5C depict in flow chart form the actual content of the second and third communication systems (to and from the network).

FIGS. 6A–6B depict in diagram form the principal routine that integrates the first communication system with the second and third communication systems.

FIG. 7 depicts in diagram form how the implementation of the present invention manages network transmissions as they are requested in rapid succession.

FIGS. 8A–8B depict in diagram form the source file SLATE.C, which includes the start-up main function, and the initialization of the system until the program is taken over by the graphical user interface (GUI).

BRIEF DESCRIPTION OF THE TABLES

Tables 1 and 2 each list the source code routines and .C files of the present invention, identifying in both Tables the page number in the Microfilm Appendix of each routine or file. Table 1 lists the routines and files in order of page number, and Table 2 lists the routines and files in alphabetical order.

Table 3 identifies key routines as they correspond to the processes depicted in FIGS. 3A and 3B.

The Microfilm Appendix includes two documents. The first, pages H1–H20, provides the actual list for the project (.PRJ) file and header (.H) files in the current implementation of the invention. The second part of the Appendix, pages C1–C133, provides the actual source code listing, arranged in alphabetical order by .C file name, and referenced in Tables 1 through 3.

With the Microfilm Appendix, Version 2.0 of the Turbo C Professional by Borland International of Scotts Valley, Calif., with the LITECOMM standard terminal software package referenced on page C25 of the Microfilm Appendix, and with the screen writing system identified in the next section, this implementation may be readily reconstructed and utilized in performing the novel features of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

While the invention is susceptible of embodiment in many different forms, there is shown in the drawings, tables, Microfilm Appendix, and will be described herein in detail, a preferred embodiment of the invention. It should be understood, however, that the present disclosure is to be considered an exemplification of the principles of the invention and is not intended to limit the spirit and scope of the invention and/or claims of the embodiments illustrated.

Turning now to the drawings, more particularly to FIG. 1, there is depicted a facsimile of a classroom with the present invention implemented therein. A representative desk (101) houses the software and computer hardware for either teacher or pupil. A computer (100) is connected to a monitor (102) whose display (e.g., Cathode Ray Tube (CRT) or Liquid Crystal Display Type (LCD)) is flush against the surface of the desk. In the Figure, 102 illustrates the surface of the monitor. An optional keyboard (103) may also be connected to the computer (100). A conventional network bus (112) connects all of the individual desks (101, 106 and 151 through 161). Such a network bus 112 may be effectuated by what is known as serial communication, but more typically will be effective using network protocols that operate at higher speeds (greater than 1.0 megabits per second) than typically available under serial protocols. Commonly used standard protocols for such networks are produced by Novell, Inc. (e.g., "Netware") and by International Business Machines (IBM) (e.g., "NetBIOS"). These conventional networks provide the means for computers to communicate with one another. The software component of the invention may be stored in a disk drive or in "read-only memory" at each station (i.e., inside the computer depicted in 100) or at the central teacher station (106). In the preferred embodiment, the software is stored in a disk drive (not shown) at the teacher station. When the pupil at a student station uses the software, a copy of it is sent over the network bus (112) and stored in the "random access memory" (or "RAM") of the user's computer (101), and is run by that computer.

It is possible, in an alternative embodiment, that the student stations (101 and 151–161) do not actually house computers with "central processing units," but instead derive not only their disk storage from the teacher's station (106) but also derive their RAM storage and computing power from the computer at the teacher stations. In this case, each student station would function as a so-called "terminal," and would not include a computer (100). FIGS. 2A–2C, discussed below, provide a schematic of the network bus 112 connections.

Also connected to the computer is a free-style handwriting system (104) to simulate to the user the ability to "write," either on the monitor or on a glass or glass-like sensor plate (105) resting above the monitor, just as one would "write" on a piece of paper with a pen or pencil. Thus, the display from the monitor (102) is directly beneath and is seen through the glass sensor (105). FIG. 1 depicts one possible writing configuration, namely the appearance of the same image on all desks if the teacher transmits the same image to all students. The handwriting system may consist of a corded or cordless light pen, in which the pen translates video signals and is so integrated with an interface card (207 of FIG. 2A) to send coordinates of the pen's position on the screen to the computer's central processing unit. Alternatively, the monitor itself may be so constructed as to allow the interception of coordinates as a pen-like object moves across its surface, as done by so-called touch screens. Finally, the system may also consist of a pen-like object and glass plate or glass-like plate, positioned directly above the monitor's surface, which are interfaced with the hardware in such a way that as the stylus moves across the surface of the plate, coordinate positions are relayed to the computer.

The preferred embodiment implementation, however, does not involve a light pen or touch screen. Instead, as mentioned, a sensor plate (105) is mounted above the monitor (102), and it is the combination of the sensor plate and stylus, rather than monitor and light pen, that produces the signals.

The housing and computer for the teacher's station (106) may be physically identical to that of any individual student station, although it is likely that a teacher's station may have an optional printer attachment (110). Any student station may also have such an optional printer attachment.

The teacher's display may also, at the teacher's option, include "icons" (111) appearing within the display. An "icon" is a small graphic symbol which, when referenced by the user, provides the user with access to the information or processes that the symbol represents. Under this implementation, each student at stations 101 and 151 through 161 are represented by a separate icon. When the teacher touches the screen where an icon for a student appears, the teacher and that student can begin hand-written screen-sharing communication. That is, both may write (using the pen system (104)) at his or her own station, and the image created by the writing of each user appears not only at that user's station, but at the other user's station as well.

FIGS. 2A–2C more fully depict the physical components of the system. In FIGS. 2A–2C, three separate and identical user or student/teacher stations are depicted (270, 271, 272). Only one of these stations 270 will be described herein, it being understood that the other two stations are identical (except as noted). The central processing unit with bus interface (213) is connected via a data bus (214) to the computer's remaining systems (209), including storage (212), (i.e., primary storage, or "RAM"; secondary storage, such as disk drive; or "read-only memory" ("ROM")), peripheral interface (217) (e.g., serial and parallel ports), auxiliary chips (210) (such as the standard "8259" interrupt controller, which prioritizes external interrupts (such as issued by a serial interface) to a central processing unit, and the network interface (208), which provides the computer with the physical means to communicate with other stations over the network bus. The central processing unit with bus interface (213) and communication lines to other components (212, 217, 210, 208), and internal communications (215 and 216) comprise the computer system (100) of FIG. 1.

Under the preferred embodiment implementation, the computer (comprised of blocks 260 and 209) may involve an IBM-compatible system with a conventional Intel 80386 processor (included as part of 213), with a standard interrupt controller (included in 217), serial port (included in 210), and "Invisible Network" Novell NetBIOS-compatible network system (with interface card depicted as 208) from Invisible Software, Inc., Foster City, Calif. In the preferred embodiment, the central processing unit (253) at the teacher's station is significantly enhanced by the processing power of at least an 80386 chip with the capacity to access large blocks of random-access memory (greater than 640 kilobytes) as well as the capacity to use large blocks of RAM as a high speed substitute for secondary (e.g., disk) storage, although a less sophisticated chip (e.g., 8088) may be used at student stations.

The handwriting system is shown here as 204, consisting of the pen or stylus (206), (104 of FIG. 1), a sensor (205) that rests above the monitor (203), and the interface system (207) (out of view in FIG. 1, but housed in the desk (101)) that translates the pen strokes

on the sensor into event codes and coordinate positions for transmission via a data bus (218) back to the peripheral interface system. Under the preferred embodiment implementation, this transmission occurs via serial cabling. Such a handwriting system (204) is available as the Screenwriter TM system, from Microtouch Systems, Inc., 55 Jonspin Road, Wilmington, Mass. 01887. When a system such as the Screenwriter is the input medium for the three-communication system depicted in 301, 332, and 333 of FIG. 3A and the graphical user interface depicted in FIG. 3B, the shared screen writing of this invention is effected. The individual stations are connected to one another via the network cabling (273, 274).

FIGS. 2A–2C depict two student stations (270 and 271) and one teacher station (272). Student station 271 and teacher station 272 include the same components (except for the aforementioned central processor unit 253 at the teacher's station.) Thus, identifiers 221 through 238 correspond identically with identifiers 201 through 218, as do identifiers 241 through 258.

FIG. 3A identifies the three concurrently operating communication systems at a single user's station (either teacher or student) under this implementation of the invention, shown as enclosures within the three dotted boxes (301, 332, 333) in FIG. 3A. The first (301) involves the free-hand pen input, from a user. The second (332) involves transmissions sent over the network to the user from other stations. The third (333) involves transmissions sent from this station over the network to other stations.

Table 3 identifies the key functions in the source code for each process in both FIGS. 3A and 3B, with a page number reference to the Microfilm Appendix. (FIGS. 4–7 diagram the most important of these functions with respect to the critical simultaneous communication systems that effect a shared writing surface.)

FIG. 3B identifies the "background" system, including the graphical user interface (GUI), that displays to the user the user's input or the input from other stations in the network.

The implementation begins execution with initialization of all of the communication systems, the GUI management system, and other features of the execution environment (312). (The GUI system in this implementation was developed by Richard Tom of TEGL Systems, Inc., Vancouver, BC, as a graphical toolbox. Source code for the TEGL portion of the implementation, as it has been adapted for use here, appears between pages C74 and C133 of the Microfilm Appendix.)

The software application itself then proceeds as a continuous interaction of four systems: the three communication systems (from the pen to the software application (301), from the software application out to other stations in the network (333), and to the software application from other stations in the network (332)) and the GUI management system (FIG. 3B).

At the beginning of the program, the pen is assumed to be off of the input surface (303). The user holding the pen (302) can keep the pen off the surface, touch the pen on the surface (305), or move the pen over the surface in a writing or drawing fashion (306). From either a touch down or a moving position, the user may lift the pen off of the surface (304). An interrupt is issued whenever the pen's status changes (353, 357 and 355 lead to interrupt 354; 352, 358, and 356 lead to interrupt 397; 359 and 361 lead to interrupt 360). The interrupt handler receives the interrupt and begins processing five bytes of information from it: the command field, and two coordinates for each of the x- and y- coordinates identifying the location of the pen on the sensor when the interrupt occurred. The principal routine to perform the interrupt handling is int_getxy, diagrammed in FIGS. 4A and 4B, and beginning on line 72 of page C35 of the Microfilm Appendix.

The lower right dotted rectangle (333) of FIG. 3A depicts the second of the three concurrent communication systems. As coordinates are processed by the int_getxy routine, an evaluation of whether the input is to be transmitted is made at lines 88 through 94 of page C36 of the Microfilm Appendix, corresponding to 334 of FIG. 3A. If the data is to be transmitted, it is sent to the sending queue for transmission to appropriate other stations via the send_que routine (line 70 of page C31 of the Microfilm Appendix). This communication system involves transmission of a data packet which includes the coordinate and event information. (FIG. 7 diagrams the send_que routine.)

The lower left dotted rectangle (332) of FIG. 3A depicts the third communication system, namely incoming transmissions. Because transmission speeds over a network (e.g., over Ethernet) are typically faster than the signals from an input device (e.g., under serial protocols), it is actually possible that of two or more individuals sharing the same screen, a "remote" writer's input may appear on the screen more quickly than the "local" writer. The software application processes incoming coordinates from the pen or from remote sites on an interrupt-management basis, and gives to users the appearance of simultaneity. (FIGS. 5A–5C depict the network communication process in greater detail.)

A remote station sends a network transmission with a packet containing coordinate and event information (311, 365) to the user's station. When the packet arrives at the local station, a network interrupt is issued (311B), which, when serviced, places the packet onto a receiving queue (rec_int, on line 8 of page C31 of the Microfilm Appendix).

The data is copied out of the queue (310) and the coordinate values are computed (309) for use as if they were derived from the input device. Thus on-page connector C (328C) leads to on-page connector C (327C) for processing by the GUI (FIG. 3B) on the same path (off-page connectors D (395D in FIG. 3A and 396D in FIG. 3B)) as the pen input (372 and 367). Once coordinates are available from either a network transmission or from an interrupt from the pen, different GUI functions, especially including drawmouse (page C69 in the Microfilm Appendix and more fully diagrammed in FIGS. 6A–6B), process the coordinates to update to user's viewing area. Thus, if the pen (at either the local or remote station) is depressed (315), the location of the depressed area must be evaluated. If the (local) user is attempting to access a "drop-down" menu or is trying to access an option by touching a "button" on the screen (316) (for example, to change the pen from writing mode to erasing mode), the choice is processed (320–321). If the (local or remote) user is instead continuously depressing the pen in a writing area (317), a line is drawn to connect the location of that depression with the most previous one (318). (These "lines" are extremely short, and give the appearance of smooth, continuous drawing or writing.) As the drawmouse diagram of FIGS. 6A–6B note, this "connecting the dots" activity may constitute erasing parts of the screen if the user is in the erasure mode. If the depression of the pen

(317) is actually a "touch down" rather than a "continued draw," the coordinates are stored for subsequent connection. The drawing routine then checks to determine whether the (local or remote) user is continuing to write or has lifted the pen off of the surface of the screen.

Off-page connectors A (308A, 323A, 325A, and 350A in FIG. 3B) represent a flow of control back to off-page connector A in FIG. 3A (300A), to the routines that evaluate the status of the pen. However, this flow of control only occurs if pen activity has produced an interrupt of the GUI to indicate that the pen status or pen position has changed. Off-page connectors B (326B, 330B, 324B, and 331B in FIG. 3B) represent a similar flow of control to off-page connector B in FIG. 3A (329B) to determine whether network transmissions are available, although the GUI checks in a systematic fashion (with the check_net function of FIGS. 5A–5C) to determine whether network interrupts have left any coordinate data from a remote user available in the network "queue."

In FIGS. 3A and 3B, a number of marked connections identify the sequence of the aforementioned operations and evaluation of command field. These marked connections include 351–353, 355–359, 361–364, 366–367, 370–382, 384–387, 389–394, and 397–398. All of these connections represent standard flow of control pathways.

FIGS. 4A and 4B diagram the function int_getxy (beginning on line 61 of page C35 of the Microfilm Appendix), which processes interrupts issued by the pen interface (207 of FIG. 2A, and 354, 360, 397 of FIG. 3A). Significant portions of this routine are written as in-line assembler (lines 74–95 of page C35, lines 99–102 of page C36, and lines 1–7 of page C37 of the Microfilm Appendix) to simplify the view of the register-level activity of this function. The function (401) begins by enabling the type of maskable interrupt issued by the interface (402). The communications register that identifies whether serial data has arrived and is waiting to be latched from an input port is tested (403) for the availability of a incoming data. If not (453A), the transmit register is tested (404). If not empty, the function begins to exit by jumping (454B) to the lines which will clear the interrupt flag and exit the function. If the transmit register is empty, (454A), another test is required for this implementation for whether an XON must be issued prior to exit (406A). If not (456), the function jumps (457) to the exit lines, as it does after issuing an XON (406B) if one is necessary (455). The purpose of the int_getxy function, is to process a positive result from the (403) test for incoming data. If data is available (453B), it is read from the input port (405) and examined.

If the byte falls within a specified range, it is the first incoming byte (or header byte (407)) of a sequence of five bytes from the pen interface which identify one of three pen events (lift up, touch down, or continue draw) and the coordinate position of the reported event. If the byte is a header (439B), the reported event is recorded and a counter for the remaining four bytes is initialized (409). The communications register to signal that another byte of data has arrived and is ready to be latched is tested (408). If the result is positive (499A), flow of control returns to the code which reads the data (405), shown in the diagram by on-page connector A (443A) to on-page connector A (400A). A negative result to 408 begins the process of exiting the function (499B).

With the counter initialized, the subsequent four bytes are evaluated and processed at 410 through 413. Each time one of the four bytes is processed, the counter is incremented and the byte is stored for translation to screen-mappable x- and y-coordinates (414–417). The pen interface under this implementation identifies a point on a 1024×1024 point grid on the sensor (205 of FIG. 2A). The screen resolution may be 640×480. The first two bytes (410 and 411) report the horizontal position, and the second two bytes (412 and 413) report the vertical position Thus, after the second byte is processed, the x-coordinate for the screen can be computed (418), and the y-coordinate for the screen can be computed (419) after the fourth byte. An XON is also issued at 419 to signify that the full five byte expected transmission has been received.

Once the header and the coordinates have been latched and initially processed, they are further processed so that the GUI can update the display. This involves testing the header byte for the three possible events (lift-off, touch down, or continued draw) (420, 438, and 438B).

The GUI is an adaptation of "mouse" routines, and the mouse terminology of those routines is retained in this source code. A mouse is a hand-held device connected to a computer to provide a user with a flexible means of changing the location of the "currently active" portion of a screen, or to choose to carry out commands available by pressing or "clicking" the buttons on the mouse. A "mouse routine" is one which translates activity with the mouse, such as moving it, clicking a button, or releasing a button, into the action intended to follow as a result of that activity Thus, a lift-off corresponds to a mouse button release (421) whereas a touch down or a continued draw correspond to depressing a mouse button (434 and 435). Once the "release" or "depress" flags are set, the "release" or "depress" variables are updated with the new coordinates (422, 436, and 437), before an evaluation of whether the pen event involves a draw (423) or an erasure (425).

In either event, the coordinates are recorded for possible transmission to other stations in the network (424 and 426), to which they are sent via the send_que function (432, 431, 430), diagrammed in FIG. 7. FIG. 4B diagrams the testing of the flags to indicate whether a transmission of the header and coordinates should be issued to the teacher, to all of the stations, or to a student station (427–429). FIGS. 4A and 4B, which together diagram the int_getxy function, are joined by the two off-page connectors C (469C in FIG. 4A and 444C in FIG. 4B) and by the two off-page connectors D (442D in FIG. 4A and 441D in FIG. 4B.

Once the new coordinates have thus been processed, and the available data register shows no new data, the function is exited. When the GUI detects that the interrupt from the pen to its background activity has produced a flag showing that a "mouse" button is depressed (i.e., that the pen is pressed against the surface of the sensor above the monitor), the GUI calls the "drawmouse" function (page C66 of the Microfilm Appendix that is diagrammed in FIGS. 6A–6B), and the coordinates of the drawing are placed on the screen. It is during the drawmouse function that the check_net function (page 60 of the Microfilm Appendix), diagrammed in FIGS. 5A–5C, is called to see if any network interrupts from a remote station have placed coor-

dinate drawing data from that station to also be included in the drawing on the screen.

The lines in FIGS. 4A and 4B depict the flow of control from one process or test within the function to the next. These lines are referenced by identifiers 439A, 439B, 445 through 446, 448 through 449, 451 through 468, and 470 through 499.

FIGS. 5A–5C together diagram the flow of control for the check_net function, on pages C69–C70 of the Microfilm Appendix. The check net function is the communication handler that translates network communications between stations into information that the GUI can use to produce the shared screen effect of the invention. This function runs in the GUI background (FIG. 3B) and is also called at various points when update values are expected from network interrupts. In particular, check_net is called by the drawmouse function as shown in FIG. 7.

The check_net function begins by reading the network queue (502) via the read_que function (page C31 of the Microfilm Appendix) to determine if any transmissions await processing. A transmission, except when involving a full screen of graphical data, occurs in increments of PACKETs, defined on line 50 of page H10 of the Microfilm Appendix. When presented in upper case letters, PACKET refers to a specific variable to be transmitted over the network. A packet includes a one byte command field, a name field to transmit a student's name, a table entry field to identify a student by code, a character field when passing typed characters (or the eraser radius during erasures), a font identifier, and the x and y coordinates identifying the location of the event being shared by the screens.

The check_net function is the conversation between stations. The "first word" of every communication between stations is the command field, and it identifies how the receiving station should interpret the "rest of the conversation." The current implementation at the source level allows these command fields: ACK_CALL, ASK_HELP, ON_LIST, BEING_HELPED, NOT_ALLOW, CALL_TEACHER, DROP_NAME, SEND_COPY, STOP_SEND, SCREEN_COPY, KBRD_INPUT, ABS (for touch down of the pen at remote station), REL (to signify continued writing after a touch down), and ERASER.

The polling (503) to determine whether an interrupt was previously issued resulting a PACKET being stored on the queue is effected by returning a zero if there was none (532A) (which simply produces a return to the calling function) or a non-zero (i.e., "true" or "yes" condition) pointer to a copy of the PACKET (532B), at which point a case statement evaluates the command field of the PACKET. (Path 532A leads to an exit diagrammed in FIG. 5B (515B) where the exit path continues to off-page connector 539B in FIG. 5C, leading to a return (562). The exit path in the diagram leads through off-page connectors B (515B in FIG. 5B and 539B in FIG. 5C.)) The flow-of-control arrows 533B, 534B, 535B, 542, 543B, 544B, 545B, 578, 579A, 580A, 581A, 582A, 583A, and 584A of FIGS. 5A–5C all signify that the test to identify the command in the PACKET has not yet succeeded. Only student stations under this implementation will receive the ACK_CALL command (504, line 51 of page C69 of the Microfilm Appendix), signifying that the teacher has acknowledged that the student has logged onto the system and has returned an identifier for an internal table at the teacher station for that student. The student station then stores the identifier (508) and the routine then exits (i.e., flow of control returns to the instruction immediately after the one that called the check_net function.) Only teacher stations will receive requests for help commands (505, line 55 of page C69 of the Microfilm Appendix) which are followed by examining whether questions are being allowed (509). If not (536A), a transmission is sent back to the student with the command field set to DISALLOW. Otherwise, the command field is set (511) to tell the student s/he is on the list for help (line 61 of page C69 of the Microfilm Appendix) or to remind the student s/he is already being helped (line 69 of page C69), and that command is sent back to the student (513) prior to exit (541). Thus, these newly set command fields (to signify "no help allowed," "already being helped," or "on list to be helped") are transmitted back to the student (512 or 513, leading to connector 517B, where the exit path continues to connector 539B in FIG. 5C, leading to a return (562)). If the student station receives one of these responses (506), the appropriate message is displayed (510), and the function exits (536).

When a new station physically logs onto the network at the time it is booted, an identifier is issued by the network software. When a student first logs onto this software implementation, it issues a call to the teacher for an identifier. This is the identifier the student stores (508) when it receives an acknowledgement (504) of this call to the teacher. The call itself (517, line 91 of page C69 of the Microfilm Appendix) is received by the teacher's station, which looks up the student's identifier issued by the network (520), and returns it to the student (525) with the command field of the outgoing PACKET set to ACK_CALL (523). Next, the GUI displays the name on the teacher's screen before restoring the screen to its appearance before the name display (526). Control then returns to the calling function (552).

A DROP_NAME command field (518, line 2 of page C70 of the Microfilm Appendix) will result when the student logs off the system; when the teacher's station receives a PACKET with this command field, the student's name is dropped (521) from the table position it took when the teacher's station received the first PACKET from the student, containing the CALL_TEACHER command (517). Once the name is dropped, control returns to the calling function (547).

If the command field requests a copy of the screen 519, (line 5 of page C70 of the Microfilm Appendix), a large transmission of a window takes place (522) from student to teacher (in contrast to the small transmission of a PACKET). Under this implementation, only teachers can request screens, and, if transmission of the screen (522) is successful (524), a flag at the student's station is turned on (527) to signify that all subsequent events are to be transmitted. This flag is evaluated by the drawmouse function, diagrammed in FIG. 6A (604).

Continuing from off-page connectors C (554C in FIG. 5B and 555C in FIG. 5C), if either a student or teacher receives a full copy of a remote screen, a PACKET is sent with the SCREEN_COPY value in the command field (556, line 12 of page C70 of the Microfilm Appendix). The receiving station must have screen space available (563). If such space is not available, an empty screen is created (577) and the screen can be received (576) before the function is exited.

If the teacher terminates communication with a student, the teacher's station will send a STOP_SEND PACKET to the student 557, (line 9 of page C70 of the

Microfilm Appendix) which will turn off the "send to teacher flag" (564) prior to exiting (597).

Under this implementation, with an optional keyboard, users can type on one another's screen simultaneously. If the PACKET specifies keyboard input (KBRD_INPUT) (558, line 18 of page C70 of the Microfilm Appendix) and an available drawing area (565), a temporary font value is recorded (575) from the PACKET (implying that two different fonts, one for each person sharing the drawing or typing area may be used simultaneously). The PACKET includes a character value for transmission in keyboard mode, which is then displayed by the GUI (574), which will also restore any drop-down menu information that is sharing the same space as the keystroke from the remote station (also 574). (If necessary, a drawing area is established to receive the input (566)).

Of the aforementioned commands, only SEND_COPY, SCREEN_COPY, and KBRD_INPUT produce changes in the user's writing area. The next two command fields, ABS and REL, produce the actual shared drawing on a screen. When an ABS is received (559, line 35 of page C70 of the Microfilm Appendix), the user at the sending station has just pressed the pen to the sensor (305 of FIG. 3A), and the absolute coordinates of the touch down are recorded (573) so that, unless the pen is immediately lifted, a connection can be made between the point at these absolute coordinates and the point at the coordinates where the next interrupt is issued by the pen's serial interface at the remote station. At that next interrupt, a new PACKET is sent by the remote station, with the command field set to REL (560, line 40 of page C70 of the Microfilm Appendix), and the relative position from the last touch down or drawing interrupt (whichever is more recent) is included in the PACKET. A line is drawn (572) from the point at the last pair of coordinates to the point at this new set of coordinates. The value of the coordinates is then saved for use when a subsequent PACKET arrives with the command field set to REL. Control then returns to the calling function (593).

The final communication mode that occurs under this implementation is the ERASER mode. If the command specifies that the remote sharing user is using an eraser (561, line 63 of page C70 of the Microfilm Appendix), a white "fillbar" (i.e., a small rectangle of blank space that can be positioned anywhere on a screen to "white out" or "erase" anything that is at that position) is set up by the GUI, which also determines whether the eraser, perhaps being at the edge of the drawing area, must be truncated (508) (and so it prepares to restore information that overlaps with the eraser (570)). The White bar (i.e., eraser) is then moved across the drawing area by the GUI (571). The size of the white bar is passed in the PACKET through the character field, which is otherwise used for transmitting keystrokes in keyboard mode (574). The center of the eraser is given by the x and y coordinates passed by the PACKET. After the GUI places the eraser with a white fillbar over the desired area, and restores any menu areas with which it overlapped, control passes back to the calling function (594).

In FIGS. 5A–5C, the lines identify the sequence of the aforementioned operations and evaluation of command field. These marked connections include all of connections from 530 through 538, 540 through 553, and 578 through 597.

FIGS. 6A–6B diagram the drawmouse function, as it appears beginning on line 65 of page C66 of the Microfilm Appendix. The function (601) begins with GUI calls (lines 72 through 77 on page C66 of the Microfilm Appendix) which set up the active drawing area. The current active point is set to the x- and y- coordinates (603, line 78 of page C66 of the Microfilm Appendix) originally assigned in the int_getxy function which processes interrupts from the pen interface. Thus, the x- and y- coordinates that are critical to this drawmouse routine are those assigned in the int_getxy function on lines 53–54, 62–63 and 70–71 on page C36 of the Microfilm Appendix), and these are the same coordinates within this function on the aforementioned line 78 of page C66 of the Microfilm Appendix. If a mouse rather than a pen is the input device and if the coordinates are to be sent to the teacher (604) or to the entire class (605), a call to the function send_pt is issued with either the TEACHER or ALL_STUDENTS as a destination parameter. send_pt is a short function (line 3 on page C32 of the Microfilm Appendix) which prepares the data for transmission through the network via the send_que function which it calls (FIG. 7).

The evaluation of whether the pen is depressed within the "frame" or "drawing area" leads to, on positive result, the execution of a loop beginning its iteration at 656A and ending its iteration at 659. The loop stops executing once the pen is no longer being depressed within the frame. The most important points in the loop are the check_net calls (609 and 612, diagrammed in FIGS. 5A–5C) to determine whether a transmission should be processed, and the draw line (or erasure) instructions at 614.

One of the most important features of this invention involves effecting simultaneous shared drawing. The draw line instruction within this loop (614) connects points whose coordinates were produced after the pen interface interrupts the application with pen signals. This draw line instruction appears on line 29 of page C67 of the Microfilm Appendix. Within the same loop, the check_net function is given two opportunities (609 and 612) to draw on the screen, corresponding to 572 of FIG. 5C and to line 62 of page C70. Within a high speed loop which captures incoming coordinate data generated by both the serial (local) or network (remote) interrupts, points can be displayed to effect the simultaneous and shared drawing.

After the initial check_net call (609) to process simultaneous remote activity, the local user's mode is evaluated as either keyboard input (610) or drawing or erasure (611) mode. If the user is in keyboard mode, the function waits for the pen to be lifted from the sensor (613). When the pen is being depressed, the user is identifying the location on the sensor where typed input should appear. Thus, once the pen is released (and the "mouse_buttons" flag (line 99 of page C66) of the mouse-based GUI is set to zero) the keystroke may be displayed (615) and the iteration of the main loop of this FIG. 7 function may start again, following another check_net call (612) to determine if any remote activity needs to be reported on the local screen.

Similarly, if the user is in a drawing or erasure mode (611), the line is drawn or erasure effected (with a white fillbar) (614). An evaluation of whether the communication is being shared with the teacher (616) (if this is a student station) or with other students (618) (if this is a teacher station) results in those coordinates with destination being sent (if a mouse rather than a pen is used) to the aforementioned sent_pt function (617 and 19), which prepares them for transmission to the appropriate

destination via the send_que function diagrammed in FIG. 7. Whether or not the local user is sending data at the time that keyboard, writing, or erasing activity occurs locally, a check_net call is issued (612) to determine if any remote activity needs to be updated on the local screen, before the iteration begins again (606).

All of identifiers 651 through 663B, 665A, 665B, 667A, and 667B refer to lines that depict the flow of control in the drawmouse function. The function is exited (620) when there is no further local or remote mouse activity within the frame or drawing area.

FIG. 7 diagrams the send_que function, as it appears beginning on line 69 of page C31 of the Microfilm Appendix. The send_que issues the Net_Send_Datagram call (page C29 of the Microfilm Appendix) that transfers packet information into a network control block ("ncb") before issuing the NetBIOS(ncb) call (line 11 of page C23 of the Microfilm Appendix) that physically transfers the ncb to a remote station.

The send_que thus manages the traffic of outgoing messages to the network. An evaluation of whether the most previous send was completed (703) is followed, upon positive result, with an evaluation of whether the sending queue is now empty. If not (754A), the packet that accompanied the call to the function is prepared for transmission. The packet is copied into a transmission packet that the aforementioned Net_Send_Datagram receives when it is called to prepare a network control block for transmission via a NetBIOS call (705). The Net_Send_Datagram call also updates the network for the next transmission (706) before the function terminated.

If the evaluation of the most recent transmission (703) shows that it is still in progress, the current packet cannot go out immediately (753A), at which point its identifier is recorded in a queue table (707), the packet is copied into the head of the queue (708) (which, in the terminology of the source code here implies that it will be the "last" out), and the appropriate queue pointer is updated (709).

If the most recent transmission is completed but the queue is not empty (754A), the new packet will still have to enter the queue rather than get sent out right away. The same instructions are followed in this case, with one noted exception: the packet identifier is stored in a queue table (712) and then the packet itself is copied into position (713), as when the packet goes into a queue while another packet is still in transmission (707 and 708). In this case, however, because the most recent transmission is completed, the packet at the "tail" of the queue (i.e., first in line to go out) is transmitted (714) and the network is reset for the next send (715). Thus, transmissions occur if requested when either there is an empty queue (754B) or when a subsequent request occurs (714).

The lines in FIG. 7 depict the flow of control from one process or test within the send_que to the next. These lines are referenced by identifiers 751 through 763. The implementation of this application may be reconstructed using the 29 source or object files identified in the SLATE.PRJ file on page H1 of the Microfilm Appendix. As SLATE.PRJ indicates, the flow of control begins with instructions in the SLATE.C file, which appears beginning on line 100 of page C49 of the Microfilm Appendix.

FIGS. 8A–8B diagram the activity within SLATE.C to begin the implementation. The main program appears at line 86 on page C71 of the Microfilm Appendix, and it completes the initialization (802), followed by a determination of whether the input device is a mouse or pen (803) Thus, the implementation may be reconstructed using a mouse instead of a pen. When the pen is used (853B), the mouse is disabled (821). Next, the environment for the application is setup by activities 804 through 809. This application requires extensive video paging which can be implemented in primary storage (804). Other initialization activities include clearing the screen (805), getting the working directory (806), setting up the serial handshake for communication with the pen or mouse (807, on line 8 of page C72 of the Microfilm Appendix), creating the menu that appears at both teacher and student stations (lines 15–26 on page C72 of the Microfilm Appendix), and creating the student-teacher interaction drop-down menus (809) that appear at both teacher and student stations (line 28 of the same page). Next, menu options that are specific to the teacher (822) or student (811) are defined after evaluation of the flag indicates whether the user is a teacher (810). This application anticipates the implementation of a set of auxiliary drawing tools, not unlike commonly available computer graphic paint programs, but also including other features such as a calculator that may be called up into the display. The SLATE.C program creates the common tools menu and defines the available options in (812). Off-page connector 823A continues by repeating the process for the general menu, namely creating teacher-specific (824) or student-specific options depending on the type of user (815). The title bar for the menus is created (816) as is a trash can icon (817). The "click areas" that define what events occur when a given spot on the screen is touched by the pen (or mouse, when a button is depressed) are then initialized (818). Finally, the icons appearing in FIG. 1 (111) that correspond to student desks, are displayed (825) at the teacher's station after the program determines that the user is a teacher (819).

The lines in FIGS. 8A–8B depict the flow of control from one process or test within the SLATE.C modules to the next. These lines are referenced by identifiers 851 through 871.

After the foregoing initialization of GUI, the program then transfers control to the GUI manager, called the "teglsupervisor." The GUI manager effectively updates the screen through the activities diagrammed in FIG. 3B, as the screen is modified by the three concurrent and interrupt-driven communication systems of FIG. 3A.

The foregoing specification describes only the preferred embodiment of the invention as shown. Other embodiments besides the one described above may be articulated as well. The terms and expressions therefore serve only to describe the invention by example only and not to limit the invention. It is expected that others will perceive differences which while differing from the foregoing, do not depart from the spirit and scope of the invention herein described and claimed.

TABLE 1

C routines and Source File Names (in CAPS) Referenced to and Ordered By Microfilm Page Number	
DEBUGUNT.C	1
showcoordinates	1
RotateStackImage	1
showbuttonstatus	1
EGAGRAPH.C	2
xorcornerbox	3
xorbox	3

TABLE 1-continued

C routines and Source File Names (in CAPS) Referenced to and Ordered By Microfilm Page Number	
setapage	3
setvpage	3
videopage	3
flipapage	3
flipvpage	3
abort_msg	4
setgraphicmode	4
vga640×480×16	4
ega640×350×16	4
egagraph_terminateexit	4
init_egagraph	4
EGAMOUSE.C	4
key	7
setshiftkeys	7
deletecapturekey	7
addcapturekey	7
teglreadkey	7
teglkeypressed	8
setmousehotspot	8
getmousesensitivity	8
setmousesensitivity	8
hidemouse	8
setmouseposition	8
cursorshape	8
showmouse	9
mouseposition	9
kbmouse	9
getbuttonpressinfo	12
getbuttonreleaseinfo	12
clearbuttoninfo	12
setmousecolor	13
controlbreakhandler	13
timerhandler	13
egamouse_terminateexit	13
checkparameters	13
timerswitch	14
swaptimerout	14
swaptimerin	14
swapegamouseoff	14
swapegamousecon	14
settimerstart	14
droptimercount	14
resettimerflag	15
setkeyboardmouse	15
setkbsteps	15
getkbsteps	15
setmouseminmax	15
frozenmouse	15
switch_t	15
ega_overlap	15
overlaps	16
freezemouse	16
unfreezemouse	16
init_egamouse	16
EMS.C	16
EMSPagesAvailable	17
AllocateExpandedMemoryPages	17
MapExpandedMemoryPages	17
GetPageFrameBaseAddress	17
DeallocateExpandedMemoryPages	17
GetVersionNumber	17
GetHandleCountUsed	17
GetPagesOwnedByHandle	18
EMSDRIVE.C	18
emsseek	18
emsblockwrite	19
emsblockread	19
emsclose	20
FONTTEST.C	20
closefontwindow	20
fontname	20
selectfont	20
createfontwindow	21
showonefont	22
showfonts	22
HEAPMEM.C	22
initheap	22
cgetmem	22
cmaxavail	23
showfreelist	23

TABLE 1-continued

C routines and Source File Names (in CAPS) Referenced to and Ordered By Microfilm Page Number	
fgetmem	24
cfreemem	24
LCCIO.C	25
LCFLSH.C	25
LCSETUP.C	25
NETBIOS.C	25
check_phys	25
adjust_name	25
fill_str	25
Net_Reset	25
Net_Cancel	25
Net_Adapter_Status	26
Net_Identify	26
Net_Trace	26
Net_Presence_Test	26
Net_Add_Name	26
Net_Add_Group_Name	26
Net_Del_Name	26
Net_Find_Name	27
Net_Call	27
Net_Listen	27
Net_Hang_Up	27
Net_Send	27
Net_Chain_Send	28
Net_Incomplete_Send	28
Net_Receive	28
Net_Chain_Receive	28
Net_Receive_Any	28
Net_Status	28
Net_Send_Datagram	29
Net_Low_Overhead_Datagram	29
Net_Send_Broadcast_Datagram	29
Net_Receive_Datagram	29
Net_Receive_Broadcast_Datagrm	29
NETSTUFF.C	30
addto_sessionlist	30
listen_int	30
rec_int	31
interrupt send_int	31
read_que	31
send_que	31
send_pt	32
send_key	32
send_erase	32
send_screen	32
receive_screen	32
click_student	33
close_all_sessions	33
init_net	33
close_net	34
PEN_ROUT.C	35
int_getxy	35
setup_pen_int	37
close_pen_int	37
init_table	37
comm_gets	37
comm_puts	38
lc_getwait	38
pen_speed	38
set_pen	38
wait_ok	38
calibrate_left	38
calibrate_right	39
swapcommon	39
swapcommoff	39
SELECTFL.C	39
insert	40
addlistentry	40
getaumberoflogicaldrives	40
getfilelist	40
freefilelist	41
barline	41
editstring	41
listfilenames	43
showdirectorylist	44
updir	44
SENSEMS.C	47
setmousesense	48
SLATE.C	49
editchar	50

TABLE 1-continued

C routines and Source File Names (in CAPS) Referenced to and Ordered By Microfilm Page Number	
debug_info	53
beep	53
add_to_queue	53
drop_from_queue	54
clear_queue	54
find_entry	54
find_in_queue	54
print_name	54
update_name	55
drop_name	55
trunc_eraser	55
within	55
fontnum	56
askforhelp	57
viewoptiontoggle	57
toggle_copy	57
trashevent	57
fileselectionoption	58
definelongbutton	58
new_drawing	58
display	59
read_screen	59
sgetc	60
sgetw	60
save_screen	60
restore_screen	61
save_drawing	62
load_drawing	63
distrib_stud	63
distrib_every	63
deskoption	63
remove_menu	64
font_select	64
eraser_size	65
set_eraser	65
set_keyboard	65
calibrate	66
drawmouse	66
drop_fromlist	67
select_icon	67
add_to_drawlist	67
store_drawing	68
close_drawing	68
clear_pad	68
exitoption	68
infooption	68
checknet	69
list_students	70
initialize	71
main	71
TEGL.C	74
clockupdate1	74
clockupdate2	74
viewoptiontoggle	75
creditbox	75
fileselectionoption	75
menumouseposition	76
askmousesense	76
calldosexec	76
creditoption	76
trashevent	77
trashoption	77
exitoption	78
infooption	78
main	78
TEGLGRPH.C	80
drawlongbutton	80
setshadowcolor	81
setshadowbordercolor	81
setshadowfillpattern	81
setshadowfillstyle	81
shadowbox	81
setshadowtexttype	81
setshadowtextshadow	81
setshadowtexthighlight	81
shadowtexthighlightoff	81
shadowtext	81
shadowboxtext	82
setteglbordershow	82
setteglbackcolor	82

TABLE 1-continued

C routines and Source File Names (in CAPS) Referenced to and Ordered By Microfilm Page Number	
setteglbordercolor	82
setteglfillpattern	82
setteglfillstyle	82
clearteglscreen	82
movebox	83
transformbox	83
ziptobox	84
zipfrombox	84
TEGLICON.C	84
TEGLMENU.C	97
positionmenu	97
togglecheckmark	97
toggleentrystatus	97
createoptionmenu	98
defineoptions	98
resizeoptionmenu	98
replaceoptiontext	99
listoptionmenu	99
setoptionmenubordercolor	102
setoptionmenucolors	102
baroptionmenu	102
resetoptionmenuevents	103
defineoptionclickarea	103
createbarmenu	104
outbaroption	104
setbarmenucolor	104
setbartextcolor	104
setbarbordercolor	104
setbarborderoff	104
setbarfillstyle	104
setbarshadowtext	105
TEGLUNIT.C	105
keybrdnextclick	105
crclickpress	106
crclickrelease	106
pageoutstatus	107
pageoutfs	107
pageoutimagestack	107
pageinfs	108
useimage	108
unuseimage	108
unlockimage	108
setimagecoordinates	108
putpartialimage	108
getpartialimage	108
linkfs	109
linkunderfs	109
unlinkfs	109
switchf	109
overlap	109
overlaparea	110
insertnewoverlap	110
mergepartialimage	112
preparepartialimage	112
pushimage	112
popimage	112
prepareforpartialupdate	113
prepareforupdate	113
prepareupdatemsclick	113
commitupdate	113
commitimageupdate	113
hideimage	113
showimage	114
rotatestackimage	114
rotateunderstackimage	114
moveframe	115
setmoverestrictions	116
setframemobility	116
setmoveframecallproc	116
movestackimage	116
dropstackimage	116
createimagebuffer	116
freeimagebuffer	117
dropimagebuffer	117
commitimageupdate	117
getfrontimage	118
getfsimage	118
clearkeyboardbuf	118
resetmouseclicks	118
resetmsclicksense	119

TABLE 1-continued

C routines and Source File Names (in CAPS) Referenced to and Ordered By Microfilm Page Number	
resetmsclickcallproc	119
resetmsclickactive	119
definemouseclickarea	119
defineglobalkeyclickarea	119
definelocalkeyclickarea	120
dropkeyclick	120
resetkeyclickcallproc	121
cursorblock	121
toggleoptionbar	121
pressbutton	121
visualbuttonpress	122
checkctrlbreak	123
selectmenu	123
teglsupervisor	124
setctrlbreakfs	124
settimertick	124
droptimertick	124
memoryerrormessage	124
abortdiskerror	125
init_teglunit	125
TEGLWRT.C	125
setproportional	125
delete	125
teglitextwidth	126
outteglitextxy	126
VIRTDSK.C	127
vdskshowfreelist	127
checksum	127
vdskseek	127
vdskblockread	127
vdskblockwrite	128
vdskgetmem	128
vdskfreemem	129
vdskreadheapdata	129
vdskwriteheapdata	130
vdskcloseheapfile	130
VIRTMEM.C	132
freevirtual	132
movefromvirtual	132
disksize	132
movetovirtual	133

TABLE 2

Alphabetized C routines and Source File Names (in CAPS) Referenced to Microfilm Page Number	
abortdiskerror	125
abort_msg	4
addcapturekey	7
addlistentry	40
addto_sessionlist	30
add_to_drawlist	67
add_to_queue	53
adjust_name	25
AllocateExpandedMemoryPages	17
askforhelp	57
askmousesense	76
barline	41
baroptionmenu	102
beep	53
calibrate	66
calibrate_left	38
calibrate_right	39
calldosexec	76
cfreemem	24
cgetmem	22
checkctrlbreak	123
checknet	69
checkparameters	13
checksum	127
check_phys	25
clearbuttoninfo	12
clearkeyboardbuf	118
clearteglscreen	82
clear_pad	68
clear_queue	54
click_student	33
clockupdate1	74

TABLE 2-continued

Alphabetized C routines and Source File Names (in CAPS) Referenced to Microfilm Page Number	
clockupdate2	74
closefontwindow	20
close_all_sessions	33
close_drawing	68
close_net	34
close_pen_int	37
cmaxavail	23
commitimageupdate	113
commitimageupdate	117
commitupdate	113
comm_gets	37
comm_puts	38
controlbreakhandler	13
crclickpress	106
crclickrelease	106
createbarmenu	104
createfontwindow	21
createimagebuffer	116
createoptionmenu	98
creditbox	75
creditoption	76
cursorblock	121
cursorshape	8
DeallocateExpandedMemoryPages	17
DEBUGUNT.C	1
debug_info	53
defineglobalkeyclickarea	119
definelocalkeyclickarea	120
definelongbutton	58
definemouseclickarea	119
defineoptionclickarea	103
defineoptions	98
delete	125
deletecapturekey	7
deskoption	63
disksize	132
display	59
distrib_every	63
distrib_stud	63
drawlongbutton	80
drawmouse	66
dropimagebuffer	117
dropkeyclick	120
dropstackimage	116
droptimercount	14
droptimertick	124
drop_fromlist	67
drop_from_queue	54
drop_name	55
editchar	50
editstring	41
ega640×350×16	4
EGAGRAPH.C	2
egagraph_terminateexit	4
EGAMOUSE.C	4
egamouse_terminateexit	13
ega_overlap	15
EMS.C	16
emsblockread	19
emsblockwrite	19
emsclose	20
EMSDRIVE.C	18
EMSPagesAvailable	17
emsseek	18
eraser_size	65
exitoption	68
exitoption	78
fgetmem	24
fileselectionoption	58
fileselectionoption	75
fill_str	25
find_entry	54
find_in_queue	54
flipapage	3
flipvpage	3
fontname	20
fontnum	56
FONTTEST.C	20
font_select	64
freefilelist	41

TABLE 2-continued

Alphabetized C routines and Source File Names (in CAPS) Referenced to Microfilm Page Number	
freeimagebuffer	117
freevirtual	132
freezemouse	16
frozenmouse	15
getbuttonpressinfo	12
getbuttonreleaseinfo	12
getfilelist	40
getfrontimage	118
getfsimage	118
GetHandleCountUsed	17
getkbsteps	15
getmousesensitivity	8
getnumberoflogicaldrives	40
GetPageFrameBaseAddress	17
GetPagesOwnedByHandle	18
getpartialimage	108
GetVersionNumber	17
HEAPMEM.C	22
hideimage	113
hidemouse	8
infooption	68
infooption	78
initheap	22
initialize	71
init_egagraph	4
init_egamouse	16
init_net	33
init_table	37
init_teglunit	125
insert	40
insertnewoverlap	110
interrupt send_int	31
int_getxy	35
kbmouse	9
key	7
keybrdnextclick	105
LCCIO.C	25
LCFLSH.C	25
LCSETUP.C	25
lc_getwait	38
linkfs	109
linkunderfs	109
listen_int	30
listfilenames	43
listoptionmenu	99
list_students	70
load_drawing	63
main	71
main	78
MapExpandedMemoryPages	17
memoryerrormessage	124
menumouseposition	76
mergepartialimage	112
mouseposition	9
movebox	83
moveframe	115
movefromvirtual	132
movestackimage	116
movetovirtual	133
NETBIOS.C	25
NETSTUFF.C	30
Net_Adapter_Status	26
Net_Add_Group_Name	26
Net_Add_Name	26
Net_Call	27
Net_Cancel	25
Net_Chain_Receive	28
Net_Chain_Send	28
Net_Del_Name	26
Net_Find_Name	27
Net_Hang_Up	27
Net_Identify	26
Net_Incomplete_Send	28
Net_Listen	27
Net_Low_Overhead_Datagram	29
Net_Presence_Test	26
Net_Receive	28
Net_Receive_Any	28
Net_Receive_Broadcast_Datagrm	29
Net_Receive_Datagram	29

TABLE 2-continued

Alphabetized C routines and Source File Names (in CAPS) Referenced to Microfilm Page Number	
Net_Reset	25
Net_Send	27
Net_Send_Broadcast_Datagram	29
Net_Send_Datagram	29
Net_Status	28
Net_Trace	26
new_drawing	58
outbaroption	104
outteeltextxy	126
overlap	109
overlaparea	110
overlaps	16
pageinfs	108
pageoutfs	107
pageoutimagestack	107
pageoutstatus	107
PEN_ROUT.C	35
pen_speed	38
popimage	112
positionmenu	97
prepareforpartialupdate	113
prepareforupdate	113
preparepartialimage	112
prepareupdatemsclick	113
pressbutton	121
print_name	54
pushimage	112
putpartialimage	108
read_que	31
read_screen	59
receive_screen	32
rec_int	31
remove_menu	64
replaceoptiontext	99
resetkeyclickcallproc	121
resetmouseclicks	118
resetmsclickactive	119
resetmsclickcallproc	119
resetmsclicksense	119
resetoptionmenuevents	103
resettimerflag	15
resizeoptionmenu	98
restore_screen	61
RotateStackImage	1
rotatestackimage	114
rotateunderstackimage	114
save_drawing	62
save_screen	60
SELECTFL.C	39
selectfont	20
selectmenu	123
select_icon	67
send_erase	32
send_key	32
send_pt	32
send_que	31
send_screen	32
SENSEMS.C	47
setapage	3
setbarbordercolor	104
setbarborderoff	104
setbarfillstyle	104
setbarmenucolor	104
setbarshadowtext	105
setbartextcolor	104
setctrlbreakfs	124
setframemobility	116
setgraphicmode	4
setimagecoordinates	108
setkbsteps	15
setkeyboardmouse	15
setmousecolor	13
setmousehotspot	8
setmouseminmax	15
setmouseposition	8
setmousesense	48
setmousesensitivity	8
setmoveframecallproc	116
setmoverestrictions	116
setoptionmenubordercolor	102

TABLE 2-continued

Alphabetized C routines and Source File Names (in CAPS) Referenced to Microfilm Page Number

setoptionmenucolors	102
setproportional	125
setshadowbordercolor	81
setshadowcolor	81
setshadowfillpattern	81
setshadowfillstyle	81
setshadowtexthighlight	81
setshadowtextshadow	81
setshadowtexttype	81
setshiftkeys	7
setteglbackcolor	82
setteglbordercolor	82
setteglbordershow	82
setteglfillpattern	82
setteglfillstyle	82
settimerstart	14
settimertick	124
setup_pen_int	37
setvpage	3
set_eraser	65
set_keyboard	65
set_pen	38
sgetc	60
sgetw	60
shadowbox	81
shadowboxtext	82
shadowtext	81
shadowtexthighlightoff	81
showbuttonstatus	1
showcoordinates	1
showdirectorylist	44
showfonts	22
showfreelist	23
showimage	114
showmouse	9
showonefont	22
SLATE.C	49
store_drawing	68
swapcommoff	39
swapcommon	39
swapegamouseoff	14
swapegamouseon	14
swaptimerin	14
swaptimerout	14
switcht	109
switch_t	15
TEGL.C	74
TEGLGRPH.C	80
TEGLICON.C	84
teglkeypressed	8
TEGLMENU.C	97
teglreadkey	7
teglsupervisor	124
teglitextwidth	126
TEGLUNIT.C	105
TEGLWRT.C	125
timerhandler	13
timerswitch	14
togglecheckmark	97
toggleentrystatus	97
toggleoptionbar	121
toggle_copy	57
transformbox	83
trashevent	57
trashevent	77
trashoption	77
trunc_eraser	55
unfreezemouse	16
unlinkfs	109
unlockimage	108
unuseimage	108
update_name	55
updir	44
useimage	108
vdskblockread	127
vdskblockwrite	128
vdskcloseheapfile	130
vdskfreemem	129
vdskgetmem	128
vdskreadheapdata	129

TABLE 2-continued

Alphabetized C routines and Source File Names (in CAPS) Referenced to Microfilm Page Number

vdskseek	127
vdskshowfreelist	127
vdskwriteheapdata	130
vga640×480×16	4
videopage	3
viewoptiontoggle	57
viewoptiontoggle	75
VIRTDSK.C	127
VIRTMEM.C	130
visualbuttonpress	122
wait_ok	38
within	55
xorbox	3
xorcornerbox	3
zipfrombox	84
ziptobox	84

TABLE 3

C routines Referenced to Identifiers in FIGS. 3A and 3B (Where GUI refers to Graphical User Interface System) Referenced to Microfile Page Number

302 set_pen	38
302 wait_ok	38
307 comm_gets	37
307 comm_puts	38
307 lc_getwait	38
307 pen_speed	38
307 setup_pen_int	37
308 int_getxy	35
310 adjust_name	25
310 check_phys	25
311 addto_sessionlist	30
311 interrupt send_int	31
311 Net_Chain_Receive	28
311 Net_Chain_Send	28
311 Net_Low_Overhead_Datagram	29
311 Net_Receive	28
311 Net_Receive_Any	28
311 Net_Receive_Broadcast_Datagrm	29
311 Net_Receive_Datagram	29
311 Net_Send	27
311 Net_Send_Broadcast_Datagram	29
311 Net_Send_Datagram	29
311 read_que	31
311 receive_screen	32
311 rec_int	31
313 baroptionmenu	102
313 calibrate	66
313 calibrate_left	38
313 calibrate_right	39
313 createbarmenu	104
313 createoptionmenu	98
313 defineglobalkeyclickarea	119
313 definelocalkeyclickarea	120
313 definemouseclickarea	119
313 defineoptionclickarea	103
313 defineoptions	98
313 ega640×350×16	4
313 getmousesensitivity	8
313 initialize	71
313 init_egagraph	4
313 init_egamouse	16
313 init_teglunit	125
313 kbmouse	9
313 outbaroption	104
313 positionmenu	97
313 resizeoptionmenu	98
313 setapage	3
313 setbarbordercolor	104
313 setbarborderoff	104
313 setbarfillstyle	104
313 setbarmenucolor	104
313 setbarshadowtext	105
313 setbartextcolor	104
313 setgraphicmode	4
313 setmousesensitivity	8
313 setoptionmenubordercolor	102

TABLE 3-continued

C routines Referenced to Idemifiers in FIGS. 3A and 3B (Where GUI refers to Graphical User Interface System) Referenced to Microfile Page Number

313 setoptionmenucolors	102
313 setvpage	3
313 swapcommoff	39
313 swapcommon	39
313 togglecheckmark	97
313 toggleoptionbar	121
313 vga640×480×16	4
314 teglsupervisor	124
316 clearbuttoninfo	12
316 crclickpress	106
316 crclickrelease	106
316 getbuttonpressinfo	12
316 getbuttoareleaseinfo	12
316 keybrdnextclick	105
316 showbuttonstatus	1
318 drawmouse	66
318 editchar	50
318 xorbox	3
318 xorcornerbox	3
321 viewoptiontoggle	57
322 clear_pad	68
322 click_student	33
322 close_drawing	68
322 display	59
322 eraser_size	65
322 list_students	70
322 load_drawing	63
322 movebox	83
322 Net_Add_Group_Name	26
322 Net_Add_Name	26
322 Net_Del_Name	26
322 Net_Find_Name	27
322 Net_Hang_Up	27
322 new_drawing	58
322 restore_screen	61
322 RotateStackImage	1
322 save_drawing	62
322 save_screen	60
322 set_eraser	65
322 set_keyboard	65
322 store_drawing	68
322 toggleentrystatus	97
322 transformbox	83
322 zipfrombox	84
322 ziptobox	84
332 add_to_drawlist	67
332 add_to_queue	53
332 askforhelp	57
332 drop_fromlist	67
332 drop_from_queue	54
332 drop_name	55
332 listen_int	30
332 Net_Listen	27
332 update_name	55
333 listen_int	30
333 Net_Listen	27
335 send_erase	32
335 send_key	32
335 send_pt	32
335 send_que	31
335 send_screen	32
336 interrupt send_int	31
337 distrib_every	63
337 distrib_stud	63
337 fill_str	25
337 Net_Chain_Receive	28
337 Net_Chain_Send	28
337 Net_Incomplete_Send	28
337 Net_Low_Overhead_Datagram	29
337 Net_Receive	28
337 Net_Receive_Broadcast_Datagrm	29
337 Net_Receive_Datagram	29
337 Net_Reset	25
337 Net_Send	27
337 Net_Send_Broadcast_Datagram	29
337 Net_Send_Datagram	29
337 receive_screen	32
337 rec_int	31
GUI abortdiskerror	125

TABLE 3-continued

C routines Referenced to Identifiers in FIGS. 3A and 3B (Where GUI refers to Graphical User Interface System) Referenced to Microfile Page Number

GUI addcapturekey	7
GUI AllocateExpandedMemoryPages	17
GUI askmousesense	76
GUI calldosexec	76
GUI cfreemem	24
GUI cgetmem	22
GUI checkctrlbreak	123
GUI checkparameters	13
GUI checksum	127
GUI clearkeyboardbuf	118
GUI clearteglscreen	82
GUI clockupdate1	74
GUI clockupdate2	74
GUI closefontwindow	20
GUI cmaxavail	23
GUI commitimageupdate	113
GUI commitimageupdate	117
GUI commitupdate	113
GUI controlbreakhandler	13
GUI createfontwindow	21
GUI createimagebuffer	116
GUI creditbox	75
GUI creditoption	76
GUI cursorblock	121
GUI cursorshape	8
GUI DeallocateExpandedMemoryPages	17
GUI delete	125
GUI deletecapturekey	7
GUI disksize	132
GUI drawlongbutton	80
GUI dropimagebuffer	117
GUI dropkeyclick	120
GUI dropstackimage	116
GUI droptimercount	14
GUI droptimertick	124
GUI egamouse_terminateexit	13
GUI ega_overlap	15
GUI emsblockread	19
GUI emsblockwrite	19
GUI emsclose	20
GUI EMSPagesAvailable	17
GUI emsseek	18
GUI eplaceoptiontext	99
GUI etteglbordershow	82
GUI exitoption	78
GUI fgetmem	24
GUI fileselectionoption	75
GUI fontname	20
GUI freeimagebuffer	117
GUI freevirtual	132
GUI freezemouse	16
GUI frozenmouse	15
GUI getfrontimage	118
GUI getfsimage	118
GUI GetHandleCountUsed	17
GUI getkbsteps	15
GUI GetPageFrameBaseAddress	17
GUI GetPagesOwnedByHandle	18
GUI getpartialimage	108
GUI GetVersionNumber	17
GUI hideimage	113
GUI hidemouse	8
GUI infooption	78
GUI initheap	22
GUI insertnewoverlap	110
GUI linkfs	109
GUI linkunderfs	109
GUI listoptionmenu	99
GUI main	78
GUI MapExpandedMemoryPages	17
GUI memoryerrormessage	124
GUI menumouseposition	76
GUI mergepartialimage	112
GUI mouseposition	9
GUI moveframe	115
GUI movefromvirtual	132
GUI movestackimage	116
GUI movetovirtual	133
GUI outteglrextxy	126

TABLE 3-continued

C routines Referenced to Identifiers in FIGS. 3A and 3B (Where GUI refers to Graphical User Interface System) Referenced to Microfile Page Number	
GUI overlap	109
GUI overlaparea	110
GUI overlaps	16
GUI pageinfs	108
GUI pageoutfs	107
GUI pageoutimagestack	07
GUI pageoutstatus	107
GUI popimage	112
GUI prepareforpartialupdate	113
GUI prepareforupdate	113
GUI preparepartialimage	112
GUI prepareupdatemsclick	113
GUI pressbutton	121
GUI pushimage	112
GUI putpartialimage	108
GUI resetkeyclickcallproc	121
GUI resetmouseclicks	118
GUI resetmsclickactive	119
GUI resetmsclickcallproc	119
GUI resetmsclicksense	119
GUI resetoptionmenuevents	103
GUI resettimerflag	15
GUI rotatestackimage	114
GUI rotateunderstackimage	114
GUI selectfont	20
GUI selectmenu	123
GUI setctrlbreakfs	124
GUI setframemobility	116
GUI setimagecoordinates	108
GUI setkbsteps	15
GUI setkeyboardmouse	15
GUI setmousecolor	13
GUI setmousehotspot	8
GUI setmouseminmax	15
GUI setmouseposition	8
GUI setmoveframecallproc	116
GUI setmoverestrictions	116
GUI setproportional	125
GUI setshadowbordercolor	81
GUI setshadowcolor	81
GUI setshadowfillpattern	81
GUI setshadowfillstyle	81
GUI setshadowtextshadow	81
GUI setshadowtexttype	81
GUI setshiftkeys	7
GUI setteglbackcolor	82
GUI setteglbordercolor	82
GUI setteglfillpattern	82
GUI setteglfillstyle	82
GUI settimerstart	14
GUI settimertick	124
GUI shadowbox	81
GUI shadowboxtext	82
GUI shadowtext	81
GUI shadowtexthighlight	81
GUI shadowtexthighlightoff	81
GUI showfonts	22
GUI showfreelist	23
GUI showimage	114
GUI showmouse	9
GUI showonefont	22
GUI swapegamouseoff	14
GUI swapegamouseon	14
GUI swaptimerin	14
GUI swaptimerout	14
GUI switcht	109
GUI switch_t	15
GUI teglkeypressed	8
GUI teglreadkey	7
GUI tegltextwidth	126
GUI timerhandler	13
GUI timerswitch	14
GUI trashevent	77
GUI trashoption	77
GUI unfreezemouse	16
GUI unlinkfs	109
GUI unlockimage	108
GUI unuseimage	108
GUI useimage	108

TABLE 3-continued

C routines Referenced to Identifiers in FIGS. 3A and 3B (Where GUI refers to Graphical User Interface System) Referenced to Microfile Page Number	
GUI vdskblockread	127
GUI vdskblockwrite	128
GUI vdskcloseheapfile	130
GUI vdskfreemem	129
GUI vdskgetmem	128
GUI vdskreadheapdata	129
GUI vdskseek	127
GUI vdskshowfreelist	127
GUI vdskwriteheapdata	130
GUI viewoptiontoggle	75
GUI visualbuttonpress	122

What I claim is:

1. A computer assisted electronic educational information communication system, comprising:

at least two stations;

at least two monitor means, one associated with each of said stations, for displaying electronic educational information in visual form;

at least two input means, one associated with each of said stations, for simultaneously and concurrently entering said information in handwritten freehand form from each of said stations and to display on at least its associated monitor means; and

communication means for virtually simultaneously and concurrently transmitting said information being entered simultaneously and concurrently at either of said input means from either station to other station, and for enabling the virtually simultaneous and concurrent display of said transmitted information on both of said monitor means associated with both of said stations such that said information being entered at a first input means simultaneously and concurrently appears on all of said monitor means while under the independent control of said first input means.

2. The system of claim 1, wherein one of said stations is adapted for an instructor and the other of said stations are adapted for students.

3. The system of claim 2, wherein said instructor's station has more than one of said monitor means.

4. The system of claim 2, wherein said communication means selectively affords said instructor's station to selectively view said information displayed at said monitor means on any of said student's stations virtually simultaneously and concurrently to the time said information is being handwritten at said student's stations.

5. The system of claim 4, wherein said instructor's station's monitor means is selectively controlled by the user implementing icons on said monitor.

6. The system of claim 2, wherein said communication means selectively affords said instructor's station to virtually simultaneously and concurrently transmit said information being handwritten at said instructor's station to all of said monitor means at all of said students' stations.

7. The system of claim 1, wherein said communication means includes a communication network, and further includes a central processing unit and bus interface, located at each of said stations, which is in data communication with said communication network.

8. The system of claim 1, wherein at least one of said input means includes a hand-held stylus for inputting free-style handwritten text and drawings.

9. The system of claim 8, wherein said stations include more than two remotely-located stations, and wherein said input means include more than two input means for simultaneously and concurrently entering said handwritten information in freehand form from said more than two stations.

10. The system of claim 1, wherein said communication means includes means for transmitting one pixel of said information being entered simultaneously and concurrently at either of said input means from either station to the other station on a pixel-by-pixel basis from alternating stations.

11. The system of claim 1, wherein said communication means includes means for enabling the display of one pixel of said information being entered simultaneously and concurrently at either of said input means from either station to the other station on a pixel-by-pixel basis from alternating stations.

12. The system of claim 1, wherein said communication means includes means for queuing said information being simultaneously and concurrently transmitted from either station to the other station.

13. A computer assisted educational information communication system, comprising:

at least two stations, each of said stations having:

at least one monitor having a display surface on which an image appears;

input means for inputting educational information in graphical form into said monitor by a user drawing or writing directly on said display surface;

peripheral interface means for simultaneously and concurrently accepting said information from said input means and for simultaneously and concurrently providing image information to said monitor; and

central processing unit means for controlling said peripheral interface means; and

communication network means for simultaneously and concurrently communicating said information in real time between the peripheral interface means of each of said stations in order to virtually simultaneously and concurrently display the information being input independently and simultaneously and concurrently by said input means at either of said stations such that said image information is simultaneously and concurrently displayed on the monitors of all of said stations and such that each user has independent control of that portion of the image information drawn or written by that user.

14. The system of claim 13, wherein said stations are comprised of more than two stations, and wherein the same image information is virtually simultaneously and concurrently displayed on said monitors of said stations as it is being simultaneously and concurrently input at any of said stations.

15. The system of claim 13, wherein one of said stations is adapted for an instructor and the other of said stations is adapted for students.

16. The system of claim 15, wherein said instructor's station selectively, simultaneously and concurrently controls the display of the information on said monitors of said student's station.

17. The system of claim 13, wherein said input means is comprised of a user controlled hand-held stylus, stylus sensor, and stylus interface means for communicating handwritten or hand-drawn information from said stylus sensor to said peripheral interface means.

18. The system of claim 17, wherein said handwritten or hand-drawn information inputted via said input means is selectively, simultaneously and concurrently displayed on said monitors of any of said stations.

19. The system of claim 13, wherein at least one of said stations further comprises a printer in data communication with said peripheral interface means.

20. The system of claim 13, wherein said peripheral interface means further comprises a bus interface means for communication with said central processing unit means and said communication network means.

21. The system of claim 13, wherein input means includes a keyboard.

22. The system of claim 13, wherein input means includes an optical scanning device.

23. The system of claim 13, wherein said communication network means includes means for simultaneously and concurrently communicating one pixel of said information in real time between the peripheral interface means of said stations on an alternating-station pixel-by-pixel basis during the time the information is being entered simultaneously and concurrently at all of said stations.

24. An instructional information system for use in an education classroom, said system comprising:

at least two remotely-located user stations in which one of said stations is an instructor station and the other of said stations are student stations, said instructor station including means for controlling said instructional information system;

interactive monitor means, located in each of said stations, for simultaneously and concurrently displaying instructional information to the user of that station and for simultaneously and concurrently accepting handwritten instructional information inputted from the user of that station; and

network communication means, connected to each of said stations, for simultaneously and concurrently communicating said inputted and displayed instructional information between said interactive monitor means of all of said stations, said network communication means controlled by said instructor station controlling means to selectively and simultaneously and concurrently display instructional information input and displayed at said instructor's station on said interactive monitor means of any of said student stations virtually simultaneously and concurrently and without interfering with the control of inputted instructional information being accepted from the user of that student station.

25. The system of claim 24, wherein said interactive monitor means utilizes a user controlled freehand writing stylus, the position of which is sensed by a stylus sensor to recognize spacial movement by the user controlled stylus to provide the inputted instructional information from extemporaneous freehand writing or drawing by the user.

26. The system of claim 25, wherein each of said user stations includes a central processing unit and memory means for storing said instructional information, and wherein said network communication means communicates in real time with said central processing units and memory means in each of said stations.

27. The system of claim 24, wherein said instructor station controlling means may selectively and simultaneously and concurrently control the display of said instructional information input at said instructor station

on said interactive monitor means of any of said student stations.

28. The system of claim 24, wherein said simultaneous and concurrent visual display of and input acceptance of said instructional information by said interactive monitor means simulates an electronic sheet of paper which is simultaneously and concurrently communicated and interactively shared in real time between the user at said instruction station and student stations.

29. The system of claim 24, wherein said network communication means includes means for communicating said inputted and displayed instructional information between said interactive monitor means of all user stations in a pixel-by-pixel format, and for queuing each pixel of said instructional said instructional information at each station during the time information is being simultaneously and concurrently transmitted from either station to the other station.

30. A method for providing educational information from a first station to a second remotely-located station of a computer assisted communication system, each of said first and second stations having an input device for directly inputting hand-drawn graphical educational information from a user of that station, and having a display monitor for displaying an image of said graphical educational information to the user of that station, the communication system including a computer network for virtually simultaneously and concurrently transferring said graphical educational information between said first and second stations as it is being input, the method comprising the steps of:

inputting primary hand-drawn graphical educational information into said system by a user at said first station;

simultaneously and concurrently displaying an image of said primary information to the user of said first station as it is being input by the user of said first station;

simultaneously and concurrently transferring said primary information from said first station to said second station over said computer network;

simultaneously and concurrently displaying an image of said primary information to the user of said second station at virtually the same time as it is being input by the user of said first station;

simultaneously and concurrently inputting secondary hand-drawn graphical information into said system by a user at said second station as said primary information is being input into said system by the user of said first station;

simultaneously and concurrently transferring said secondary information from said second station to said first station over said computer network; and

simultaneously and concurrently displaying an image of said secondary information to the user of said first station along with said displayed image of said primary information as said secondary information is being input by the user of said second station and with independent control of that portion of the primary or secondary information being input:

31. The method according to claim 30, wherein said computer assisted communication system further includes a third remotely-location station, and wherein the method further comprises the step of simultaneously and concurrently displaying said image of said primary information to the user of said third station as it is being input by user of said first station.

32. The method according to claim 31, further comprising the step of simultaneously and concurrently selecting between said first, second and third stations before transferring said primary information.

33. The method according to claim 32, wherein said selecting step includes the step of implementing icons on said display monitor.

34. The method according to claim 30, wherein said input device includes a user-controlled freehand writing stylus which simulates to the user the ability to write on said display monitor, and wherein the method further comprises the step of sensing the position of said stylus on said display monitor to recognize spacial movement directed by the user, thereby providing the hand-drawn graphical information into the system.

35. The method according to claim 34, wherein said primary and secondary information inputting, displaying, and transferring steps are performed on a pixel-by-pixel basis.

36. The method according to claim 30, wherein said inputting, displaying, and transferring steps simulate to the users of said first and second stations that the users are simultaneously and concurrently sharing the same display image.

37. The method according to claim 30, wherein said displaying steps include the step of combining images of said primary and second information to be displayed on a single display monitor.

38. The method according to claim 30, wherein the method further comprises the step of simultaneously and concurrently storing said primary information from said first station in said second station when said secondary information is being input into said system by said user at said second station.

39. The method according to claim 30, wherein said primary and secondary information, displaying, and transferring steps are performed on a pixel-by-pixel basis.

* * * * *

EXHIBIT B

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70.00 203

PATENT
Atty. Dkt. 0867/5084

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24 AUG 5 1991
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THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Eric R. Hamilton	)
Title:	COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM	)
Serial No.:	07/510,141	)
Filed:	April 17, 1990	)
Examiner:	P. Kubel	)
Art Unit:	332	)

CERTIFICATE OF MAILING

I hereby certify that this paper is being deposited with the United States Postal Service with sufficient postage as Express Mail in an envelope addressed to: Honorable Commissioner of Patents and Trademarks, Washington, D.C. 20231, on this date.

Robert Smith
(Signature of person making deposit)

8/5/91
(Date)

RB729742244US
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AMENDMENT A

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

AUG - 9 '91
GROUP 330

Dear Sir:

This communication is responsive to the Office Action dated February 5, 1991, concerning the above-referenced application.

Applicant has enclosed with this amendment a Petition for a three-month Extension of Time to Respond to the February 5, 1991 Office Action.

Please amend the above-identified application as follows:

In the Specification:

Page 2, line 1, delete the comma after "classroom";

Page 3, line 5, insert a comma after "Inc.";

Page 5, line 4, insert a comma after "capability";

Page 6, line 21, change "specific" to --the specific--;

Page 6, line 33, change "main()" to --main--;

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060 MC 08/08/91 07510141 1 1 203 90.00 CK

EXHIBIT B
PAGE 1

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Page 6, line 34, delete "invention";

Page 7, line 29, insert a comma after "Appendix";

Page 8, line 8, before "102 illustrates" insert --In the Figure,--;

Page 9, line 27, change "The" to --Alternatively, the--;

Page 11, line 11, after "is connected" insert --via a data bus--;

Page 11, line 14, change "("ROM")" to --("ROM")--;

Page 11, line 14, after "interface" insert --(217)--;

Page 11, line 15, delete "(217)";

Page 11, line 15, after "chips", insert --(210)--;

Page 11, line 18, change "unit" to --unit)--;

Page 11, line 23, change "208" to --208)--;

Page 11, line 23, change "215" to --(215--;

Page 11, line 23, delete "260,";

Page 11, line 26, after "comprised of" insert --blocks--;

Page 12, line 4, after "unit" insert --(253)--;

Page 12, line 5, delete "(253)";

Page 12, line 19, after "transmission" insert --via a data bus--;

Page 12, line 21, after "Such a" insert --handwriting--;

Page 13, line 4, change "272" to --(272)--;

Page 15, line 5, after "The" insert --lower right--;

Page 15, line 5, change "333" to --(333)--;

Page 19, line 18, change "1024x1024" to --1024 x 1024--;

Page 19, line 20, change "640x480" to --640 x 480--;

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Page 22, lines 8, change "checknet" to --Checknet--;

Page 22, lines 22, change "checknet" to --Checknet--;

Page 23, line 10, change "(532A" to --(Step 532A--;

Page 32, line 19, change "main()" to --main--;

Page 42, line 12, after "information" insert --simultaneously--;

In the Drawings:

Please amend Figures 1 and 2 in accordance with the proposed corrections made in red ink on the attached photocopies of the informal drawings.

In the Claims:

Sub B2

Claim 1. (Once Amended) A computer assisted instructional information delivery system comprising:

at least two stations;

at least two [interactive monitors, each positioned in] monitor means, one associated with each of said two stations, [wherein said monitor displays] for displaying instructional information in visual form;

[stylus] at least two input means, one associated with each of said two stations, for entering handwritten instructional information in freehand form on [each one of said monitors] at least its associated monitor means; and

communication means for virtually simultaneously transmitting instructional information being entered [from said stylus] at either of said two input means from either station to the other station, [as inputted on one of said monitors] and for virtually simultaneously displaying said transmitted instructional information on [said monitors, such that said stylus means may be utilized to enter visual instructional information onto said station's monitors and displayed on said monitors simultaneously] both of said monitor means associated with both of said stations.

Claim 2. The system of Claim 1, wherein one of said stations is for an instructor and one or more of said stations are for students.

Claim 3. (Once Amended) The system of Claim 2, wherein said instructor's station has more than one of said [interactive monitors] monitor means.

Claim 4. (Once Amended) The system of Claim [3] 2, wherein said communication means selectively affords said instructor's station to selectively view [more than one] instructional information displayed at any of said [interactive monitors] monitor means at any of said students' stations virtually simultaneously to the time said information is being handwritten at said students' stations.

Claim 5. (Once Amended) The system of Claim 4, wherein said instructor's station's [interactive] monitor means is selectively [instructed] controlled by the user implementing icons on said monitor.

Please cancel claim 6.

Claim 7. (Once Amended) The system of Claim [6] 1, wherein said communication means [is] includes a communication network, and further includes a central processing unit and bus interface, located at each of said stations, which is in data communication with said [serial] communication network.

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Sub B4 Claim 8. (Once Amended) A computer assisted instructional information delivery system, comprising:

at least two stations, each of said stations having:

at least one [interactive] monitor;

[information] input means for inputting instructional information in graphical form into [each of] said [interactive monitors] monitor;

peripheral interface means for accepting the instructional information from [and to] said [information] input means and for providing instructional information to [and from] said [interactive] monitor;

central processing unit means for controlling [the instructional information from] said peripheral interface means; and

communication network means for communicating [the instructional] information in real time [from said central processing unit means] between the peripheral interface means of each of said two stations in order to simultaneously display the instructional information being input on said [interactive] monitors at either of said two stations [the instructional information].

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Claim 9. (Once Amended) The system of Claim 8, wherein said [instruction] instructional information is simultaneously displayed on said monitors at each of said two stations [and inputted simultaneously on said interactive monitors of] as it is being simultaneously input at each of said [at least] two stations.

Claim 10. (Once Amended) The system of Claim 8, wherein one of said [at least] two stations [are] is for an instructor and one of said [at least] two stations is for one or more students.

Claim 11. (Once Amended) The system of Claim 10, wherein said instructor's station selectively controls the display [or input] of the instructional information on said [interactive] monitors of [each] said students' station.

Claim 12. (Once Amended) The system of Claim 8, wherein said [information] input means is comprised of a user controlled hand-held stylus, stylus sensor, and stylus interface means for communicating [the] handwritten instructional information from said stylus sensor to said peripheral interface means.

Claim ~~13~~ 19. (Once Amended) The system of Claim ~~8~~ 13, wherein at least one of said stations further [comprise] comprises a printer [and keyboard] in data communication with said peripheral interface means.

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Claim ~~14~~ 20. (Once Amended) The system of Claim ~~8~~ 13, wherein said peripheral interface means further [comprising] comprises a bus interface means for communication with said central processing unit means and [for communication with] said communication network means.

Claim 15. (Once Amended) The system of Claim [8] 12, wherein said handwritten instructional information inputted via said [information] input means is selectively and simultaneously displayed on [one or more] said [interactive] monitors of more than two of said stations.

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Claim 16. (Once Amended) An instructional information system for use in an educational classroom, said system comprising:

at least two remotely-located user stations in which one station is an instructor station and one or more stations are student stations, said instructor station including means for controlling said instructional information system;

interactive monitor means, located in each of said user stations, for [visual] visually displaying instructional information to the user of that station and for accepting freehand inputted [instruction] instructional information from the user of that station [, said interactive monitor means located in each of said stations]; and

network communication means, connected to each user station, for communicating said inputted and displayed instructional information between said interactive monitor means of all user stations, said network communication means controlled by said instructor station controlling means to selectively and simultaneously display [the] instructional information input and displayed at said instructor's station on said interactive monitor means of any of said student stations at virtually the same time inputted instructional information is being accepted from the user of that student station.

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Claim ~~17~~ 25. (Once Amended) The system of Claim ~~16~~ 24 [in which] wherein said interactive monitor means utilizes a user controlled freehand writing stylus, the position of which is sensed by a stylus sensor to recognize spacial movement by the user controlled stylus to [evidence] provide the inputted instructional information from extemporaneous freehand writing or drawing by the user.

Claim ~~18~~ 26. (Once Amended) The system of Claim [16] ~~17~~ 25, wherein each of said user stations includes a central processing unit and memory means for storing said instructional information, and wherein said network communication means communicates in real time with said central processing units and memory means in each of said stations.

Claim 19. (Once Amended) The system of Claim 16, wherein said [instructor's] instructor station [by said interactive monitor means] controlling means may selectively and simultaneously control the display [instruction] of instructional information [to or from] input at said instructor station on said interactive monitor means of any number of said student stations.

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Claim 20. (Once Amended) The system of Claim [19] 16, wherein said [selective] visual display of and input acceptance of instructional information by said interactive monitor means simulates an electronic sheet of paper which may be simultaneously communicated and interactively shared in real time between the users at said instructor station and student stations.

Please add the following new claims:

-- Claim 21. The system of Claim 1, wherein at least one of said input means includes a hand-held stylus for inputting free-style handwritten text and drawings.

Claim 22. The system of Claim 21, wherein said system includes more than two remotely-located stations, and wherein said communication means includes means for entering handwritten instructional information in freehand form from more than two stations.

Claim 23. The system of Claim 2, wherein said communications means selectively affords said instructor's station to virtually simultaneously transmit instructional information being handwritten at said instructor's station to all of said monitor means at all of said students' stations.

Claim ~~24~~ 21. The system of Claim ~~8~~ 13, wherein said input means includes a keyboard.

Claim ~~25~~ 22. The system of Claim ~~8~~ 13, wherein said input means includes an optical scanning device.

Claim 26. The system of Claim 10, wherein said instructor's station selectively controls the input means of the instructional information on said monitors of said students' station.

Claim 27. A method for providing instructional information from a first station to a second remotely-located station of a computer assisted instructional delivery system, each of said first and second stations having an input device for directly inputting hand-drawn graphical information from a user of that station, and having a display monitor for displaying an image of said graphical information to the user of that station, the delivery system including a computer network for transferring said graphical information between said first and second stations at virtually the same time as it is being input, the method comprising the steps of:

inputting primary hand-drawn graphical information into said system by a user at said first station;

displaying an image of said primary information to the user of said first station at virtually the same time as it is being input by the user of said first station;

transferring said primary information from said first station to said second station over said computer network;

displaying an image of said primary information to the user of said second station at virtually the same time as it is being input by the user of said first station;

inputting secondary hand-drawn graphical information into said system by a user at said second station, said secondary information based upon said primary information;

transferring said secondary information from said second station to said first station over said computer network; and

displaying an image of said secondary information to the user of said first station along with said displayed image of said primary information at virtually the same time as said secondary information is being input by the user of said second station.

Claim 28. The method according to claim 27, wherein said computer assisted delivery system includes a third station, and wherein the method further comprises the step of displaying an image of said primary information to the user of said third station at virtually the same time as it is being input by the user of said first station.

Claim 29. The method according to claim 28, further comprising the step of selecting between said first and third stations before transferring said primary information.

Claim 30. The method according to claim 29, wherein said selecting step includes the step of implementing icons on said display monitor.

Claim 31. The method according to claim 27, wherein said input device includes a user-controlled freehand writing stylus which simulates to the user the ability to write on said display monitor, and wherein the method further comprises the step of sensing the position of said stylus on said display monitor to recognize spacial movement directed by the user, thereby providing the hand-drawn graphical information into the system.

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Claim ~~32~~ 36. The method according to claim ~~27~~ 30, wherein said inputting, displaying, and transferring steps simulate to the users of said first and second stations that the users are simultaneously sharing the same display image.

C. 1 and concurrently

Claim ~~33~~ 37. The method according to claim ~~27~~ 30, wherein said ~~image~~ displaying steps include the step of combining images of said primary and secondary information to be displayed on a single display monitor.--

---

REMARKS

Applicant respectfully requests favorable reconsideration of the present application in light of the above amendments and in view of the reasons which follow. Upon review of the preceding Office Action, it is believed that the amended claims are now in proper condition for allowance.

Applicant has included with this amendment a copy of the Revocation of Prior Powers of Attorney and Appointment of New Power of Attorney which was previously filed on July 23, 1991. An Associate Power of Attorney is also enclosed with this amendment.

After entry of the above amendments, claims 1-5 and 7-33 are pending in this application. The above amendments to the claims and the new claims are clearly supported in the specification, particularly at pages 3-13, and in the claims as originally filed.

Applicant has included proposed corrections to Figures 1 and 2 of the informal drawings which have been made in red ink on the attached photocopies. These changes are of a formal nature and have been proposed to further clarify which reference numerals are used to identify which elements in the drawings. No new matter has been added. Applicant will submit corrected formal drawings upon an indication of allowable subject matter.

The amendments to the claims have been made to more particularly point out and distinctly claim Applicant's invention, and to ensure the claims are proper under 35 U.S.C. §112. New dependent claims 21-26 have been added to provide additional limitations to further define the subject matter of Applicant's invention. New method claims 27-33 have also been added to cover the method for using the claimed instructional delivery system. Applicant has also included Claim 2 in this amendment for the Examiner's convenience, even though Claim 2 has not been amended.

In the February 5, 1991 Office Action, the Examiner has referred to U.S. Patent No. 4,846,694 to Erhardt, yet this reference was not listed on Applicant's Information Disclosure Citation (Form PTO-1449) nor on the Notice of References Cited by the Examiner (Form PTO-892). Applicant respectfully requests that the Examiner provide a Supplementary Notice of References Cited with the forthcoming Office Action such that the Erhardt reference may properly be made of record.

The Examiner has rejected claims 1-20 under 35 U.S.C. §103 as being unpatentable over Shapiro in view of Erhardt. The

Examiner stated that Shapiro discloses a computer training system with several student computers interfaced to a central microprocessor, wherein the instructor's workstation display can be displayed on each of the student's video monitors and the students' workstation display can be displayed on the instructor's workstation monitor. The Examiner further stated that Erhardt discloses a computer interfaced to a liquid crystal display and a stylus for entering instructional information into the computer. The Examiner stated that the adaptation of a stylus to be used with a computer training system would have been obvious to a person having ordinary skill in the art, and therefore concluded that this combination renders Applicant's claims 1-20 obvious. Applicant respectfully traverses this rejection.

Applicant's claims 1-26, as amended, recite an instructional information system, preferably for use in an educational classroom setting, wherein an instructor occupies one station and one or more students occupy one or more other stations. A display monitor is positioned in each station to provide a display of instructional information in a visual form. Each station also includes an input device, such as a stylus or light pen, for inputting freehand written or graphical instructional information into the system. A network communication system provides simultaneous, two-way communication between the instructor and students by communicating the instructional information from the input device at one station to the display of another station, and vice-versa. The instructional information is displayed

virtually simultaneously at each of the workstations as it is being input at another workstation. Thus, in essence, the invention allows a teacher to interactively share an "electronic sheet of paper" with one or more students in a classroom. The following sample classroom scenario sets forth the typical application of the invention:

Suppose that an eleventh grade teacher introduces a new mathematical idea to her students, such as solving a radical equation. With the current technology, the teacher hands out the problem on a piece of paper and/or presents the problem on the chalkboard, and the students begin working to solve it. The students' varying level of skill determines the length of time required to reach a solution. Thirty seconds later, the fastest student has an answer, and a few seconds after that, a number of students have completed their work. The teacher now faces a minor dilemma, in that if she calls on one of the students who have completed the problem, the answer is then revealed to the other students -- including those who probably need most to work-through the problem. On the other hand, if she waits for all the students to finish, she implicitly is denying reinforcement for the students who completed the problem. Regardless of whether she waits or doesn't wait for all students to finish the problem, she is emphasizing only the result of reaching an answer to the problem rather than following the correct mathematical steps in arriving at the correct answer. Although in the ideal situation, the teacher would be able to individually monitor and communicate with each and

every student during the entire process of solving the mathematical problem, in reality, the teacher can only respond to a few students, and generally only to the resulting mathematical answers.

In contrast, by using the invention, the students can write on their respective displays, and the teacher can view their mathematical work simultaneously, allowing for individualized communication and attention. She can draw a simple "check-mark" on each individual's monitor if the work and answer is correct, or she can provide the correct answer, without disclosing the answer and preempting the continued efforts of other students. More importantly, however, is that when the teacher notices that a student is trying to use an inappropriate algorithm, or has made an error that will influence the outcome of the solution, she is able to spot the mistake and indicate such to the student by making a notation to that effect that will appear only on that student's display, next to the error, on the same "electronic sheet" on which the student is still working. Furthermore, if a student is missing one step needed to complete a multistep problem, the teacher can mark the step directly on the same "electronic sheet of paper" on which the student is still working. The teacher, because of the two-way communication, can then determine immediately whether the student is proceeding correctly with the next step. If so, the teacher can so indicate on the student's "electronic sheet", or if not, the teacher can continue to provide assistance on the student's "electronic sheet" -- with the student being able to take over or participate at any time. Hence, not only are the answers

not disclosed by the students who first completed the problem, but also the individual interaction between the teacher and student is maintained during the process of working on the problem.

This fundamental concept of communicating and writing simultaneously on the same display image from remote locations is not taught or suggested in the prior art. None of the prior art of record permits a first user at one location to enter handwritten information into his interactive display monitor, and transmit the same information virtually simultaneously to a second ~~user at~~ another location such that it appears that the two ~~users are~~ sharing the same interactive display monitor. To the ~~best~~ of Applicant's knowledge, even today's Electronic Mail systems, operating over various types of communications networks, cannot simultaneously share handwritten or hand-drawn graphical or freehand information over the network such that two or more users can modify the same graphical display image at virtually the same time. As will be seen below, prior technology has either been limited to non-simultaneous transmission of graphical images (e.g., Shapiro et al., below) or non-graphical images (e.g., typical Electronic Mail systems).

Shapiro et al., U.S. Patent No. 4,715,818, describes a computer video monitor interconnection system wherein an associated video monitor at an instructor's workstation can be selectively connected to one or more of a plurality of computer video monitors at respective student workstations, such that a display of the instructor's video monitor is displayed on the connected student

video monitors. Moreover, the computers and associated video monitors at the plurality of student workstations can be selectively connected to the computer video monitor at the instructor's workstation. In other words, the Shapiro computer training system is essentially an arrangement for switching video signals. However, the Shapiro system cannot simultaneously transmit information in both directions between the student station and the instructor station. In the Shapiro et al. system, at any given time, only one station can input information. The student's computer must be disconnected from the instructor's monitor before the instructor's computer can be connected to that same monitor. There is no teaching or suggestion in Shapiro to have both computers connected to the same monitor at the same time. In view of this distinction alone, it cannot be said that Applicant's claimed technique of simultaneously inputting and displaying instructional information, i.e., the sharing of an electronic piece of paper, is obvious.

Erhardt, U.S. Patent No. 4,846,694, describes a computer controlled overhead projector display system for demonstrating the use of a computer terminal using a standard overhead projector. This prior art system is a prime example of one-way communication of instructional information, i.e., Erhardt does not contemplate any communication by the student responding back to the teacher in any form.

Even if the stylus input device of Erhardt were combined with the video switching system of Shapiro et al., the claimed

features of Applicant's invention would still not be met. The proposed combination would not include any communication means for virtually simultaneously transmitting instructional information being entered at either of the two input devices from a first station to a second station, and for virtually simultaneously displaying the transmitted instructional information on both of the monitor devices associated with the first and second stations. Moreover, the proposed combination could not allow the instructor's station to selectively view any or all of the interactive monitors at the students' stations at the same time the information is being entered at the student's stations. In other words, the proposed combination could not provide real-time, simultaneous, two-way communication of handwritten instructional information between the interactive monitors of two or more stations.

In view of these reasons and the above amendments, withdrawal of the 35 U.S. C. §103 rejection of claims 1-20 is respectfully requested.

Regarding new dependent claims 21-26, Applicant submits that these dependent claims provide additional limitations of patentable significance when considered as a whole in combination with the other elements of their respective parent claims.

Applicant has added method claims 27-33 reciting the method of using the computer assisted instructional delivery system claimed above. Independent method claim 27 and its dependent claims include specific limitations describing the system structure and operation which correspond to the system structure and

operation of apparatus claims 1-26. Hence, Applicant submits that method claims 27-33 are also allowable over the prior art of record.

Applicant believes that the present application is now in condition for allowance. Favorable consideration of the amended claims is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date: 8/5/91

By Douglas A. Boehm
Douglas A. Boehm
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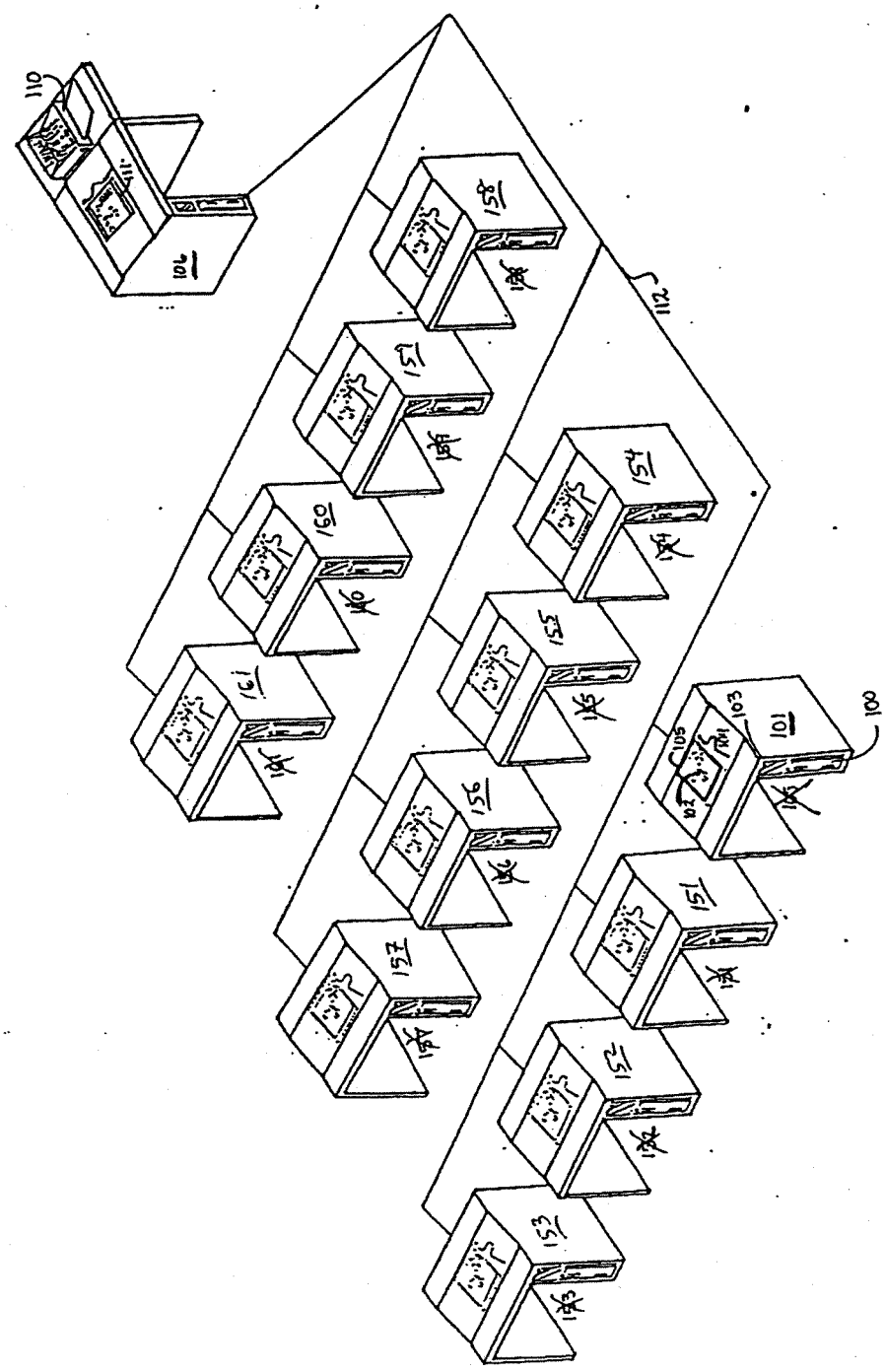

Figure 1

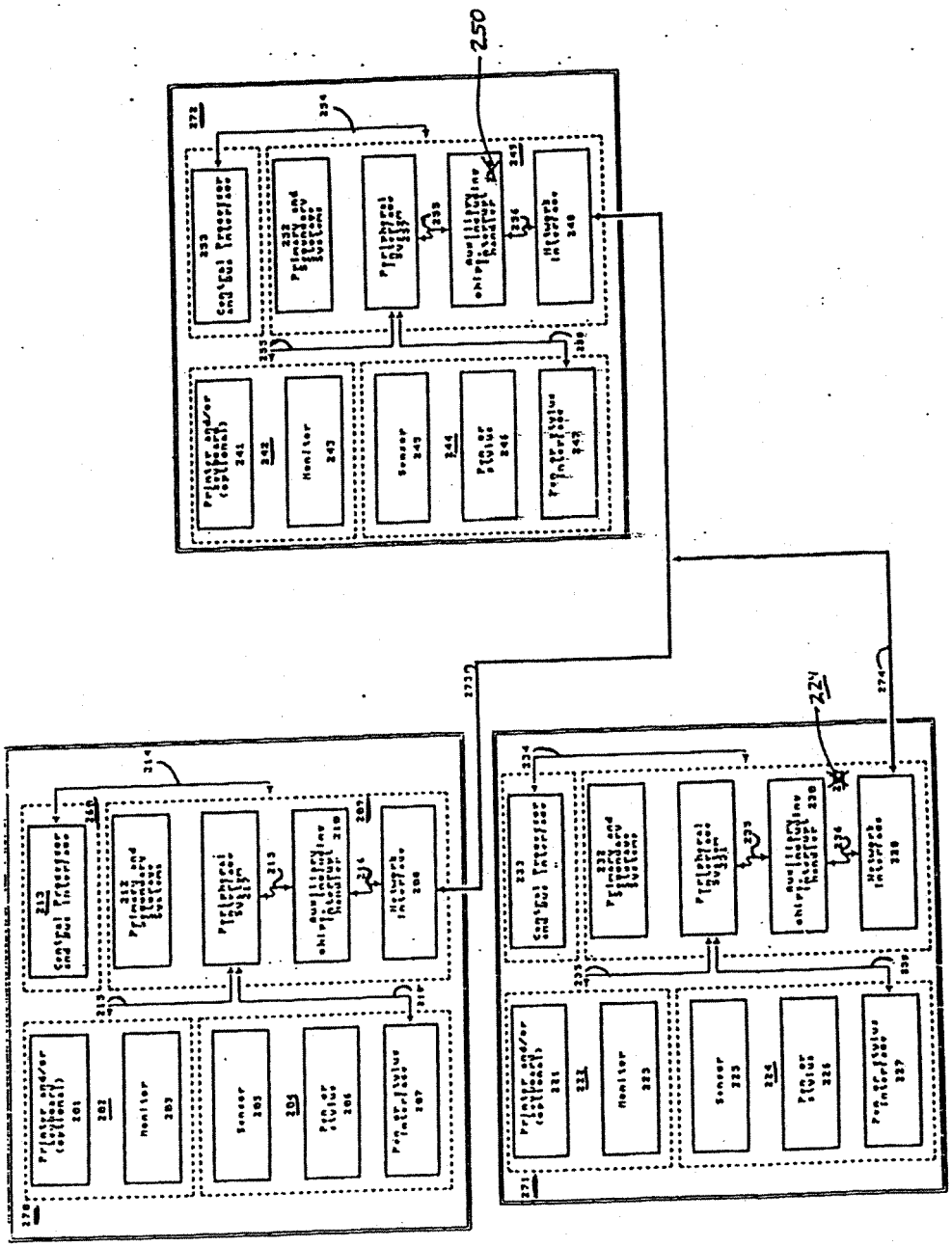

Figure 2

332 8-16-91

Date: August 5, 1991
File No.: 0867/50841 #8

MAIL ROOM 24 AUG 5 1991 PAT. & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of Eric R. Hamilton

Serial No.: 07/510,141

Filed: April 17, 1990

For: COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM

Group Art Unit: 332

Examiner: P. Kubel

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on this date.

8/5/91 Robert Smith
Date

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THE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

Sir:

Transmitted herewith is an amendment in the above-identified application.

RECEIVED AUG-9 91 GROUP 330

( ) No additional fee is required.

Fee Calculation For Claims As Amended

	As Amended		Previously Paid For		Present Extra	Rate	Additional Fee
Total Claims	32	-	20	=	12	x $20.00 =	$ 240.00
Independent Claims	4	-	3	=	1	x $60.00 =	$ 60.00
Fee for Multiple Claims						$200.00 =	$ 0.00
						Total Additional Fee	$ 300.00
							$ 150.00

(X) Small Entity Fee (reduced by half)

(X) A check in the amount of $ 150.00 is attached.

( ) Charge $_____ to Deposit Account No. 23-0920.

(X) The Commissioner is hereby authorized to charge any additional fees which may be required to this application under 37 C.F.R. §§1.16-1.17, or credit any overpayment, to Deposit Account No. 23-0920. Should no proper amount be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 23-0920. A duplicate copy of this sheet is enclosed.

135 S. LaSalle Street
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WELSH & KATZ, LTD

By: Douglas G. Bolan 8/5/91
Registration No. 32,014

ADM064/1290

EXHIBIT C



Second College Edition

THE AMERICAN HERITAGE DICTIONARY

EXHIBIT C
PAGE 1

Ad·am's apple (ăd'əmz) *n.* The projection of the largest laryngeal cartilage at the front of the throat, esp. in men. [Trans. of Heb. *tappūah hāādām.*]

Adam's needle *n.* The Spanish bayonet (sense 2). [From the spines on its leaves.]

a·dapt (ə-dăpt') *v.* **a·dapt·ed, a·dapt·ing, a·dapts.** —*tr.* To adjust to a specified use or situation. —*intr.* To become adapted. [Lat. *adaptare* : *ad-*, to + *aptare*, to fit < *aptus*, fitting.]

a·dapt·a·ble (ə-dăp'tə-bəl) *adj.* Capable of adapting or of being adapted. —**a·dapt'a·bil'i·ty, a·dapt'a·ble·ness** *n.*

ad·ap·ta·tion (ăd'ăp-tā'shən) *n.* **1. a.** The state of being adapted. **b.** The act or process of adapting. **2.** Something that is changed or changes so as to become suitable to a new or special use or situation. **3.** An alteration or adjustment, often hereditary, by which a species or individual improves its condition in relationship to its environment. **4.** The responsive alteration of a sense organ to repeated stimuli. **5.** Change in behavior of an individual or group in adjustment to new or modified cultural surroundings. —**ad'ap·ta'tion·al** *adj.* —**ad'ap·ta'tion·al·ly** *adv.*

a·dapt·er also **a·dapt·or** (ə-dăp'tər) *n.* **1.** One that adapts. **2.** A device used to effect operative compatibility between different parts of one or more pieces of apparatus.

a·dap·tion (ə-dăp'shən) *n.* Adaptation.

a·dap·tive (ə-dăp'tĭv) *adj.* Tending toward, fit for, or having a capacity for adaptation. —**a·dap'tive·ly** *adv.* —**a·dap'tive·ness** *n.*

adaptive radiation *n.* The evolution of a relatively unspecialized species into several related species characterized by different specializations that fit them for life in various environments.



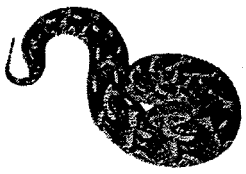
addax

A·dar (ä-där') *n.* The sixth month of the year in the Hebrew calendar. See table at **calendar.** [ME < Heb. *Adhār* < Akkadian *addaru* < *adāru*, to be dark.]

Adar She·ni (shä-nē') *n.* Veadar. [Heb. *Adhār shēnī*, second Adar.]

ad·ax·i·al (ăd-ăk'sē-əl) *adj.* Of, relating to, or being on the side toward the stem or axis.

add (ăd) *v.* **add·ed, add·ing, adds.** —*tr.* **1.** To join or unite so as to increase in size, quantity, or scope. **2.** To combine (a column of figures, for example) to form a sum. **3.** To say or write further. —*intr.* **1.** To create or constitute an addition: *an exploit that will add to her reputation.* **2.** To find a sum in arithmetic. —***phrasal verbs.*** **add up.** *Informal.* To be reasonable, plausible, or consistent; make sense. **add up to.** *Informal.* To mean; indicate. [ME *adden* < Lat. *addere* : *ad-*, to + *dare*, to give.] —**add'a·ble, add'i·ble** *adj.*



adder[2]

ad·dax (ăd'ăks') *n.* An antelope, *Addax nasomaculatus*, of northern Africa having long, spirally twisted horns. [Lat., of African orig.]

add·ed-val·ue tax (ăd'ĭd-văl'yōō) *n.* Value-added tax.

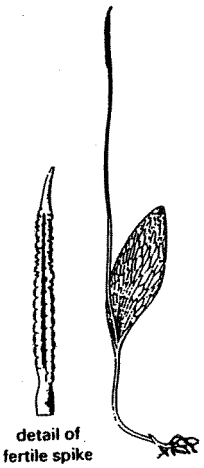
ad·dend (ăd'ĕnd', ə-dĕnd') *n.* Any of a set of numbers to be added. [Short for ADDENDUM.]

ad·den·dum (ə-dĕn'dəm) *n., pl.* **-da** (-də). Something added or to be added, esp. a supplement to a book. [Lat. < *addere*, to add.]

add·er[1] (ăd'ər) *n.* One that adds, esp. a computer device that performs arithmetic addition.

ad·der[2] (ăd'ər) *n.* **1.** Any of various venomous Old World snakes of the family Viperidae, esp. the common viper, *Vipera berus*, of Eurasia. **2.** Any of several nonvenomous snakes popularly believed to be harmful. [ME < *an addre*, alteration of *a naddre* : *a*, a + *naddre*, snake < OE *nædre.*]

ad·der's-mouth (ăd'ərz-mouth') *n.* Any of various orchids of the genus *Malaxis*, having clusters of small, usually greenish flowers. [From the resemblance of its flowers to the open mouths of snakes.]



detail of fertile spike

adder's-tongue

ad·der's-tongue (ăd'ərz-tŭng') *n.* **1.** Any of several ferns of the genus *Ophioglossum*, having a single sterile, leaflike frond, and a spore-bearing stalk. **2.** The dogtooth violet. [From the resemblance of the spike at the base of the frond to a snake's tongue.]

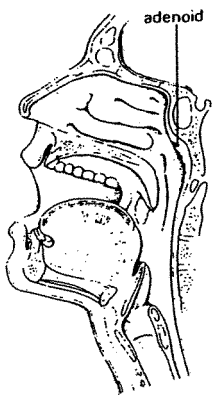
ad·dict (ə-dĭkt') *tr.v.* **-dict·ed, -dict·ing, -dicts.** To devote or give (oneself) habitually or compulsively: *addicted to alcohol.* —*n.* (ăd'ĭkt). **1.** One who is addicted, esp. to narcotics. **2.** A devoted fan: *a soap opera addict.* [< Lat. *addictus*, bondsman, p.part of *addicere*, to sentence : *ad-*, to + *dicere*, to adjudge.] —**ad·dic'tion** *n.* —**ad·dic'tive** *adj.*

Ad·di·son's disease (ăd'ĭ-sənz) *n.* A disease caused by failure of the adrenal cortex to function, marked by a bronze-like skin pigmentation, anemia, and prostration. [After Thomas *Addison* (1793–1860), its discoverer.]

ad·di·tion (ə-dĭsh'ən) *n.* **1.** The act or process of adding. **2.** Something added, esp. a room or section added to a building. **3.** The process of computing with sets of numbers so as to find their sum. —***idioms.*** **in addition.** Also; as well as. **in addition to.** Over and above; besides. [ME < OFr. < Lat. *additio* < *additus*, p.part. of *addere*, to add.] —**ad·di'tion·al** *adj.* —**ad·di'tion·al·ly** *adv.*

ad·di·tive (ăd'ĭ-tĭv) *adj.* Marked by, produced by, or involving addition. —*n.* A substance added in small amounts to something else to improve, strengthen, or otherwise alter it.

additive identity *n.* An identity element that in a given mathematical system leaves unchanged any element to which it is added.



adenoid

additive identity element *n.* Zero.

additive inverse *n.* Inverse (sense 2.b.).

ad·dle (ăd'l) *v.* **-dled, -dling, -dles.** —*tr.* To muddle; confuse: *"My brain is a bit addled by whiskey"* (O'Neill). —*intr.* **1.** To become rotten; spoil. **2.** To become confused. —*adj.* **1.** Mixed up; confused: *addle-brained.* **2.** Spoiled or rotten. [< ME *adel*, muddled < OE, filth.]

ad·dress (ə-drĕs') *tr.v.* **-dressed, -dress·ing, -dress·es. 1.** To speak to. **2.** To make a formal speech to. **3.** To direct (a spoken or written message) to the attention of: *address a protest to the Council.* **4.** To mark with a destination: *address a letter.* **5. a.** To direct (oneself) in speech to. **b.** To direct the efforts or attention of (oneself): *address oneself to a task.* **6.** To dispatch or consign (a ship, for example) to an agent or factor. **7.** To adjust and aim the club at (a golf ball) in preparing for a stroke. —*n.* (ə-drĕs'). **1.** A formal spoken or written communication: *polite forms of address.* **2.** A formal speech. **3.** *(also* ăd'rĕs'*).* The written or printed indication on mail or other deliverable items indicating destination. **4.** *(also* ăd'rĕs'*).* The location at which a particular organization or person may be found or reached. **5.** Often **addresses.** Courteous attentions; wooing. **6.** The manner or bearing of a person, esp. in conversation. **7.** Skillfulness or tact in handling a situation. **8.** The act of dispatching or consigning a ship, as to an agent or factor. **9.** *Computer Sci.* A number used in information storage or retrieval that is assigned to a specific memory location. [ME *adressen* < OFr. *adresser* : *a-*, to (< Lat. *ad-*) + *dresser*, to arrange. — see DRESS.]

ad·dress·a·ble (ə-drĕs'ə-bəl) *adj.* Accessible through an address, as in computer memory.

ad·dress·ee (ăd'rĕ-sē', ə-drĕs'ē') *n.* One to whom something is addressed.

ad·dress·er also **ad·dres·sor** (ə-drĕs'ər) *n.* A person who or a machine that addresses.

ad·duce (ə-dōōs', ə-dyōōs') *tr.v.* **-duced, -duc·ing, -duc·es.** To cite as an example or means of proof in an argument; bring forward for consideration. [Lat. *adducere*, to bring to : *ad-*, to + *ducere*, to lead.] —**ad·duce'a·ble, ad·duc'i·ble** *adj.*

ad·duct (ə-dŭkt', ă-) *tr.v.* **-duct·ed, -duct·ing, -ducts.** *Physiol.* To pull or draw toward the main axis. Used of muscles. [Back-formation from ADDUCTOR.] —**ad·duc'tion** *n.* —**ad·duc'tive** *adj.*

ad·duc·tor (ə-dŭk'tər) *n.* A muscle that adducts. [NLat. < Lat. *adducere*, to bring to. —see ADDUCE.]

-ade *suff.* A sweetened beverage of: *limeade.* [Fr., ult. < Lat. *-ata*, fem. of *-atus*, -ate.]

A·dé·lie penguin (ə-dā'lē) *n.* A common Antarctic penguin, *Pygoscelis adeliae*, of medium size, that has white underparts and a black back and head, and that lives and breeds in large exposed rookeries. [After the *Adélie* Coast, Antarctica.]

-adelphous *suff.* Having one or more groups of stamens: *diadelphous.* [NLat. *-adelphus* < Gk. *adelphos*, brother.]

a·demp·tion (ə-dĕmp'shən) *n. Law.* The disposal by a testator of specific property bequeathed in his will so as to invalidate the bequest. [Lat. *ademptio*, a taking away < *adimere*, to take away : *ad-*, to + *emere*, to take.]

aden- *pref.* Variant of **adeno-.**

ad·e·nec·to·my (ăd'n-ĕk'tə-mē) *n.* Surgical excision of a gland.

ad·e·nine (ăd'n-ēn') *n.* A purine derivative, $C_5H_5N_5$, that is a constituent of nucleic acid in organs, as the pancreas and spleen.

ad·e·ni·tis (ăd'n-ī'tĭs) *n.* Inflammation of a lymph node or gland.

adeno- or **aden-** *pref.* Gland: *adenectomy.* [< Gk. *adēn.*]

ad·e·no·car·ci·no·ma (ăd'n-ō-kär'sə-nō'mə) *n.* A malignant tumor originating in glandular tissue. —**ad'e·no·car'ci·nom'a·tous** (-nŏm'ə-təs, -nō'mə-təs) *adj.*

ad·e·no·hy·poph·y·sis (ăd'n-ō-hī-pŏf'ĭ-sĭs) *n.* The anterior and intermediate glandular lobes of the pituitary gland. —**ad'e·no·hy·poph'y·se·al, ad'e·no·hy·poph'y·si·al** *adj.*

ad·e·noid (ăd'n-oid') *n.* Lymphoid tissue growth in the nose above the throat that when swollen may obstruct nasal breathing, induce postnasal discharge, and make speech difficult.

ad·e·noi·dal (ăd'n-oid'l) *adj.* **1.** Glandlike; glandular. **2.** Of or pertaining to the adenoids. **3 a.** Having a nasal or constricted tone: *an adenoidal singer.* **b.** Mouth-breathing or gaping.

ad·e·no·ma (ăd'n-ō'mə) *n.* An epithelial tumor of glandular origin and structure that is usually benign or of low-grade malignancy. —**ad'e·nom'a·tous** (-ŏm'ə-təs) *adj.*

a·den·o·sine (ə-dĕn'ə-sēn') *n.* An organic compound, $C_{10}H_{13}N_5O_4$, that is a structural component of nucleic acids. [Blend of ADENINE and RIBOSE.]

adenosine di·phos·phate (dī-fŏs'fāt') *n.* ADP.

adenosine mon·o·phos·phate (mŏn'ō-fŏs'fāt') *n.* **1.** Cyclic AMP. **2.** AMP.

adenosine triphosphate *n.* ATP.

ad·e·no·vi·rus (ăd'n-ō-vī'rəs) *n.* Any of various animal viruses that cause respiratory diseases, as catarrh, in humans. —**ad'e·no·vi'ral** *adj.*

a·den·yl·ate cy·clase (ə-dĕn'l-āt sī'klās, ăd'n-īl'āt) or **ad·e·nyl cyclase** (ăd'n-īl) *n.* The enzyme that catalyzes forma-

EXHIBIT C
PAGE 2

goods; wealth; riches. **2.** A plentiful supply; abundance. **3.** A flowing toward.

af·flu·en·cy (ăf'lo͞o'ən-sē, ə-flo͞o'-) *n.* Affluence.

af·flu·ent (ăf'lo͞o-ənt) *adj.* **1.** Rich; wealthy: *an affluent society.* **2.** Copious; abundant. **3.** Flowing freely. —*n.* A stream or river that flows into another or other body of water; tributary. [ME, abundant < OFr. < Lat. *affluens,* pr.part. of *affluere,* to abound in : *ad-,* to + *fluere,* to flow.] —**af'flu·ent·ly** *adv.*

af·flux (ăf'lŭks') *n.* A flowing to or toward a particular area: *an afflux of blood to the head.* [Lat. *affluxus,* p.part. of *affluere,* to flow to. —see AFFLUENT.]

af·ford (ə-fôrd', ə-fōrd') *tr.v.* **-ford·ed, -ford·ing, -fords. 1.** To have the financial means for; be able to meet the expense of. **2.** To be able to spare or give up: *could afford an hour for lunch.* **3.** To be able to do or perform (something) without incurring harm or criticism, or with benefit to oneself: *can afford to be tolerant.* **4.** To provide: *a sport affording good exercise.* [ME *aforthen* < OE *geforċian,* to carry out < *forċian,* to further < *forð,* forward.] —**af·ford'a·ble** *adj.*

af·for·est (ə-fôr'ĭst, ə-fŏr'-) *tr.v.* **-est·ed, -est·ing, -ests.** To convert (open land) into forest. [Med. Lat. *afforestare* : *ad-,* to + *forestare* < *foresta,* forest.] —**af·for'es·ta'tion** (ə-fôr'ĭ-stā'shən, ə-fŏr'-) *n.*

af·fran·chise (ə-frăn'chīz') *tr.v.* **-chised, -chis·ing, -chis·es.** To free from servitude; liberate from obligation or liabilities. [ME < OFr. *afranchir, afranchiss-* : *a-,* to (< Lat. *ad-*) + *franchir,* to free < *franc,* free. —see FRANK.]

af·fray (ə-frā') *n.* A noisy quarrel or brawl. —*tr.v.* **-frayed, -fray·ing, -frays.** *Archaic.* To frighten. [ME < OFr. *esfrei* < *esfreer,* to disturb.]

af·fri·cate (ăf'rĭ-kĭt) *n.* A speech sound produced when the breath stream is completely stopped and then released at articulation, the *t* plus *sh* sound in *clutch* or the *j* sound in *judge.* [Lat. *affricare, affricat-,* to rub against : *ad-,* to + *fricare,* to rub.]

af·fric·a·tive (ə-frĭk'ə-tĭv) *adj.* Of, pertaining to, or forming an affricate. —*n.* An affricate.

af·fright (ə-frīt') *Archaic.* —*tr.v.* **-fright·ed, -fright·ing, -frights.** To arouse fear in; terrify. —*n.* **1.** Terror. **2.** A cause of terror. **3.** The act of frightening. [ME *afrighten* < OE *afyrhtan.*] —**af·fright'ment** *n.*

af·front (ə-frŭnt') *tr.v.* **-front·ed, -front·ing, -fronts. 1.** To insult intentionally, esp. openly. **2.** To meet face to face defiantly; confront. —*n.* **1.** An open or intentional offense, slight, or insult. **2.** *Obs.* An encounter or meeting. [ME *afrounten* < OFr. *afronter* : Lat. *ad-,* to + Lat. *frons,* face.]

af·fu·sion (ə-fyo͞o'zhən) *n.* A pouring on of liquid, as in baptism. [LLat. *adfusio,* < *affundere,* to pour on : *ad-,* to + *fundere,* to pour.]

Af·ghan (ăf'găn', -gən) *n.* **1.** A native of Afghanistan. **2.** Pashto. **3. afghan.** A coverlet of wool, knitted or crocheted in colorful geometric designs. **4.** An Afghan hound. —*adj.* Of or pertaining to Afghanistan, its people, or their language. [Pashto *afghāni.*]

Afghan hound *n.* A large, slender dog of an ancient breed, having long, thick hair, a pointed muzzle, and drooping ears.

af·ghan·i (ăf-găn'ē, -gä'nē) *n.* See table at **currency.** [Pashto.]

a·fi·cio·na·do (ə-fĭsh'ē-ə-nä'dō, ə-fĭs'ē-, ə-fē'sē-) *n., pl.* **-dos.** An enthusiastic admirer or follower; devotee; fan. [Sp. < p.part. of *aficionar,* to induce a liking for < *aficion,* liking < Lat. *affectio,* affection.]

a·field (ə-fēld') *adv.* **1.** Off the usual or desired track. **2.** Away from one's home or usual environment. **3.** To or on a field.

a·fire (ə-fīr') *adj. & adv.* **1.** On fire; burning. **2.** Intensely interested and involved.

a·flame (ə-flām') *adj. & adv.* **1.** On fire; flaming. **2.** Keenly excited and interested.

a·float (ə-flōt') *adj. & adv.* **1.** Floating. **2.** On a boat or ship away from the shore; at sea. **3.** In circulation; prevailing. **4.** Awash; flooded. **5.** Drifting about; moving without guidance. **6.** Free or out of difficulty, esp. financial difficulty: *couldn't keep the business afloat.*

a·flut·ter (ə-flŭt'ər) *adj.* In a flutter; nervous and excited.

a·foot (ə-fo͝ot') *adj. & adv.* **1.** Walking; on foot. **2.** In the process of being carried out; astir.

a·fore (ə-fôr', ə-fōr') *adv., prep., & conj. Archaic.* Before. [ME < OE *onforan* : *on,* at + *for,* fore.]

a·fore·men·tioned (ə-fôr'mĕn'shənd, ə-fōr'-) *adj.* Mentioned previously or before.

a·fore·said (ə-fôr'sĕd', ə-fōr'-) *adj.* Spoken of earlier.

a·fore·thought (ə-fôr'thôt', ə-fōr'-) *adj.* Planned or intended beforehand; premeditated: *malice aforethought.*

a·fore·time (ə-fôr'tīm', ə-fōr'-) *Archaic.* —*adv.* At a former or past time; previously. —*adj.* Earlier; former.

a for·ti·o·ri (ā fôr'tē-ôr'ē, ā fōr'tē-ō'rī') *adv.* For a stronger reason; all the more. Used of a conclusion arrived at with greater logical necessity than another. [Lat.]

a·foul of (ə-foul') *prep.* In or into a condition of collision, entanglement, or conflict. —*idiom.* **run (or fall) afoul of.** To become entangled or in conflict with.

a·fraid (ə-frād') *adj.* **1.** Filled with fear. **2.** Reluctant; averse: *not afraid of work.* **3.** Filled with regret: *I'm afraid you're wrong.* [ME *affraied,* p.part. of *affraien,* to frighten < OFr. *esfreer,* to disturb.]

A-frame (ā'frām) *n.* A structure, as a house, with steeply angled sides and a roof that reaches to the ground. [From its being shaped like a capital *A.*]

af·reet also **af·rit** (ăf'rēt', ə-frēt') *n. Arabic Myth.* A powerful evil spirit or gigantic and monstrous demon. [Ar. *'ifrīt.*]

a·fresh (ə-frĕsh') *adv.* Once more; anew; again.

Af·ri·can (ăf'rĭ-kən) *adj.* Of or pertaining to Africa or any of its peoples or languages. —*n.* **1.** A person born or living in Africa. **2.** A member of one of the indigenous peoples of Africa.

African lily *n.* A plant, *Agapanthus africanus,* native to southern Africa, having rounded clusters of blue, violet, or white flowers.

African mahogany *n.* **1. a.** Any of several African trees of the genus *Khaya,* esp. *K. ivorensis,* having wood similar to that of true mahogany. **b.** The wood of this tree, used for furniture, musical instruments, and boat interiors. **2.** Any of various other African woods resembling true mahogany.

African marigold *n.* A widely cultivated plant, *Tagetes erecta,* native to Mexico, having finely divided foliage and showy, rounded orange or yellow flowers.

African sleeping sickness *n.* Sleeping sickness.

African violet *n.* Any of several plants of the genus *Saintpaulia,* native to tropical Africa and widely cultivated as house plants, esp. *S. ionantha,* having violet, white, or pink flowers.

Af·ri·kaans (ăf'rĭ-käns', -känz') *n.* A language that developed from 17th-century Dutch and is an official language of the Republic of South Africa. [Afr. < Du. *Afrikaansch,* African.]

Af·ri·ka·ner (ăf'rĭ-kä'nər) *n.* An Afrikaans-speaking descendant of the Dutch settlers of South Africa. [Afr., African < Lat. *Africanus.*]

af·rit (ăf'rĕt', ə-frēt') *n.* Variant of **afreet.**

Af·ro (ăf'rō) *n., pl.* **-ros.** A rounded, bushy hair style. —*adj.* **1.** Of or for an Afro: *an Afro comb.* **2.** Directly or indirectly African in style. [Perh. short for AFRO-AMERICAN.]

Afro- *pref.* African: *Afro-Asiatic.* [< Lat. *Afer,* an African.]

Af·ro-A·mer·i·can (ăf'rō-ə-mĕr'ĭ-kən) *adj.* Of or pertaining to American blacks of African ancestry, their history, or their culture. —*n.* An American black of African ancestry.

Af·ro-A·si·at·ic (ăf'rō-ā'zhē-ăt'ĭk, -zē-) *n.* A family of languages of southwestern Asia and northern Africa. —**Af'ro-A'si-at'ic** *adj.*

aft (ăft) *adv. & adj. Naut.* At, in, toward, or close to the stern of a vessel. [Prob. shortening of ABAFT.]

af·ter (ăf'tər) *prep.* **1.** Behind in place or order. **2.** In quest or pursuit of: *seek after fame.* **3.** Concerning: *asked after you.* **4.** Subsequent in time to; at a later time than: *come after dinner.* **5.** Subsequent to and because of or regardless of: *friends after all their differences.* **6.** Following continually: *year after year.* **7.** Next to or lower than in order or importance. **8.** In the style of; in imitation of: *satires after Horace.* **9.** With the same or close to the same name as; in honor or commemoration of: *named after her mother.* **10.** According to the nature or desires of; in conformity to: *a man after my own heart.* **11.** Past the hour of: *five minutes after three.* —*adv.* **1.** Behind; in the rear. **2.** At a later or subsequent time; afterward. —*adj.* **1.** Subsequent in time or place; later; following: *in after years.* **2.** *Naut.* Nearer the stern of a vessel; *farther aft.* —*conj.* Following or subsequent to the time that: *I saw her after I arrived.* —*idiom.* **after all. 1.** When everything is considered. **2.** Eventually; ultimately. [ME < OE *æfter.*]

af·ter·birth (ăf'tər-bûrth') *n.* The placenta and fetal membranes expelled from the uterus after childbirth.

af·ter·burn·er (ăf'tər-bûr'nər) *n.* **1.** A device for augmenting the thrust of a jet engine by burning additional fuel with the uncombined oxygen in the hot exhaust gases. **2.** A device for burning or chemically altering unburned or partially burned carbon compounds in exhaust gases.

af·ter·care (ăf'tər-kâr') *n.* Treatment or special care given to convalescent patients, esp. after undergoing surgery.

af·ter·clap (ăf'tər-klăp') *n.* An unexpected, often unpleasant sequel to a matter that had been considered closed.

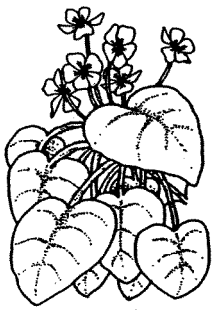
af·ter·damp (ăf'tər-dămp') *n.* An asphyxiating mixture of gases, primarily nitrogen and carbon dioxide, left in a mine after a fire or explosion.

af·ter·deck (ăf'tər-dĕk') *n. Naut.* The part of a ship's deck past amidships toward the stern.

af·ter·ef·fect (ăf'tĭr-ĭ-fĕkt') *n.* An effect following its cause after some delay, esp. a delayed or prolonged physiological or psychological response to a stimulus.

af·ter·glow (ăf'tər-glō') *n.* **1.** The light emitted or remaining after removal of a source of illumination, esp.: **a.** The atmospheric glow after sunset. **b.** The glow of an incandescent metal as it cools. **c.** Emission from a phosphor after removal of excitation. **2.** The comfortable feeling following a pleasant experience. **3.** A lingering impression of past brilliance.

af·ter-hours (ăf'tər-ourz') *adj.* **1.** Occurring after closing time: *after-hours drinking.* **2.** Open after a legal or established closing time: *an after-hours club.*



African violet

com·mon·place (kŏm'ən-plās') *adj.* Not remarkable; ordinary. —*n.* **1. a.** A trite or obvious remark; platitude. **b.** Something that is ordinary or common. **2.** *Archaic.* A passage marked for reference or entered in a commonplace book. [Transl. of Lat. *locus communis,* generally applicable theme, transl. of Gk. *koinos topos.*]

commonplace book *n.* A personal journal in which quotable passages, literary excerpts, and comments are written.

common pleas *n.* A court of common pleas (sense 1).

common salt *n.* **1.** Salt. **2.** Sodium chloride. **3.** Table salt (sense 1).

common school *n.* A public elementary school.

common sense *n.* Native good judgment. [Transl. of Lat. *sensus communis,* common feelings of humanity.]

common stock *n.* Ordinary capital shares of a corporation that have exclusive residual claim on the net assets and net income of the corporation after all prior claims have been paid.

common time *n. Mus.* A meter with four quarter notes to the measure.

com·mon·weal (kŏm'ən-wēl') *n.* **1.** The public good or welfare. **2.** *Archaic.* A commonwealth.

com·mon·wealth (kŏm'ən-wĕlth') *n.* **1.** The people of a nation or state; body politic. **2.** A nation or state governed by the people; republic. **3. Commonwealth. a.** The official title of some U.S. states, including Kentucky, Virginia, Massachusetts, and Pennsylvania. **b.** The official title of Puerto Rico, indicating its special status as a self-governing, autonomous political unit voluntarily associated with the United States. **4.** *Archaic.* Commonweal (sense 1). [ME *commune welthe* : *commune,* common + *welthe,* well-being. —see WEALTH.]

com·mo·tion (kə-mō'shən) *n.* **1.** A condition of turbulent motion. **2.** Civil disturbance or insurrection; disorder. **3.** An agitated disturbance; hubbub: *heard a commotion in the hall.* [ME *commocioun* < Lat. *commotio* < *commovēre,* to disturb : *com-* (intensive) + *movēre,* to move.] —**com·mo'tion·al** *adj.*

com·move (kə-mōōv') *tr.v.* **-moved, -mov·ing, -moves.** To agitate; disturb. [ME *commeven* < OFr. *commovoir* < Lat. *commovere.* —see COMMOTION.]

com·mu·nal (kə-myōō'nəl, kŏm'yə-) *adj.* **1.** Of or pertaining to a commune. **2.** Of or pertaining to a community. **3. a.** Of or belonging to the people of a community; public. **b.** Marked by collective ownership and control of goods and property. [Fr. < LLat. *communalis* < Lat. *communis,* common.] —**com'mu·nal'i·ty** (kŏm'yə-năl'ĭ-tē) *n.* —**com·mu'nal·ly** *adv.*

com·mu·nal·ism (kə-myōō'nə-lĭz'əm, kŏm'yə-nə-) *n.* **1.** A theory or system of government in which virtually autonomous local communities are loosely bound in a federation. **2.** Belief in or practice of communal ownership, as of goods and property. **3.** Strong devotion to the interests of one's own ethnic group rather than those of society as a whole. —**com·mu'nal·ist** *n.* —**com·mu'nal·is'tic** *adj.*

com·mu·nal·ize (kə-myōō'nə-līz', kŏm'yə-nə-) *tr.v.* **-ized, -iz·ing, -iz·es.** To convert into communal property.

Com·mu·nard (kŏm'yə-närd') *n.* **1.** A member or advocate of the Commune of Paris of 1871. **2. communard.** One that lives in a commune. [Fr. < *commune,* division. —see COMMUNE².]

com·mune¹ (kə-myōōn') *intr.v.* **-muned, -mun·ing, -munes. 1. a.** To converse intimately; exchange thoughts and feelings. **b.** To be in accord: *communing with nature.* **2.** To receive the Eucharist. [ME *communen* < OFr. *communier* < *commune,* common.]

com·mune² (kŏm'yōōn', kə-myōōn') *n.* **1.** The smallest local political division of various European countries, governed by a mayor and municipal council. **2. a.** A local community organized with a government for promoting local interests. **b.** A municipal corporation in the Middle Ages. **3. a.** A small, often rural community whose members have common interests and in which property is shared or owned jointly. **b.** The people of a commune. [Fr. < Med. Lat. *communia,* community < Lat. *communis,* common.]

com·mu·ni·ca·ble (kə-myōō'nĭ-kə-bəl) *adj.* **1.** Capable of being communicated or transmitted: *communicable diseases.* **2.** Talkative. —**com·mu'ni·ca·bil'i·ty, com·mu'ni·ca·ble·ness** *n.* —**com·mu'ni·ca·bly** *adv.*

com·mu·ni·cant (kə-myōō'nĭ-kənt) *n.* **1.** A person who receives or is entitled to receive Communion. **2.** A person who communicates. —*adj.* Communicating.

com·mu·ni·cate (kə-myōō'nĭ-kāt') *v.* **-cat·ed, -cat·ing, -cates.** —*tr.* **1. a.** To make known; impart: *communicate information.* **b.** To display; manifest. **2.** To spread to others; transmit (a disease, for example): *a carrier who communicated typhus.* —*intr.* **1.** To have an interchange, as of ideas. **2.** To express oneself in such a way that one is readily and clearly understood. **3.** To receive Communion. **4.** To be connected: *apartments that communicate.* [Lat. *communicare, communicat-* < *communis,* common.] —**com·mu'ni·ca'tor** *n.*

Usage: The newer intransitive sense denoting effective self-expression is now well established. Thus: *A fund of knowledge is secondary to a teacher's ability to communicate.* This example is acceptable to a majority of the Usage Panel.

com·mu·ni·ca·tion (kə-myōō'nĭ-kā'shən) *n.* **1.** The act of communicating; transmission. **2.** The exchange of thoughts, messages, or information, as by speech, signals, or writing. **3.** Something communicated; message. **4. communications.** A means of communicating, esp.: **a.** A system for sending and receiving messages, such as mail, telephone, or television. **b.** A network of routes for sending messages and transporting troops and supplies. **5. communications.** The art and technology of communicating. —**com·mu'ni·ca'tion·al** *adj.*

communications satellite *n.* An artificial satellite used to aid communications, as by reflecting or relaying a radio signal.

com·mu·ni·ca·tive (kə-myōō'nĭ-kā'tĭv, -kə-tĭv) *adj.* **1.** Inclined to communicate readily; talkative. **2.** Of or pertaining to communication. —**com·mu'ni·ca'tive·ly** *adv.* —**com·mu'ni·ca'tive·ness** *n.*

com·mun·ion (kə-myōōn'yən) *n.* **1.** An act or instance of sharing, as of thoughts or feelings. **2.** A religious or spiritual fellowship. **3.** A body of Christians with a common religious faith who practice the same rites; denomination. **4. Communion. a.** The Christian sacrament in which consecrated bread and wine are partaken of in celebration of Christ's Last Supper. **b.** The consecrated elements of this sacrament. **c.** The part of the Mass or a liturgy in which this sacrament is received. [ME *communioun,* Christian fellowship, Eucharist < LLat. *communio,* Eucharist < Lat., mutual participation < *communis,* common.]

com·mu·ni·qué (kə-myōō'nĭ-kā', -myōō'nĭ-kā') *n.* An official announcement. [Fr. < *commiquer,* to announce < Lat. *communicare,* to communicate.]

com·mu·nism (kŏm'yə-nĭz'əm) *n.* **1.** A social system characterized by the common ownership of the means of production and subsistence and by the organization of labor for the common advantage of all members. **2. a.** A system of government in which the state controls the means of production and a single, often authoritarian party holds power with the intention of establishing a higher social order in which all goods are equally shared by the people. **b.** The Marxist-Leninist version of Communist doctrine that is the basis for the system of government in the Soviet Union. [Fr. *communisme* < *commun,* common < OFr. *comune.*]

Com·mu·nist (kŏm'yə-nĭst) *n.* **1. a.** A member of a Marxist-Leninist party. **b.** A supporter of such a party or movement. **2. communist.** A communalist. **3.** A Communard. **4.** Often **communist.** A radical viewed as a subversive or revolutionary. —*adj.* Also **communist.** Pertaining to, characteristic of, or resembling communism or Communists.

com·mu·nis·tic (kŏm'yə-nĭs'tĭk) *adj.* Of, characteristic of, or inclined to communism. —**com'mu·nis'ti·cal·ly** *adv.*

Communist Party *n.* A Marxist-Leninist party, usually one originally belonging to the Third International.

com·mu·ni·tar·i·an (kə-myōō'nĭ-târ'ē-ən) *n.* A member or supporter of a communistic community.

com·mu·ni·ty (kə-myōō'nĭ-tē) *n., pl.* **-ties. 1. a.** A group of people living in the same locality and under the same government. **b.** The district or locality in which such a group lives: *a small rural community.* **2.** A group or class having common interests: *the scientific community.* **3.** Similarity or identity: *a community of interests.* **4.** Society as a whole; the public. **5.** *Ecol.* **a.** A group of plants and animals living in a specific region under relatively similar conditions. **b.** The region in which they live. **6.** Common possession or participation. [ME *communite,* citizenry < OFr. *communite* < Lat. *communitas,* fellowship < *communis,* common.]

community antenna television *n.* Cable television.

community center *n.* A meeting place used by members of a community for social, cultural, or recreational purposes.

community chest *n.* A welfare fund financed by private contributions for aiding various charitable organizations.

community college *n.* A junior college without residential facilities that is often government-funded.

community property *n.* Property owned jointly by a husband and wife.

com·mu·nize (kŏm'yə-nīz') *tr.v.* **-nized, -niz·ing, -niz·es. 1.** To subject to public ownership or control. **2.** To convert to Communist principles or control. [< Lat. *communis,* common.] —**com'mu·ni·za'tion** *n.*

com·mut·a·ble (kə-myōō'tə-bəl) *adj.* Capable of being commuted; interchangeable. —**com·mut'a·bil'i·ty** *n.*

com·mu·tate (kŏm'yə-tāt') *tr.v.* **-tat·ed, -tat·ing, -tates.** To reverse the direction of (an alternating electric current) each half-cycle to produce a unidirectional current. [Back-formation < COMMUTATION.]

com·mu·ta·tion (kŏm'yə-tā'shən) *n.* **1.** A substitution, exchange, or interchange. **2. a.** The substitution of one kind of payment for another. **b.** The payment substituted. **3.** The travel of a commuter. **4.** *Elect.* **a.** The conversion of alternating to unidirectional current. **b.** The reversing of current direction. **5.** *Law.* A reduction of a penalty to a less severe one. [ME *communtacioun* < Lat. *commutatio* < *commutare,* to commute.]

commutation ticket *n.* A ticket issued at a reduced rate by a railroad, bus, or other transportation company for passage over a given route for a specified number of trips.

com·mu·ta·tive (kŏm'yə-tā'tĭv, kə-myōō'tə-tĭv) *adj.* **1.** Pertaining to, involving, or characterized by substitution, interchange, or exchange. **2.** Independent of order. Used of a

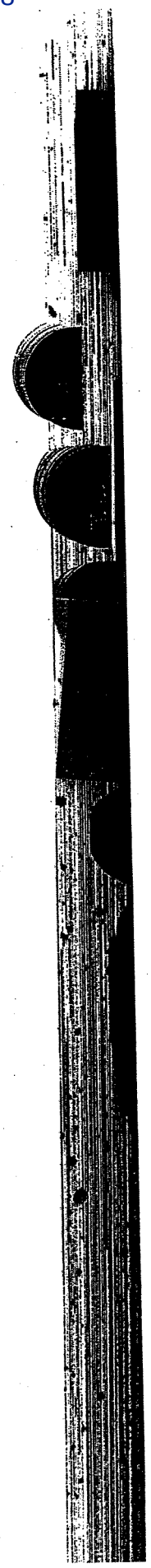


EXHIBIT C
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orum edition of Keats. **b.** One closely similar to an original; version: *The boy was a smaller edition of his father.* **3.** All the copies of a single press run of a newspaper: *the morning edition.* [OFr. < Lat. *editio,* publication < *edere,* to publish : *ex-,* out + *dare,* to give.]

ed·i·tor (ĕd′ĭ-tər) *n.* **1.** A person who edits, esp. as an occupation. **2.** One who writes editorials. **3.** A device for editing film, consisting basically of a splicer and viewer. **4.** *Computer Sci.* A routine that performs editing functions. [LLat., publisher < Lat. *edere,* to publish. —see EDITION.]

ed·i·to·ri·al (ĕd′ĭ-tôr′ē-əl, -tōr′-) *n.* **1.** An article in a publication expressing the opinion of its editors or publishers. **2.** A commentary on radio or television expressing the opinion of the station or network. —*adj.* **1.** Of, concerning, or relating to an editor. **2.** Of the nature of an editorial. —**ed′i·to′ri·al·ly** *adv.*

ed·i·to·ri·al·ize (ĕd′ĭ-tôr′ē-ə-līz′, -tōr′-) *intr.v.* **-ized, -iz·ing, -iz·es. 1.** To express an opinion in or as if in an editorial. **2.** To present an opinion in the guise of an objective report. —**ed′i·to′ri·al·i·za′tion** *n.* —**ed′i·to′ri·al·i′zer** *n.*

editor in chief *n., pl.* **editors in chief.** The editor having final responsibility for the operations and policies of a publication.

ed·i·tor·ship (ĕd′ĭ-tər-shĭp′) *n.* The position, functions, or guidance of an editor.

E·dom·ite (ē′də-mīt′) *n.* A member of a Semitic people inhabiting an area southeast of the Dead Sea in ancient times. [After *Edom,* a region of ancient Palestine.] —**E′dom·it′ish** *adj.*

EDTA (ē′dē-tē-ā′) *n.* A crystalline acid, $C_{10}H_{16}N_2O_8$, used as a chelating agent. [Abbr. of *ethylenediaminetetraacetic acid.*]

ed·u·ca·ble (ĕj′ə-kə-bəl) *adj.* Capable of being educated. [EDUC(ATE) + -ABLE.]

ed·u·cate (ĕj′ə-kāt′) *v.* **-cat·ed, -cat·ing, -cates.** —*tr.* **1.** To provide with knowledge or training, esp. through formal schooling; teach. **2.** To provide with training for some particular purpose: *educated him for the priesthood.* **3.** To provide with information; inform. **4.** To stimulate or develop the mental or moral growth of. —*intr.* To teach or instruct a person or group. [ME *educaten* < Lat. *educare.*]

ed·u·cat·ed (ĕj′ə-kā′tĭd) *adj.* **1.** Having an education, esp. one above the average. **2. a.** Showing evidence of schooling or instruction. **b.** Cultivated; cultured. **3.** Based on experience and some factual knowledge: *an educated guess.*

ed·u·ca·tion (ĕj′ə-kā′shən) *n.* **1. a.** The act or process of educating or being educated. **2.** The knowledge or skill obtained or developed by a learning process. **3.** The field of study that is concerned with teaching and learning pedagogy.

ed·u·ca·tion·al (ĕj′ə-kā′shən-əl) *adj.* **1.** Of or relating to education. **2.** Serving to educate; instructive: *an educational film.* —**ed′u·ca′tion·al·ly** *adv.*

educational television *n.* **1.** Public television. **2.** A video system that provides instructional material.

ed·u·ca·tive (ĕj′ə-kā′tĭv) *adj.* Educational.

ed·u·ca·tor (ĕj′ə-kā′tər) *n.* **1.** One trained in teaching; teacher. **2.** A specialist in the theory and practice of education.

e·duce (ĭ-dōōs′, ĭ-dyōōs′) *tr.v.* **e·duced, e·duc·ing, e·duc·es. 1.** To draw or bring out; elicit. **2.** To assume or work out from given facts; deduce. [Lat. *educere* : *ex-,* out + *ducere,* to lead.] —**e·duc′i·ble** *adj.* —**e·duc′tion** (ĭ-dŭk′shən) *n.*

Ed·ward·i·an (ĕd-wôr′dē-ən, -wär′-) *adj.* Of, relating to, or characteristic of the reign of Edward VII of England, during whose reign the styles and views were opulent, elegant, ornate, and refined.

-ee[1] *suff.* **1. a.** One that receives or benefits from a specified action: *addressee.* **b.** One that possesses a specified thing: *mortgagee.* **2.** One that performs a specified action: *absentee.* [ME *-e* < OFr. < Lat. *-atus,* -ate.]

Usage: The suffix *-ee* has generally been used to indicate a person to whom something has been done or upon whom some right has been conferred: *appointee, grantee.* It has come to be used also with reference to a person in a specified condition (*absentee, refugee, amputee*) or even a person performing some action (*escapee, standee*). The Usage Panel accepts the use of *standee* and *escapee* in speech and is about evenly divided on their acceptability in writing. Less well established coinages, such as *returnee,* are best avoided.

-ee[2] *suff.* **1. a.** One resembling: *goatee.* **b.** A particular kind of: *bootee.* Used often as a diminutive. **2.** One connected with: *bargee.* [Alteration of -Y[1].]

eel (ēl) *n., pl.* **eel** or **eels. 1.** Any of various long, snakelike marine or freshwater fishes of the order Anguilliformes or Apodes, esp. *Anguilla rostrata,* of eastern North America, or *A. anguilla,* of Europe, characteristically migrating from fresh water to the Sargasso Sea to spawn. **2.** Any of several fishes similar or related to the eel. [ME *ele* < OE *æl.*]

eel·grass (ēl′grăs′) *n.* **1.** Any of several submerged aquatic plants of the genus *Zostera,* growing along the North Atlantic coast and having narrow, grasslike leaves. **2.** Any of several similar or related plants, such as tape grass.

eel·pout (ēl′pout′) *n., pl.* **eelpout** or **-pouts.** Any of various marine fishes of the family Zoarcidae, having an elongated body and a large head. [ME **elepout* < OE *æle-puta.*]

eel·worm (ēl′wûrm′) *n.* Any of various, often parasitic nematode worms, such as the vinegar eel.

e'en[1] (ēn) *n.* Evening.

e'en[2] (ēn) *adv.* Even.

-eer *suff.* One associated with, concerned with, or engaged in: *balladeer.* [OFr. *-ier* < Lat. *-arius,* -ary.]

e'er (âr) *adv.* Ever.

ee·rie or **ee·ry** (ĭr′ē) *adj.* **-ri·er, -ri·est. 1. a.** Inspiring fear or dread; weird. **b.** Supernatural in aspect or character; mysterious. **2.** *Scot.* Frightened or intimidated by superstition. [ME *eri,* fearful < OE *earg,* cowardly.] —**ee′ri·ness** *n.*

ef (ĕf) *n.* The letter *f.*

ef·face (ĭ-fās′) *tr.v.* **-faced, -fac·ing, -fac·es. 1.** To erase or make indistinct by or as if by rubbing; wipe out. **2.** To conduct (oneself) inconspicuously. [Fr. *effacer* < OFr. : Lat. *ex-,* out + Lat. *facies,* face.] —**ef·face′a·ble** *adj.* —**ef·face′ment** *n.* —**ef·fac′er** *n.*

ef·fect (ĭ-fĕkt′) *n.* **1.** Something brought about by a cause or agent; result. **2.** The way in which something acts upon or influences an object: *the effect of a drug on the nervous system.* **3.** The power or capacity to achieve the desired result; influence. **4.** The condition of being in full force or execution: *goes into effect tomorrow.* **5. a.** Something that produces a specific impression or supports a general design or intention: *sound effects.* **b.** A particular impression: *an effect of spaciousness.* **c.** The production of a particular impression: *She cries just for effect.* **6. a.** The basic meaning. **b.** Intention; purport. **7. effects.** Movable goods; property. —*tr.v.* **-fect·ed, -fect·ing, -fects. 1.** To produce as a result; bring into existence. **2.** To bring about. —***idioms.*** **in effect. 1.** In fact; actually. **2.** In essence; virtually. **3.** In active force; in operation. **take effect.** To become operative. —See Usage note at **affect**[1]. [ME < OFr. < Lat. *effectus,* p.part. of *efficere,* to accomplish : *ex-,* out + *facere,* to make.] —**ef·fect′er** *n.* —**ef·fect′i·ble** *adj.*

Synonyms: *effect, consequence, result, outcome, upshot, sequel, consummation.* These nouns denote occurrences, situations, or conditions that are traceable to something antecedent. An *effect* is that which is produced by the action of an agent or cause and follows it in time, either immediately or shortly. A *consequence* also follows the action of an agent and is traceable to it, but the relationship between them is less sharply definable and less immediate than that between a cause and its effect. A *result* is an effect, or the last in a series of effects, that follows a cause and that is viewed as the end product of the operation of the cause. An *outcome* is a result that has clear definition; the term is even stronger than *result* in implying finality, and may suggest operation of a cause over a relatively long period. An *upshot* is a decisive result, often arrived at abruptly or in the nature of a climax. A *sequel* is a logical but relatively long-range consequence of an antecedent action. *Consummation* refers to the final, decisive stage of an action directed toward achievement of a specific end.

ef·fec·tive (ĭ-fĕk′tĭv) *adj.* **1.** Having an intended or expected effect. **2.** Producing or designed to produce the desired impression or response: *an effective speech.* **3.** Operative; in effect: *The law is effective immediately.* **4.** Existing in fact; actual: *a decline in the effective demand.* **5.** Prepared for use or action, esp. in warfare. —*n.* A soldier or a piece of military equipment that is ready for combat. —**ef·fec′tive·ly** *adv.* —**ef·fec′tive·ness, ef′fec·tĭ′vi·ty** *n.*

ef·fec·tor (ĭ-fĕk′tər) *n.* **1.** An organ at the end of a nerve that activates either gland secretion or muscular contraction. **2.** *Computer Sci.* A device used to produce a desired change in an object in response to input.

ef·fec·tu·al (ĭ-fĕk′chōō-əl) *adj.* Producing or sufficient to produce a desired effect; fully adequate. —**ef·fec′tu·al′i·ty, ef·fec′tu·al·ness** *n.* —**ef·fec′tu·al·ly** *adv.*

ef·fec·tu·ate (ĭ-fĕk′chōō-āt′) *tr.v.* **-at·ed, -at·ing, -ates.** To bring about; effect. [Med. Lat. *effectuare* < Lat. *efficere.* —see EFFECT.] —**ef·fec′tu·a′tion** *n.*

ef·fem·i·na·cy (ĭ-fĕm′ə-nə-sē) *n.* The quality or condition of being effeminate.

ef·fem·i·nate (ĭ-fĕm′ə-nĭt) *adj.* **1.** Having qualities or characteristics more often associated with women than men; unmanly. **2.** Characterized by weakness and excessive refinement. [ME *effeminat* < Lat. *effeminatus,* p.part. of *effeminare,* to make feminine : *ex,* from + *femina,* woman.] —**ef·fem′i·nate** *n.* —**ef·fem′i·nate·ly** *adv.* —**ef·fem′i·nate·ness** *n.*

ef·fen·di (ĭ-fĕn′dē) *n.* Sir. Used as a title of respect in Turkey. [Turk. *efendi* < Mod. Gk. *aphentēs,* master, alteration of Gk. *authentēs,* master.]

ef·fer·ent (ĕf′ər-ənt) *adj.* **1.** Directed away from a central organ or section. **2.** Carrying impulses from the central nervous system to an effector. [Fr. *efférent* < Lat. *efferens,* pr.part. of *efferre,* to carry off : *ex,* away + *ferre,* to carry.] —**ef′fer·ent** *n.* —**ef′fer·ent·ly** *adv.*

ef·fer·vesce (ĕf′ər-vĕs′) *intr.v.* **-vesced, -vesc·ing, -vesc·es. 1.** To emit small bubbles as gas comes out of a liquid. **2.** To show high spirits or vivacity. [Lat. *effervescere* : *ex-* (intensive) + *fervescere,* to start boiling < *fervēre,* to boil.] —**ef′-**



eel

associations is encouraged in order to elicit repressed thoughts and emotions.

free·bie also **free·bee** (frē'bē) *n. Slang.* Something given or received gratis: *"such freebies as subway and bus maps"* (New York Magazine). [< FREE.]

free·board (frē'bôrd', -bōrd') *n.* **1.** *Naut.* The distance between the water line and the uppermost full deck. **2.** The distance between the ground and the undercarriage of an automobile.

freeboard deck *n.* The uppermost deck that is officially considered completely watertight.

free·boot (frē'bo͞ot') *intr.v.* **-boot·ed, -boot·ing, -boots.** To act as a freebooter; plunder. [Back-formation < FREEBOOTER.]

free·boot·er (frē'bo͞o'tər) *n.* A person who pillages and plunders, esp. a pirate. [Du. *vrijbuiter* < *vrijbuit,* plunder : *vrij,* free + *buit,* booty.]

free·born (frē'bôrn') *adj.* **1.** Born as a free person. **2.** Pertaining to or befitting a person born free.

free city *n.* A city governed as an autonomous political unit under international auspices.

freed·man (frēd'mən) *n.* A man who has been freed from bondage.

free·dom (frē'dəm) *n.* **1.** The condition of being free of restraints. **2.** Liberty of the person from slavery, oppression, or incarceration. **3. a.** Political independence. **b.** Possession of civil rights; immunity from the arbitrary exercise of authority. **4.** Exemption from unpleasant or onerous conditions: *freedom from unfair labor practices.* **5.** The capacity to exercise choice; free will: *has the freedom to do as he wishes.* **6.** Ease or facility of movement. **7.** Frankness or boldness; lack of modesty or reserve: *the new freedom in movies and novels.* **8. a.** Unrestricted use or access: *was given the freedom of their research facilities.* **b.** The right of enjoying all of the privileges of membership or citizenship: *the freedom of the city.* [ME *fredom* < OE *frēodom.*]

Synonyms: *freedom, liberty, license.* These nouns refer to the power to act, speak, or think without the imposition of restraint. *Freedom* is the most general term and preferable when total absence of restraint or lack of restraint in general is meant. *Liberty* applies especially to individual rights defined by law and thus suggests absence of specific restrictions. However, *freedom* is sometimes also used in the narrower sense associated with individual rights. *License* in one sense denotes abuse of freedom; in another it refers to exemption from prevailing rules, granted in special cases.

freedom of the seas *n.* **1.** The doctrine that ships of any nation may travel through international waters unhampered. **2.** The right of neutral shipping in wartime to trade at will except where blockades are established.

freed·wom·an (frēd'wo͝om'ən) *n.* A woman who has been freed from bondage.

free electron *n.* An electron that is not bound to an atom, esp. an electron in a conductor that is available to move in a current.

free energy *n.* **1.** A thermodynamic quantity that is the difference between the internal energy and the product of the absolute temperature and entropy of a system. **2.** A thermodynamic quantity that is the difference between the enthalpy and the product of the absolute temperature and entropy of a system.

free enterprise *n.* The freedom of private businesses to operate competitively for profit with minimal government regulation.

free fall *n.* **1.** The fall of a body within the atmosphere without a drag-producing device such as a parachute. **2.** The unconstrained motion of a body in a gravitational field.

free flight *n.* Flight, as of an aircraft or spacecraft, after termination of powered flight.

free-float·ing (frē'flō'tĭng) *adj.* **1.** Not committed or decided. **2.** Experienced without an obvious basis or cause: *free-floating anxiety.*

free-for-all (frē'fər-ôl') *n.* A brawl, argument, or competition in which one and all take part.

free·form (frē'fôrm') *adj.* Designating a usually flowing asymmetric shape or outline free of formal conventions.

free form *n. Ling.* A morpheme capable of standing alone and retaining meaning.

free-hand (frē'hănd') *adj.* Drawn by hand without the aid of tracing or drafting devices: *a freehand sketch.* —**free'hand'** *adv.*

free hand *n.* Freedom to do or decide as one sees fit.

free-hand·ed (frē'hăn'dĭd) *adj.* Openhanded; generous. —**free'hand'ed·ly** *adv.* —**free'hand'ed·ness** *n.*

free-heart·ed (frē'här'tĭd) *adj.* **1.** Unreserved; open. **2.** Generous; liberal. —**free'heart'ed·ly** *adv.* —**free'heart'ed·ness** *n.*

free·hold (frē'hōld') *n.* **1.** *Law.* **a.** An estate held in fee or for life. **b.** The tenure by which such an estate is held. **2.** A tenure of an office or a dignity for life. [ME *frehold,* transl. of Norman Fr. *fraunc tenement.*] —**free'hold'er** *n.*

free lance *n.* **1.** A person, esp. a writer or an artist, who sells his services to employers without a long-term commitment to any one of them. **2.** One who remains uncommitted to a party and proceeds as an independent. **3.** A medieval mercenary.

free-lance (frē'lăns') *intr. & tr.v.* **-lanced, -lanc·ing, -lanc·es.** To work as or produce and sell as a free lance. —*adj.* Of, pertaining to, or produced by a free lance. —**free'-lanc'er** *n.*

free-liv·ing (frē'lĭv'ĭng) *adj.* **1.** Given to self-indulgence. **2.** *Biol.* Living or moving independently; not part of a parasitic or symbiotic relationship.

free·load (frē'lōd') *intr.v.* **-load·ed, -load·ing, -loads.** *Slang.* To take advantage of the charity, generosity, or hospitality of others. —**free'load'er** *n.*

free love *n.* The belief in or practice of sexual relations without marriage and without formal obligations.

free·man (frē'mən) *n.* **1.** A person not in slavery or serfdom. **2.** One who possesses the rights or privileges of a citizen.

free·mar·tin (frē'mär'tn) *n.* A sterile or otherwise sexually deficient female calf born as the twin of a bull calf. [Orig. unknown.]

free·ma·son (frē'mā'sən) *n.* **1.** A member of a guild of skilled, itinerant masons of the Middle Ages. **2. Freemason.** A member of the Free and Accepted Masons, an international secret fraternity.

free·ma·son·ry (frē'mā'sən-rē) *n.* **1.** Spontaneous fellowship and sympathy among a number of people. **2. Freemasonry.** The institutions, precepts, and rites of the Freemasons.

free on board *adj. & adv.* Without fee for delivery on board or into a carrier at a specified point or location.

free port *n.* A port or an area of a port in which imported goods can be held or processed free of customs duties before re-export.

free·r (frē'ər) *adj.* Comparative of **free.**

free radical *n.* An atom or group of atoms having at least one unpaired electron.

free rein *n.* Unlimited freedom to act or make decisions.

free ride *n.* Something acquired without the ordinary effort or cost. —**free rider** *n.*

free·sia (frē'zhə, -zhē-ə, -zē-ə) *n.* Any of several plants of the genus *Freesia,* native to southern Africa, having one-sided clusters of fragrant, variously colored flowers. [NLat., after Friedrich H. T. *Freese* (d. 1876).]

free silver *n.* The free coinage of silver, esp. at a fixed ratio to gold.

free soil *n.* U.S. territory in which slavery was prohibited before the Civil War.

free-soil (frē'soil') *adj.* **1.** Prohibiting slavery: *free-soil states.* **2. a.** Opposing the extension of slavery prior to the U.S. Civil War. **b. Free-Soil.** Pertaining to or designating a U.S. political party founded in 1848 to oppose the extension of slavery into U.S. Territories and the admission of slave states into the Union.

free-spo·ken (frē'spō'kən) *adj.* Candid in expression; outspoken. —**free'-spo'ken·ness** *n.*

free·st (frē'ĭst) *adj.* Superlative of **free.**

free-stand·ing (frē'stăn'dĭng) *adj.* Standing independently free of support or attachment.

free-stone (frē'stōn') *n.* **1.** A stone, such as limestone, soft enough to be cut easily without shattering or splitting. **2.** A fruit, esp. a peach, having a stone that does not adhere to the pulp.

free-style (frē'stīl') *n.* A competitive event, as swimming, in which the contestant may choose his own style.

free-swim·ming (frē'swĭm'ĭng) *adj.* Able to swim freely; not sessile or attached: *the free-swimming larva of the oyster.* —**free'-swim'mer** *n.*

free-think·er (frē'thĭng'kər) *n.* One who has rejected authority and dogma, esp. in his religious thinking, in favor of rational inquiry and speculation. —**free'think'ing** *adj. & n.*

free thought *n.* Freethinking; unorthodox thought.

free throw *n. Basketball.* A foul shot.

free-throw line (frē'thrō') *n. Basketball.* The foul line (sense 2).

free trade *n.* Trade between nations or states without protective customs tariffs. —**free trader** *n.*

free university *n.* An independent unaccredited organization set up by students within a university for the study of nontraditional subjects.

free verse *n.* Verse that does not follow a conventional metrical or stanzaic pattern and has either an irregular rhyme or no rhyme. [Trans. of Fr. *vers libre.*]

free·way (frē'wā') *n.* **1.** A highway with several lanes and no intersections or stoplights; expressway. **2.** A highway without tolls.

free·wheel (frē'hwēl', -wēl') *intr.v.* **-wheeled, -wheel·ing, -wheels.** To live or move freely, aimlessly, or irresponsibly.

free wheel *n.* **1.** An automotive transmission device that allows the drive shaft to continue turning when its speed is greater than that of the engine shaft. **2.** A device in the rear-wheel hub of a bicycle that permits the wheel to turn without pedal action, as in coasting.

free-wheel·ing (frē'hwē'lĭng, -wē'-) *adj.* **1.** Pertaining to or equipped with free wheel. **2.** *Informal.* **a.** Free of restraints or rules in organization, methods, or procedure. **b.** Heedless of consequences; carefree.

free-will (frē'wĭl') *adj.* Done of one's own accord; voluntary.

free will *n.* **1.** The ability or discretion to choose; free choice. **2.** The power, attributed esp. to human beings, of making free choices that are unconstrained by external circumstances or by necessity. [Transl. of LLat. *liberum arbitrium.*]

free world *n.* The portion of the world marked by demo-



freesia

han·dle (hăn′dl) *v.* **-dled, -dling, -dles.** —*tr.* **1.** To touch, lift, or hold with the hands. **2.** To operate with the hands; manipulate. **3.** To deal with or have responsibility for; conduct: *handle corporation law.* **4. a.** To direct, execute, or dispose of: *handle an investment.* **b.** To manage, administer to, or represent: *handle a boxer.* **5.** To confront or cope with: *handle a crowd; handle a problem.* **6.** To deal or trade in the purchase or sale of: *the branch office that handles grain exports.* —*intr.* To act or function under operation: *a car that handles well in the snow.* —*n.* **1.** A part that is designed to be held or operated with the hand. **2.** An opportunity or means for achieving a purpose. **3.** *Slang.* A person's name. **4.** The total amount of money bet on an event or over a set period of time. [ME *handelen* < OE *handlian.*]

han·dle·bar (hăn′dl-bär′) *n.* Often **handlebars.** A curved metal steering bar, as on a bicycle.



handlebar mustache

handlebar mustache *n.* A long, curved mustache resembling a handlebar.

han·dler (hănd′lər) *n.* **1.** One that handles something. **2.** *Sports.* **a.** A person who trains or exhibits an animal, such as a dog. **b.** A person who acts as the trainer or second of a boxer.

han·dling (hănd′lĭng) *n.* **1.** The act or an instance of one that handles something. **2.** The way in which a matter, esp. a delicate one, is taken care of. **3.** The way in which a presentation, esp. an artistic or theatrical work, is treated.

hand-made (hănd′mād′) *adj.* Made or prepared by hand rather than by machine.

hand-maid (hănd′mād′) also **hand-maid-en** (-mād′n) *n.* **1.** A female servant or attendant. **2.** Something that serves as an aid.

hand-me-down (hănd′mē-doun′) *adj.* **1.** Handed down to one person after being used and discarded by another. **2.** Of inferior quality; shabby. —*n.* Something passed on from one person to another.

hand-off (hănd′ôf′, -of′) *n. Football.* A play in which one player hands the ball to another.

hand organ *n.* A barrel organ operated by turning a crank.

hand-out (hănd′out′) *n.* **1.** Food, clothing, or money given to a beggar. **2.** A folder or leaflet circulated free of charge. **3.** A prepared news or publicity release.

hand-pick (hănd′pĭk′) *tr.v.* **-picked, -pick·ing, -picks.** **1.** To gather or pick by hand. **2.** To select personally. —**hand′-picked′** *adj.*

hand-print (hănd′prĭnt′) *n.* An outline or an indentation left by a hand on a surface.

hand puppet *n.* A puppet (sense 2).

hand-rail (hănd′rāl′) *n.* A narrow rail to be grasped with the hand for support.



hand organ

hand-saw (hănd′sô′) *n.* A small saw operated by hand.

hand's-breadth or **hand's breadth** (hăndz′brĕdth′) *n.* Variant of **handbreadth.**

hand-sel (hănd′səl) also **han-sel** (hăn′-) *Chiefly Brit.* —*n.* **1.** A gift to express good wishes at the beginning of a new year or enterprise. **2.** The first money or barter taken in, as by a new business or on the opening day of business, esp. when considered a token of good luck. **3. a.** A first payment; earnest money. **b.** A specimen or foretaste of what is to come. —*tr.v.* **-seled, -sel·ing, -sels** or **-selled, -sel·ling, -sels.** **1.** To give a handsel to. **2.** To launch with a ceremonial gesture or gift. **3.** To do or use for the first time. [ME *hanselle* < OE *handselen* and ON *handsal,* transfer.]

hand-set (hănd′sĕt′) *n.* A portable telephone transmitter and receiver module.

hand-shake (hănd′shāk′) *n.* The grasping of right hands by two people as in greeting or leave-taking.

hands-off (hăndz′ôf′, -of′) *adj.* Characterized by nonintervention: *a hands-off foreign policy.*

hand-some (hăn′səm) *adj.* **-som·er, -som·est.** **1.** Pleasing and dignified in form or appearance. **2.** Generous or copious: *a handsome reward.* **3.** Marked by or requiring skill or dexterity: *did some handsome maneuvers on the skating rink.* **4.** Appropriate or fitting. **5.** Moderately large. [ME *handsom,* handy.] —**hand′some·ly** *adv.* —**hand′some·ness** *n.*

hands-on (hăndz′ŏn′, -ôn′) *adj.* Involving active participation; applied, as opposed to theoretical: *"We're involved in hands-on operations, pulling levers, pushing buttons"* (Arthur R. Taylor).



handstand

hand-spike (hănd′spīk′) *n.* A bar used as a lever.

hand-spring (hănd′spring′) *n.* A gymnastic feat in which the body is flipped completely forward or backward from an upright position, landing first on the hands, then on the feet.

hand-stand (hănd′stănd′) *n.* The act of balancing on the hands with one's feet in the air.

hand-to-hand (hănd′tə-hănd′) *adj.* Being at close quarters.

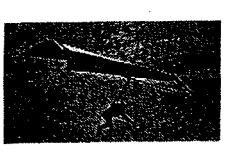
hand-to-mouth (hănd′tə-mouth′) *adj.* Having or providing only the bare essentials.

hand-work (hănd′wûrk′) *n.* Work done by hand rather than by machine.

hand-wo·ven (hănd′wō′vən) *adj.* **1.** Woven on a hand-operated loom: *handwoven rugs.* **2.** Woven by hand: *handwoven baskets.*

hand-writ·ing (hănd′rī′tĭng) *n.* **1.** Writing done with the hand. **2.** The writing characteristic of a particular person.

hand·y (hăn′dē) *adj.* **-i·er, -i·est.** **1.** Skillful in using one's hands, esp. in a variety of ways. **2.** Readily accessible. **3.** Useful; convenient: *a handy gadget.* **4.** Easy to use or handle: *a handy reference book.* [< HAND.] —**hand′i·ness** *n.*



hang glider

hand·y·man also **handy man** (hăn′dē-măn′) *n.* One who does odd jobs or various small tasks.

hang (hăng) *v.* **hung** (hŭng), **hang·ing, hangs.** —*tr.* **1.** To fasten from above with no support from below; suspend. **2.** To suspend or fasten so as to allow free movement at or about the point of suspension: *hang a door.* **3.** *past tense & past participle* **hanged** or **hung.** To execute by suspending by the neck. **4.** To fix or attach at an appropriate angle: *hang a scythe to its handle.* **5.** To alter the hem of (a garment) so as to fall evenly at a specified height. **6.** To furnish, decorate, or appoint by suspending objects around or about: *hang a room with curtains.* **7.** To hold or incline downward; let droop: *hang one's head in sorrow.* **8.** To attach to a wall: *hang wallpaper.* **9.** To deadlock (a jury) by failing to render a unanimous verdict. **10.** *Baseball.* To throw (a pitch) in such a manner so as to fail to break. —*intr.* **1.** To be attached from above with no support from below. **2.** To die as a result of hanging. **3.** To remain suspended or poised over a place or object; hover. **4.** To attach oneself as an impediment or dependent; cling. **5.** To incline downward; droop. **6.** To depend: *everything hangs on the committee's decision.* **7.** To pay strict attention: *hang on every word.* **8.** To remain unresolved or uncertain: *Her future hung in the balance.* **9.** To fit the body in loose lines: *a dress that hangs well.* **10.** To be on display, as in a gallery. **11.** *Baseball.* To fail to break or move in the intended way, as a curve ball. —**phrasal verbs. hang around.** *Informal.* **1.** To spend time idly; loiter. **2.** To keep company; consort. **hang back.** To be averse; hold back. **hang off.** To hold back; be averse. **hang on. 1.** To cling tightly to something. **2.** To continue persistently; persevere. **3.** To keep a telephone connection open. **hang onto.** To hold or cling tightly to. **hang out.** *Slang.* To spend one's free time in a certain place. **hang together. 1.** To stand united; stick together. **2.** To constitute a coherent totality. **hang up. 1.** To suspend on a hook or hanger. **2.** To replace (a telephone receiver) on its cradle. **3.** To retard or impede; hinder: *hang up a project.* **4.** To halt the movement or action of. **5.** To end a telephone conversation. **6.** To become halted or snagged. —*n.* **1.** The way in which something hangs. **2.** A downward inclination or slope. **3.** Particular meaning or significance. **4.** *Informal.* The proper method for doing, using, or handling something: *get the hang of it.* **5.** A suspension of motion; slackening. —*idioms.* **give (or care) a hang.** To be concerned or anxious. **hang fire. 1.** To be slow in firing, as a gun. **2.** To delay. **hang in there.** *Informal.* To persevere despite difficulties; persist. **hang loose.** *Slang.* To stay calm or relaxed. **hang tough.** *Informal.* To remain firmly resolved: *"We are going to hang tough on this"* (Donald T. Regan). **let it all hang out.** *Slang.* **1.** To be completely relaxed. **2.** To be completely candid. [ME *hongen,* partly < OE *hangian,* to hang, and partly < OE *hōn,* to hang.]

Usage: *Hanged,* as the past tense and past participle of *hang,* is used in the sense of "put to death by hanging." In the following example *hung* would be unacceptable to a majority of the Usage Panel: *Frontier courts hanged many a prisoner after a summary trial.* In all other senses of the word, *hung* is the preferred form as past tense and past participle.

han·gar (hăng′ər, hăng′gər) *n.* A structure esp. for housing or repairing aircraft. [Fr. < OFr., prob. < Med. Lat. *angarium,* shed for shoeing horses.]

hang-dog (hăng′dôg′, -dŏg′) *adj.* **1.** Shamefaced or guilty. **2.** Downcast; intimidated. —*n.* A sneaky or despicable person.

hang·er (hăng′ər) *n.* **1.** One that hangs. **2.** A contrivance to which something hangs or by which something is hung. **3.** A device around which a garment is draped for hanging from a hook or rod. **4.** A loop or strap by which something is hung. **5.** A bracket on an automobile's spring shackle designed to hold it to the chassis. **6.** A decorative strip of cloth hung on a garment or wall.

hang·er-on (hăng′ər-ŏn′, -ôn′) *n., pl.* **hang·ers-on** (hăng′-ərz-). A sycophant; parasite.

hang glider *n.* A device resembling a kite from which a harnessed rider hangs while gliding from a height.

hang·ing (hăng′ĭng) *n.* **1.** An execution on a gallows. **2.** Something hung, as draperies or a tapestry. **3.** A descending slope or inclination. —*adj.* **1.** Situated on a sharp declivity. **2.** Projecting downward; overhanging. **3.** Suited for holding something that hangs. **4. a.** Deserving death by hanging: *a hanging crime.* **b.** Disposed to inflict the sentence of death by hanging: *a hanging judge.*

hanging indention *n.* The indention of every line in a paragraph except the first.

hang·man (hăng′mən) *n.* One employed to execute condemned prisoners by hanging.

hang·nail (hăng′nāl′) *n.* A small piece of dead skin at the side or the base of a fingernail that is partly detached from the rest of the skin. [Alteration of AGNAIL.]

hang-out (hăng′out′) *n.* A frequently visited place.

hang·o·ver (hăng′ō′vər) *n.* **1.** Unpleasant physical effects following the heavy use of alcohol. **2.** A letdown, as after a

EXHIBIT C
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teristic thick yellow crusts. [Lat. < *impetere,* to attack. —see IMPETUS.]

im·pe·trate (ĭm′pĭ-trāt′) *tr.v.* **-trat·ed, -trat·ing, -trates.** **1.** To obtain by entreaty or petition. **2.** To beseech. [Lat. *impetrare, impetrat-,* to obtain : *in-* (intensive) + *patrare,* to bring about.] —**im′pe·tra′tion** *n.* —**im′pe·tra′tor** *n.*

im·pet·u·os·i·ty (ĭm-pĕch′ōō-ŏs′ĭ-tē) *n., pl.* **-ties.** **1.** The quality or condition of being impetuous. **2.** An impetuous act.

im·pet·u·ous (ĭm-pĕch′ōō-əs) *adj.* **1.** Characterized by sudden energy, action, or emotion; impulsive: *an impetuous decision he'll come to regret.* **2.** Having or marked by violent force: *impetuous, heaving waves.* [ME < OFr. *impetueux* < Lat. *impetuosus* < *impetus,* impetus.] —**im·pet′u·ous·ly** *adv.* —**im·pet′u·ous·ness** *n.*

Synonyms: *impetuous, heedless, hasty, headlong, sudden.* These adjectives describe persons and their actions and decisions when marked by abruptness or lack of deliberation. *Impetuous* suggests impulsiveness, impatience, or lack of thoughtfulness. *Heedless* implies carelessness or lack of a sense of responsibility or proper regard for the consequences of action. *Hasty* and *headlong* both stress hurried action, and the latter especially implies recklessness. *Sudden* is applied to action or to personal attributes, such as moods, that make themselves apparent abruptly or unexpectedly.

im·pe·tus (ĭm′pĭ-təs) *n., pl.* **-tus·es.** **1. a.** An impelling force; impulse. **b.** Something that incites; stimulus. **2.** The force or energy associated with a moving body. [Lat., attack < *impetere,* to attack : *in-,* against + *petere,* to go towards, seek.]

im·pi·e·ty (ĭm-pī′ĭ-tē) *n., pl.* **-ties.** **1.** The quality or state of being impious. **2.** An impious act. **3.** Undutifulness.

im·pinge (ĭm-pĭnj′) *intr.v.* **-pinged, -ping·ing, -ping·es.** **1.** To collide or strike: *Sound waves impinge on the eardrum.* **2.** To encroach; trespass: *impinging on my privacy.* [Lat. *impingere,* to push against : *in-,* against + *pangere,* to fasten.] —**im·pinge′ment** *n.* —**im·ping′er** *n.*

im·pi·ous (ĭm′pē-əs, ĭm-pī′-) *adj.* **1.** Not pious; lacking reverence. **2.** Lacking due respect or dutifulness. [Lat. *impius,* irreverent, undutiful : *in-,* not + *pius,* reverent, dutiful.] —**im′pi·ous·ly** *adv.* —**im′pi·ous·ness** *n.*

imp·ish (ĭm′pĭsh) *adj.* Of or befitting an imp; mischievous. —**imp′ish·ly** *adv.* —**imp′ish·ness** *n.*

im·plac·a·ble (ĭm-plăk′ə-bəl, -plā′kə-) *adj.* Incapable of appeasement or mitigation; inexorable: *implacable foes.* [Lat. *implacabilis* : *in-,* not + *placabilis,* placable.] —**im·plac′a·bil′i·ty, im·plac′a·ble·ness** *n.* —**im·plac′a·bly** *adv.*

im·plant (ĭm-plănt′) *tr.v.* **-plant·ed, -plant·ing, -plants.** **1.** To entrench or set in firmly, as in the ground. **2.** To establish permanently, as in the mind or consciousness; instill. **3.** *Med.* To insert or embed surgically, as in grafting. —*n.* (ĭm′plănt′). Something implanted, esp. surgically implanted tissue. —**im′plan·ta′tion** *n.*

im·plau·si·ble (ĭm-plô′zə-bəl) *adj.* Not plausible; difficult to believe. —**im·plau′si·bil′i·ty, im·plau′si·ble·ness** *n.* —**im·plau′si·bly** *adv.*

im·plead (ĭm-plēd′) *tr.v.* **-plead·ed, -plead·ing, -pleads.** To sue in a court of law. [ME *empleden* < AN *empleder* : *en-* (intensive < Lat. *in-*) + *pleder,* to plead. —see PLEAD.]

im·ple·ment (ĭm′plə-mənt) *n.* **1.** A tool, utensil, or instrument. **2.** An article used to outfit or equip. **3.** A means employed to achieve a given end; agent. —*tr.v.* (ĭm′plə-mĕnt′) **-ment·ed, -ment·ing, -ments.** **1.** To put into practical effect; carry out: *implement the new procedures.* **2.** To supply with implements. [ME < LLat. *implementum,* a filling up < Lat. *implēre,* to fill up : *in-* (intensive) + *plēre,* to fill.] —**im′ple·men·ta′tion** (ĭm′plə-mən-tā′shən, -mĕn-) *n.*

im·pli·cate (ĭm′plĭ-kāt′) *tr.v.* **-cat·ed, -cat·ing, -cates.** **1.** To involve or connect intimately or incriminatingly. **2.** To imply. **3.** *Archaic.* To interweave or entangle; entwine. [Lat. *implicare, implicat-,* to entangle, unite : *in-,* in + *plicare,* to fold.]

im·pli·ca·tion (ĭm′plĭ-kā′shən) *n.* **1.** The act of implicating or the condition of being implicated. **2.** The act of implying or the condition of being implied. **3.** Something that is implied, esp.: **a.** An indirect indication. **b.** An inference. —**im′pli·ca′tive** *adj.* —**im′pli·ca′tive·ly** *adv.*

im·plic·it (ĭm-plĭs′ĭt) *adj.* **1.** Implied or understood although not directly expressed: *thought we had an implicit understanding.* **2.** Contained in the nature of something although not readily apparent: *could see a great pianist implicit in the talented but unpolished young musician.* **3.** Having no doubts or reservations; unquestioning: *implicit trust.* [Lat. *implicitus,* var. of *implicatus,* p.part. of *implicare,* to entangle. —see IMPLICATE.] —**im·plic′it·ly** *adv.* —**im·plic′it·ness** *n.*

implicit differentiation *n.* The process of isolating the derivative of a dependent variable of an implicit function by differentiating each term of the function separately, expressing the desired derivative as a symbol, and solving the resulting expression for the symbol.

implicit function *n.* A mathematical expression in which the function of concern is not directly expressed but must be arrived at by manipulation of the expression.

im·plode (ĭm-plōd′) *v.* **-plod·ed, -plod·ing, -plodes.** —*intr.* To undergo implosion. —*tr.* **1.** To pronounce by implosion. **2.** To cause to undergo implosion. [IN-[2] + (EX)PLODE.]

im·plore (ĭm-plôr′, -plōr′) *tr.v.* **-plored, -plor·ing, -plores.** **1.** To appeal to in supplication; beseech. **2.** To plead or beg for urgently; entreat. [Lat. *implorare* : *in-,* in + *plorare,* to weep.] —**im′plo·ra′tion** *n.* —**im·plor′er** *n.* —**im·plor′ing·ly** *adv.*

im·plo·sion (ĭm-plō′zhən) *n.* **1.** A violent collapse inward, as of a highly evacuated glass vessel. **2.** Violent compression. **3.** The stopping of the breath in the formation of a stop consonant. [IN-[2] + (EX)PLOSION.]

im·plo·sive (ĭm-plō′sĭv) *adj.* Pronounced by implosion. —*n.* A consonant pronounced by implosion.

im·ply (ĭm-plī′) *tr.v.* **-plied, -ply·ing, -plies.** **1.** To involve or suggest by logical necessity; entail: *His goals imply a good deal of hard work.* **2.** To say or express indirectly: *His tone implied a malicious purpose.* **3.** *Obs.* To entangle. —See Usage note at **infer.** [ME *implien,* to enfold < OFr. *emplier* < Lat. *implicare.* —see IMPLICATE.]

im·po·lite (ĭm′pə-līt′) *adj.* Not polite; discourteous. [Lat. *impolitus,* unpolished, inelegant : *in-,* not + *politus,* polished, p.part. of *polire,* to polish.] —**im′po·lite′ly** *adv.* —**im′po·lite′ness** *n.*

im·pol·i·tic (ĭm-pŏl′ĭ-tĭk) *adj.* Not wise or expedient; not politic. —**im·pol′i·tic·ly** *adv.*

im·pon·der·a·ble (ĭm-pŏn′dər-ə-bəl) *adj.* Incapable of being evaluated or weighed with precision. —**im·pon′der·a·bil′i·ty, im·pon′der·a·ble·ness** *n.* —**im·pon′der·a·bly** *adv.*

im·pone (ĭm-pōn′) *tr.v.* **-poned, -pon·ing, -pones.** *Obs.* To wager or stake. [Lat. *imponere,* to place upon : *in-,* on + *ponere,* to place.]

im·port (ĭm-pôrt′, -pōrt′, ĭm′pôrt′, -pōrt′) *v.* **-port·ed, -port·ing, -ports.** —*tr.* **1.** To bring or carry in from an outside source, esp. to bring in (goods) from a foreign country for trade or sale. **2.** To carry or hold the meaning of; signify: *a high inflation rate importing hard times for the consumer.* **3.** To imply. **4.** *Archaic.* To have meaning for. —*intr.* To be significant. —*n.* (ĭm′pôrt′, -pōrt′). **1.** Something imported. **2.** The occupation of importing. **3.** Meaning; signification. **4.** Importance; significance: *a Supreme Court decision with a far-reaching import on the issue of criminal rights.* [ME *importen* < Lat. *importare* : *in-,* in + *portare,* to carry.] —**im·port′a·bil′i·ty** *n.* —**im·port′a·ble** *adj.* —**im·port′er** *n.*

im·por·tance (ĭm-pôr′tns) *n.* **1.** The condition or quality of being important; significance. **2.** Personal status; standing. **3.** *Obs.* An important matter. **4.** *Obs.* Meaning; import. **5.** *Obs.* Importunity.

Synonyms: *importance, consequence, moment, significance, import, weight.* These nouns refer to the quality of a thing that makes it influential or worthy of note, esteem, or the like. *Importance,* the most general term, usually can be substituted for any of the others, although it lacks their special implications. *Consequence* is especially applicable to persons or things of notable rank or position and to things that are important with respect to what follows them as an outcome or development. *Moment* implies importance or consequence that is readily apparent. *Significance* and *import* refer to the quality of a thing, often not readily apparent, that gives the thing special meaning or value. *Weight* is frequently used when a personal evaluation or judgment of importance is suggested.

im·por·tant (ĭm-pôr′tnt) *adj.* **1.** Marked by or having great value, significance, or consequence. **2.** Suggesting or having an air of great weight or moment; authoritative. **3.** *Obs.* Importunate. [OFr. < OItal. *importante* < Med. Lat. *importans,* pr.part. of *importare,* to mean < Lat., to import.] —**im·por′tant·ly** *adv.*

Usage: The following sentence may be written with the adjective *important: The truth is evident; more important, it will prevail.* It may also be written with an adverb: *The truth is evident; more importantly, it will prevail.* Most grammarians prescribe the adjective form, in which *important* stands for "what is important." But half the members of the Usage Panel accept the adverbial form.

im·por·ta·tion (ĭm′pôr-tā′shən, -pōr-) *n.* **1.** The act or business of importing. **2.** Something imported.

im·por·tu·nate (ĭm-pôr′chə-nĭt) *adj.* Stubbornly or unreasonably persistent in request or demand. —**im·por′tu·nate·ly** *adv.* —**im·por′tu·nate·ness** *n.*

im·por·tune (ĭm′pôr-tōōn′, -tyōōn′, ĭm-pôr′chən) *tr.v.* **-tuned, -tun·ing, -tunes.** **1.** To beset with repeated and insistent requests. **2.** *Obs.* To ask for insistently and repeatedly. **3.** *Obs.* To annoy; vex. —*adj.* Importunate. [Med. Lat. *importunari,* to be troublesome < Lat. *importunus,* inconvenient: *in-,* not + *portus,* harbor.] —**im′por·tune′ly** *adv.* —**im′por·tun′er** *n.*

im·por·tu·ni·ty (ĭm′pôr-tōō′nĭ-tē, -tyōō′-) *n., pl.* **-ties.** **1.** The act of importuning. **2.** The state or quality of being importunate.

im·pose (ĭm-pōz′) *v.* **-posed, -pos·ing, -pos·es.** —*tr.* **1.** To establish or apply as compulsory; levy: *impose a tax.* **2.** To apply or make prevail by or as if by authority: *impose a peace settlement.* **3.** To obtrude or force (oneself, for example) upon another or others. **4.** *Printing.* To arrange (type or plates) on an imposing stone. **5.** To pass off on others: *He imposed a fraud on his company.* —*intr.* To take unfair advantage of something or someone: *always imposing on her generosity.* [OFr. < Lat. *impositus,* p.part. of *imponere,* to place upon: *in-,* on + *ponere,* to place.] —**im·pos′er** *n.*

im·pos·ing (ĭm-pō′zĭng) *adj.* Impressive or awesome.

3. Not clearly defined; indefinite. —**in'de·ci'sive·ly** *adv.* —**in'de·ci'sive·ness** *n.*

in·de·clin·a·ble (ĭn'dĭ-klī'nə-bəl) *adj.* Having no set of grammatical inflections.

in·de·com·pos·a·ble (ĭn-dē'kəm-pō'zə-bəl) *adj.* Not capable of being split into component parts.

in·dec·o·rous (ĭn-dĕk'ər-əs) *adj.* Lacking propriety or good taste. —**in·dec'o·rous·ly** *adv.* —**in·dec'o·rous·ness** *n.*

in·de·cor·um (ĭn'dĭ-kôr'əm, -kōr'-) *n.* 1. Lack of decorum; impropriety. 2. An instance of indecorous behavior or action.

in·deed (ĭn-dēd') *adv.* 1. Without a doubt; certainly; truly. 2. In fact; in reality. 3. Admittedly; unquestionably. —*interj.* Used to express surprise, skepticism, or irony. [ME *indede*, in fact : *in*, in + *dede*, deed.]

in·de·fat·i·ga·ble (ĭn'dĭ-făt'ĭ-gə-bəl) *adj.* Incapable of being fatigued; tireless. [Lat. *indefatigabilis* : *in-*, not + *defatigare* to tire out (*de-*, thoroughly + *fatigare*, to weary).] —**in'de·fat'i·ga·bil'i·ty, in'de·fat'i·ga·ble·ness** *n.* —**in'de·fat'i·ga·bly** *adv.*

in·de·fea·si·ble (ĭn'dĭ-fē'zə-bəl) *adj.* Not capable of being annulled or made void. —**in'de·fea'si·bil'i·ty** *n.* —**in'de·fea'si·bly** *adv.*

in·de·fec·ti·ble (ĭn'dĭ-fĕk'tə-bəl) *adj.* 1. Having the ability to resist defect or failure; lasting. 2. Without flaw or defect; perfect. —**in'de·fec'ti·bil'i·ty** *n.* —**in'de·fec'ti·bly** *adv.*

in·de·fen·si·ble (ĭn'dĭ-fĕn'sə-bəl) *adj.* Not capable of being defended, esp.: a. Inexcusable; unpardonable. b. Invalid; untenable. c. Vulnerable to physical attack. —**in'de·fen'si·bil'i·ty, in'de·fen'si·ble·ness** *n.* —**in'de·fen'si·bly** *adv.*

in·de·fin·a·ble (ĭn'dĭ-fī'nə-bəl) *adj.* Not capable of being defined, described, or analyzed. —*n.* One that is indefinable. —**in'de·fin'a·ble·ness** *n.* —**in'de·fin'a·bly** *adv.*

in·def·i·nite (ĭn-dĕf'ə-nĭt) *adj.* Not definite, esp.: a. Unclear; vague. b. Lacking precise limits. c. Uncertain; undecided. [Lat. *indefinitus* : *in-*, not + *definitus*, definite.] —**in·def'i·nite·ly** *adv.* —**in·def'i·nite·ness** *n.*

indefinite article *n. Gram.* An article, as English *a* or *an*, that does not fix the identity of the noun modified.

indefinite integral *n. Math.* The set of all functions of which a given function is the derivative, usually represented by $\int f(x)dx + C$, where $\int f(x)dx$ is any member of the set and C is an arbitrary constant.

indefinite pronoun *n. Gram.* A pronoun, as English *any* or *some*, that does not specify the identity of its object.

in·de·his·cent (ĭn'dĭ-hĭs'ənt) *adj.* Not splitting open at maturity: *indehiscent fruit.* —**in'de·his'cence** *n.*

in·del·i·ble (ĭn-dĕl'ə-bəl) *adj.* 1. Incapable of being removed, erased, or washed away; permanent. 2. Making a mark not easily erased or washed away: *an indelible laundry pencil.* [Lat. *indelebilis* : *in-*, not + *delebilis*, capable of being destroyed < *delēre*, to destroy.] —**in·del'i·bil'i·ty, in·del'i·ble·ness** *n.* —**in·del'i·bly** *adv.*

in·del·i·ca·cy (ĭn-dĕl'ĭ-kə-sē) *n., pl.* **-cies.** 1. The quality or condition of being indelicate. 2. Something that is indelicate.

in·del·i·cate (ĭn-dĕl'ĭ-kĭt) *adj.* 1. a. Offensive to or lacking in propriety. b. Bordering on vulgarity; coarse. 2. Prone to or marked by lack of sensitivity to the feelings of others; tactless. —**in·del'i·cate·ly** *adv.* —**in·del'i·cate·ness** *n.*

in·dem·ni·fi·ca·tion (ĭn-dĕm'nə-fĭ-kā'shən) *n.* 1. a. The act of indemnifying. b. The condition of being indemnified. 2. Something that indemnifies; indemnity.

in·dem·ni·fy (ĭn-dĕm'nə-fī') *tr.v.* **-fied, -fy·ing, -fies.** 1. To protect against damage, loss, or injury; insure. 2. To make compensation to for damage, loss, or injury suffered. [< Lat. *indemnis*, uninjured : *in-*, not + *damnum*, harm.] —**in·dem'ni·fi'er** *n.*

in·dem·ni·ty (ĭn-dĕm'nĭ-tē) *n., pl.* **-ties.** 1. Security against damage, loss, or injury. 2. A legal exemption from liability for damages. 3. Compensation for damage, loss, or injury suffered. [ME *indempnite* < AN < LLat. *indemnitas* < Lat. *indemnis*, uninjured. —see INDEMNIFY.]

in·de·mon·stra·ble (ĭn'dĭ-mŏn'strə-bəl) *adj.* Incapable of being proved or demonstrated. —**in'de·mon'stra·ble·ness, in'de·mon'stra·bil'i·ty** *n.* —**in'de·mon'stra·bly** *adv.*

in·dene (ĭn'dēn') *n.* A colorless organic liquid, C_9H_8, obtained from coal tar and used in preparing synthetic resins. [IND(OLE) + -ENE.]

in·dent[1] (ĭn-dĕnt') *v.* **-dent·ed, -dent·ing, -dents.** —*tr.* 1. a. To cut or tear (a document with two or more copies) along an irregular line so that the parts can later be matched for establishing authenticity. b. To draw up (a document) in duplicate or triplicate. 2. a. To notch or serrate the edge of; make jagged. b. To make notches, grooves, or holes in (wood, for example) for the purpose of mortising. c. To fit or join together by or as if by mortising. 3. To set (the first line of a paragraph, for example) in from the margin. 4. *Chiefly Brit.* To order (goods) by purchase order or official requisition. —*intr.* 1. To form an indentation. 2. *Chiefly Brit.* To draw up or order an indent. —*n.* (ĭn-dĕnt', ĭn'dĕnt'). 1. An indenture. 2. A U.S. certificate issued at the close of the Revolutionary War for interest due on the public debt. 3. *Chiefly Brit.* An official requisition or purchase order for goods. 4. An indention. [ME *endenten*, to notch < OFr. *endenter* < Med. Lat. *indentare* : Lat. *in-*, in + Lat. *dens*, tooth.] —**in·dent'er** *n.*

in·dent[2] (ĭn-dĕnt') *tr.v.* **-dent·ed, -dent·ing, -dents.** 1. To make a dent in. 2. To impress (a design, for example); stamp. —*n.* (ĭn-dĕnt', ĭn'dĕnt'). An indentation.

in·den·ta·tion (ĭn'dĕn-tā'shən) *n.* 1. a. The act of indenting. b. The condition of being indented. 2. A notch or jagged cut in an edge. 3. A recess in a border, coastline, or other boundary. 4. The blank space between a margin and the beginning of an indented line.

in·den·tion (ĭn-dĕn'shən) *n.* 1. a. The act of indenting. b. The condition of being indented. 2. The blank space between a margin and the beginning of an indented line. 3. *Archaic.* An indentation or dent.

in·den·ture (ĭn-dĕn'chər) *n.* 1. a. A document in duplicate having indented edges. b. A legal deed or contract executed between two or more parties. c. Often **indentures.** A contract binding one party into the service of another for a specified term. d. An official or authenticated inventory, list, or voucher. 2. Indentation. —*tr.v.* **-tured, -tur·ing, -tures.** 1. To bind into the service of another by indenture. 2. *Archaic.* To form an indentation in. [ME *endenture*, a written agreement < AN < OFr. *endenter*, to indent.]

in·de·pend·ence (ĭn'dĭ-pĕn'dəns) *n.* 1. The state or quality of being independent. 2. *Archaic.* Sufficient income for self-support; competence.

Independence Day *n.* July 4, a U.S. legal holiday celebrating the anniversary of the adoption of the Declaration of Independence in 1776.

in·de·pend·en·cy (ĭn'dĭ-pĕn'dən-sē) *n., pl.* **-cies.** 1. Independence. 2. An independent territory or state. 3. Independency. The Independent movement in 17th-century England.

in·de·pend·ent (ĭn'dĭ-pĕn'dənt) *adj.* 1. Politically autonomous; self-governing. 2. Free from the influence, guidance, or control of another or others; self-reliant: *an independent mind.* 3. Not determined or influenced by someone or something else; not contingent: *an independent study of air pollution.* 4. Affiliated with or loyal to no one political party or organization: *an independent voter.* 5. Not dependent on or affiliated with a larger or controlling group or system: *an independent food store.* 6. a. Financially self-sufficient; self-supporting. b. Providing or being sufficient income to enable one to live without working: *a person of independent means.* 7. *Math.* a. Not dependent on other variables: *an independent variable.* b. Of or pertaining to a system of equations no one of which is necessarily satisfied by a set of values of the independent variables that satisfy all the others. c. Of, pertaining to, describing, or being an outcome of a trial of a chance experiment the probability of which does not depend on the outcome of any other trial of the chance experiment. —*n.* 1. One that is independent, esp. a voter who does not pledge allegiance to any one political party. 2. **Independent.** A member of a movement in England in the 17th century advocating the political and religious independence of individual congregations. 3. **Independent.** *Chiefly Brit.* A Congregationalist.

independent clause *n. Gram.* A clause that contains a subject, a verb, and sometimes an object and modifiers, and that is capable of standing alone as a complete sentence.

in·depth (ĭn'dĕpth') *adj.* Detailed; thorough: *an in-depth study.*

in·de·scrib·a·ble (ĭn'dĭ-skrī'bə-bəl) *adj.* 1. Incapable of being described. 2. Exceeding description: *indescribable delight.* —**in'de·scrib'a·bil'i·ty, in'de·scrib'a·ble·ness** *n.* —**in'de·scrib'a·bly** *adv.*

in·de·struc·ti·ble (ĭn'dĭ-strŭk'tə-bəl) *adj.* Incapable of being destroyed; unbreakable. —**in'de·struc'ti·bil'i·ty, in'de·struc'ti·ble·ness** *n.* —**in'de·struc'ti·bly** *adv.*

in·de·ter·min·a·ble (ĭn'dĭ-tûr'mə-nə-bəl) *adj.* 1. Incapable of being fixed or measured; not ascertainable. 2. Incapable of being finally settled or decided. —**in'de·ter'min·a·bly** *adv.*

in·de·ter·mi·na·cy (ĭn'dĭ-tûr'mə-nə-sē) *n.* The state or quality of being indeterminate.

in·de·ter·mi·nate (ĭn'dĭ-tûr'mə-nĭt) *adj.* 1. a. Not precisely determined: *a person of indeterminate age.* b. Incapable of being determined. c. Lacking clarity or precision; vague. d. Not known in advance. 2. *Bot.* Not terminating in a flower and continuing to grow at the apex: *an indeterminate inflorescence.* [ME *determinat* < LLat. *indeterminatus* : Lat. *in-*, not + *determinatus*, determinate.] —**in'de·ter'mi·nate·ly** *adv.* —**in'de·ter'mi·nate·ness, in'de·ter'mi·na'tion** *n.*

in·de·ter·min·ism (ĭn'dĭ-tûr'mə-nĭz'əm) *n.* 1. Indeterminacy; unpredictability. 2. The philosophical doctrine that in some circumstances volition occurs independent of physiological and psychological antecedents. —**in'de·ter'min·ist** *n.* —**in'de·ter'min·is'tic** *adj.*

in·dex (ĭn'dĕks') *n., pl.* **-dex·es** or **-di·ces** (-dĭ-sēz'). 1. Something that serves to guide, point out, or otherwise facilitate reference, esp.: a. An alphabetized listing of names, places, and subjects included in a printed work that gives for each item the page on which it is mentioned. b. A series of notches cut into the edge of a book for easy access to chapters or other divisions. c. A table, file, or catalogue. 2. Something that reveals or indicates; sign: *"Her face . . . was a fair index to her disposition"* (Samuel Butler).

b. The condition of being so stimulated. 2. An agency, as a person or a work of art, that moves the intellect or emotions or that prompts action or invention. 3. Something that is inspired; a sudden creative act or idea. 4. The quality of inspiring or exalting: *a painting full of inspiration.* 5. *Theol.* Divine guidance or influence exerted directly upon the mind and soul of man. 6. The act of breathing in; inhalation.

in·spi·ra·tion·al (ĭn'spə-rā'shə-nəl) *adj.* 1. Of or pertaining to inspiration. 2. Providing or intended to convey inspiration. 3. Resulting from inspiration. —**in'spi·ra'tion·al·ly** *adv.*

in·spi·ra·tor (ĭn'spə-rā'tər) *n.* 1. An inhaler. 2. A respirator.

in·spir·a·to·ry (ĭn-spīr'ə-tôr'ē, -tōr'ē) *adj.* Of, pertaining to, or used for the drawing in of air.

in·spire (ĭn-spīr') *v.* **-spired, -spir·ing, -spires.** —*tr.* 1. To affect, guide, or arouse by divine influence. 2. To fill with noble or reverent emotion; exalt: *hymns that inspire the congregation.* 3. To stimulate to creativity or action. 4. To elicit; arouse: *a woman capable of inspiring a man's devotion.* 5. To be the cause or source of; bring about: *an invention that inspired many imitations.* 6. To inhale (air). 7. *Archaic.* a. To breathe upon. b. To breathe life into. —*intr.* 1. To stimulate energies, ideals, or reverence. 2. To inhale. [ME *enspiren* < OFr. *enspirer* < Lat. *inspirare* : *in-*, into + *spirare*, to breathe.] —**in·spir'er** *n.* —**in·spir'ing·ly** *adv.*

in·spir·it (ĭn-spĭr'ĭt) *tr.v.* **-it·ed, -it·ing, -its.** To instill courage or life into; animate.

in·spis·sate (ĭn-spĭs'āt', ĭn'spĭ-sāt') *intr. & tr.v.* **-sat·ed, -sat·ing, -sates.** To thicken or cause to thicken, as by boiling or evaporation; condense. [< LLat. *inspissatus*, thickened : Lat. *in-* (intensive) + *spissus*, thick.] —**in'spis·sa'tion** *n.* —**in·spis'sa'tor** *n.*

in·sta·bil·i·ty (ĭn'stə-bĭl'ĭ-tē) *n., pl.* **-ties.** Lack of stability.

in·stall also **in·stal** (ĭn-stôl') *tr.v.* **-stalled, -stall·ing, -stalls** also **-stals.** 1. To set in position and connect or adjust for use. 2. To induct into an office, rank, or position: *a ceremony to install the new prime minister.* 3. To settle in an indicated place or condition; establish: *installed herself in the spare room.* [ME *installen* < OFr. *installer* < Med. Lat. *installare* : *in-*, in + *stallum*, place.] —**in·stall'er** *n.*

in·stal·la·tion (ĭn'stə-lā'shən) *n.* 1. a. The act of installing. b. The state of being installed. 2. A system of machinery or other apparatus set up for use. 3. A military base or camp.

in·stall·ment[1] also **in·stal·ment** (ĭn-stôl'mənt) *n.* 1. One of several successive payments in settlement of a debt. 2. A portion of something issued at intervals. 3. A chapter or part of a literary work presented serially. —*modifier: the installment plan.* [Alteration of obs. *estallment* < OFr. *estaler*, to place, fix < *estal*, place, of Germanic orig.]

in·stall·ment[2] also **in·stal·ment** (ĭn-stôl'mənt) *n.* Installation.

in·stance (ĭn'stəns) *n.* 1. Something that is representative of a group or class; example. 2. A legal proceeding or process; suit. 3. A step in a process. 4. a. Prompting; request: *called at the instance of his wife.* b. *Archaic.* Urgent solicitation. 5. *Obs.* An impelling motive. —*tr.v.* **-stanced, -stanc·ing, -stanc·es.** 1. To offer as an example; cite. 2. To demonstrate or show by being an example; exemplify. [ME *instaunce* < OFr. *instance* < Lat. *instantia*, presence < *instans*, present. —see INSTANT.]

in·stan·cy (ĭn'stən-sē) *n.* 1. Urgency. 2. Immediateness; instantaneousness.

in·stant (ĭn'stənt) *n.* 1. A very brief time; moment. 2. A particular point in time: *the instant he arrives.* 3. The current month: *your letter of the 15th instant.* —*adj.* 1. Immediate: *instant attention.* 2. Imperative; urgent: *an instant need.* 3. Now under consideration; present. 4. a. Designed for quick preparation with minimal effort: *instant mashed potatoes.* b. Appearing, done, or taking place with or as if with maximum quickness and ease. —*adv.* Instantly. [ME < OFr. < Lat. *instans*, present, pr.part. of *instare*, to approach : *in-*, on + *stare*, to stand.]

in·stan·ta·ne·ous (ĭn'stən-tā'nē-əs) *adj.* 1. Occurring or completed without perceptible delay. 2. Present or occurring at a specific instant: *instantaneous velocity.* [Med. Lat. *instantaneus* < Lat. *instans*, present. —see INSTANT.] —**in'stan·ta'ne·ous·ly** *adv.* —**in'stan·ta'ne·ous·ness** *n.*

in·stan·ter (ĭn-stăn'tər) *adv.* Without delay; instantly. [Med. Lat. < Lat., urgently < *instans*, present. —see INSTANT.]

in·stant·ly (ĭn'stənt-lē) *adv.* 1. At once; immediately. 2. *Archaic.* Urgently. —*conj.* As soon as.

instant replay *n.* A recording of an event on videotape for playback immediately upon completion of the event.

in·star[1] (ĭn-stär') *tr.v.* **-starred, -star·ring, -stars.** To stud with or as if with stars.

in·star[2] (ĭn'stär') *n.* An insect or other arthropod between molts, as during metamorphosis. [NLat. < Lat., image, form.]

in·state (ĭn-stāt') *tr.v.* **-stat·ed, -stat·ing, -states.** To establish in office; install.

in·stau·ra·tion (ĭn'stô-rā'shən) *n. Archaic.* 1. Renovation; restoration. 2. Institution; establishment. [Lat. *instauratio* < *instaurare*, to renew.]

in·stead (ĭn-stĕd') *adv.* In the place of something previously mentioned; as an alternative or substitute: *Planning to drive, he walked instead.* [ME *in sted of*, in place of.]

instead of *prep.* In place of; rather than.



instrument

in·step (ĭn'stĕp') *n.* 1. The arched middle part of the human foot. 2. The part of a shoe or stocking covering the instep.

in·sti·gate (ĭn'stĭ-gāt') *tr.v.* **-gat·ed, -gat·ing, -gates.** 1. To urge on; goad. 2. To foment; stir up. [Lat. *instigare, instigat-*.] —**in'sti·ga'tion** *n.* —**in'sti·ga'tive** *adj.* —**in'sti·ga'tor** *n.*

in·still also **in·stil** (ĭn-stĭl') *tr.v.* **-stilled, -still·ing, -stills** also **-stils.** 1. To introduce by gradual, persistent efforts; implant: *"morality . . . may be instilled into their minds"* (Jefferson). 2. To pour in drop by drop. [Lat. *instillare*, to drip in : *in-*, in + *stillare*, to drip < *stilla*, drop.] —**in'stil·la'tion** (ĭn'stə-lā'shən) *n.* —**in·still'er** *n.*

in·stinct (ĭn'stĭngkt') *n.* 1. a. The innate aspect of behavior that is unlearned, complex, and normally adaptive. b. A powerful motivation or impulse. 2. An innate capability or aptitude. —*adj.* (ĭn-stĭngkt'). 1. *Obs.* Impelled from within. 2. Imbued; filled: *words instinct with love.* [ME < Lat. *instinctus*, impulse < p.part. of *instinguere*, to incite : *in-*, on + *stinguere*, to prick.]

in·stinc·tive (ĭn-stĭngk'tĭv) *adj.* 1. Of, pertaining to, or arising from instinct. 2. Arising from a natural impulse; spontaneous and unthinking: *an instinctive dislike of spiders.* —**in·stinc'tive·ly** *adv.*

in·sti·tute (ĭn'stĭ-tōōt', -tyōōt') *tr.v.* **-tut·ed, -tut·ing, -tutes.** 1. a. To establish, organize, and set in operation. b. To initiate; begin. 2. To establish or invest in an office or position. —*n.* 1. *Obs.* The act of instituting. 2. Something instituted, esp. an authoritative rule or precedent. 3. An organization founded to promote some cause: *an institute for the deaf.* 4. a. An educational institution. b. The building or buildings housing such an institution. 5. A short, intensive workshop or seminar on one specific subject. 6. **Institutes.** A digest of the principles or rudiments of some subject, esp. a legal abstract. [ME *instituten* < Lat. *institutus*, p.part. of *instituere*, to establish : *in-*, in + *statuere*, to set up < *stare*, to stand.] —**in'sti·tut'er, in'sti·tu'tor** *n.*

in·sti·tu·tion (ĭn'stĭ-tōō'shən, -tyōō'shən) *n.* 1. The act of instituting. 2. a. A custom, practice, relationship, or behavioral pattern of importance in the life of a community or society. b. *Informal.* An ever-present feature; fixture. 3. a. An established organization or foundation, esp. one dedicated to public service or to culture. b. The building or buildings housing such an organization. 4. A place of confinement, as a mental asylum. —**in'sti·tu'tion·al** *adj.* —**in'sti·tu'tion·al·ly** *adv.*

in·sti·tu·tion·al·ism (ĭn'stĭ-tōō'shə-nə-lĭz'əm, -tyōō'-) *n.* 1. Adherence to or belief in established forms, esp. belief in organized religion. 2. Use of institutions for those incapable of self-maintenance. —**in'sti·tu'tion·al·ist** *n.*

in·sti·tu·tion·al·ize (ĭn'stĭ-tōō'shə-nə-līz', -tyōō'-) *tr.v.* **-ized, -iz·ing, -iz·es.** 1. To make into, treat as, or give the character of an institution to. 2. To commit (a person) to an institution. —**in'sti·tu'tion·al·i·za'tion** *n.*

in·stroke (ĭn'strōk') *n.* An inward stroke, esp. a piston stroke moving away from the crankshaft.

in·struct (ĭn-strŭkt') *v.* **-struct·ed, -struct·ing, -structs.** —*tr.* 1. To furnish with knowledge; teach. 2. To give orders to; direct. —*intr.* To serve as an instructor. [ME *instructen* < Lat. *instructus*, p.part. of *instruere*, to prepare : *in-*, in + *struere*, to build.]

in·struc·tion (ĭn-strŭk'shən) *n.* 1. The act, practice, or profession of instructing. 2. a. Imparted knowledge. b. An imparted or acquired item of knowledge; lesson. 3. *Computer Sci.* A machine code telling a computer to perform a particular operation. 4. Often **instructions.** A direction; order. —**in·struc'tion·al** *adj.*

in·struc·tive (ĭn-strŭk'tĭv) *adj.* Conveying knowledge or information; enlightening. —**in·struc'tive·ly** *adv.* —**in·struc'tive·ness** *n.*

in·struc·tor (ĭn-strŭk'tər) *n.* 1. One who instructs; teacher. 2. a. An academic rank below assistant professor. b. One who holds such a rank. —**in·struc'tor·ship'** *n.*

in·stru·ment (ĭn'strə-mənt) *n.* 1. a. Means by which something is done; agency. 2. a. One used to accomplish some purpose. b. A person used and controlled by another; dupe. 3. A mechanical implement. 4. A device for recording or measuring, esp. such a device functioning as part of a control system. 5. A device for producing music. 6. A legal document. —*tr.v.* (-mĕnt') **-ment·ed, -ment·ing, -ments.** 1. To provide or equip with instruments. 2. To address a legal document to. [ME < Lat. *instrumentum*, tool < *instruere*, to prepare. —see INSTRUCT.]

in·stru·men·tal (ĭn'strə-mĕn'tl) *adj.* 1. Serving as a means or agency; implemental. 2. Of, pertaining to, or accomplished with an instrument or tool. 3. Performed on or written for a musical instrument. 4. *Gram.* Of or designating a case used typically to express means, agency, or accompaniment. —*n. Gram.* 1. The instrumental case. 2. A word in the instrumental case. —**in'stru·men'tal·ly** *adv.*

in·stru·men·tal·ism (ĭn'strə-mĕn'tl-ĭz'əm) *n.* A pragmatic theory that ideas are instruments that function as guides of action, their validity being determined by the success of the action.

in·stru·men·tal·ist (ĭn-strə-mĕn'tl-ĭst) *n.* 1. One who plays a musical instrument. 2. An advocate or student of instrumentalism.

in·stru·men·tal·i·ty (ĭn'strə-mĕn-tăl'ĭ-tē) *n., pl.* **-ties.** 1. The

EXHIBIT C
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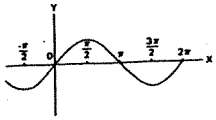
"Simple Simon went a poeching/For to shoot some game./A mantrap caught him by the leg/Which gave poor Simon pain."



"He went for water with a sieve/But soon it all ran through . . ."

Simple Simon
Woodcut illustrations



sine curve

simple harmonic motion *n. Physics.* A periodic motion that may be described as a sinusoidal function of time; specifically, the motion of a particle that obeys the equation $x = A\cos(kt + \phi)$, where x is the displacement of the particle from the origin at any time t, A is the maximum displacement, ϕ is the initial phase or angular displacement at $t = 0$, and k is a constant equal to 2π times the frequency of the oscillation.

simple honors *pl.n.* Three honors in trump or three aces at no-trump held by the same side in bridge.

simple interest *n.* Interest paid only on the original principal, not on the interest accrued.

simple machine *n.* A machine (sense 1.b.).

simple microscope *n.* A microscope having one lens or lens system, as a magnifying glass or hand lens.

sim·ple-mind·ed (sĭm′pəl-mīn′dĭd) *adj.* **1.** Not sophisticated; artless. **2.** Stupid or silly. **3.** Mentally defective. —**sim′ple-mind′ed·ly** *adv.* —**sim′ple-mind′ed·ness** *n.*

simple pendulum *n.* A pendulum (sense 1).

simple sentence *n.* A sentence having no coordinate or subordinate clauses, as *The cat purred.*

Simple Simon *n.* A foolish fellow; simpleton. [After *Simple Simon,* a character in a nursery rhyme.]

simple sugar *n.* A monosaccharide.

sim·ple·ton (sĭm′pəl-tən) *n.* A silly or stupid person; fool. [< SIMPLE.]

sim·plex (sĭm′plĕks′) *adj.* Denoting a system of telegraphy in which only one message may be sent in either direction at one time. [Lat. *simplex,* simple.]

sim·plic·i·ty (sĭm-plĭs′ĭ-tē) *n., pl.* **-ties. 1.** The property, condition, or quality of being simple. **2.** Absence of luxury or showiness; plainness. **3.** Absence of affectation or pretense. **4.** Lack of good sense or intelligence; foolishness. [ME *symplicite* < OFr. < Lat. *simplicitas* < *simplex,* simple.]

sim·pli·fy (sĭm′plə-fī′) *tr.v.* **-fied, -fy·ing, -fies.** To make simple or simpler; render less complex or intricate. [Fr. *simplifier* < Med. Lat. *simplificare* : Lat. *simplus,* simple + *facere,* to make.] —**sim′pli·fi·ca′tion** *n.* —**sim′pli·fi′er** *n.*

sim·plism (sĭm′plĭz′əm) *n.* The tendency to oversimplify an issue or problem by ignoring complexities or complications. [Fr. *simplisme* < OFr. *simple,* simple.] —**sim·plis′tic** (sĭm-plĭs′tĭk) *adj.* —**sim·plis′ti·cal·ly** *adv.*

sim·ply (sĭm′plē) *adv.* **1.** In a simple manner; plainly. **2.** Foolishly. **3.** Merely; only: *We knew him simply as Bill.* **4.** Absolutely; altogether: *simply delicious.* **5.** Frankly; candidly: *You are, quite simply, inadequate for this job.*

simply connected *adj.* Of, being, or characterized by a mathematical surface that is divided into two separate parts by every simple closed curve within it.

simply ordered *adj.* Having any three mathematical elements transitively related and any two elements equal or connected by an asymmetric relationship.

sim·u·la·cra (sĭm′yə-lā′krə, -lăk′rə) *n.* Plural of **simulacrum.**

sim·u·la·cre (sĭm′yə-lā′kər, -lăk′ər) *n. Archaic.* A simulacrum.

sim·u·la·crum (sĭm′yə-lā′krəm, -lăk′rəm) *n., pl.* **-la·cra** (-lā′krə, -lăk′rə). **1.** An image or representation of something. **2.** An unreal or vague semblance of something. [Lat. < *simulare,* to simulate < *similis,* like.]

sim·u·lar (sĭm′yə-lər, -lär′) *Archaic.* —*n.* One that simulates; simulator. —*adj.* Simulated; sham.

sim·u·late (sĭm′yə-lāt′) *tr.v.* **-lat·ed, -lat·ing, -lates. 1.** To have or take on the appearance, form, or sound of; imitate. **2.** To make a pretense of; feign: *simulate an interest.* —*adj.* (-lĭt, -lāt′). Simulated; assumed. [Lat. *simulare, simulat-* < *similis,* like.] —**sim′u·la′tive** *adj.*

sim·u·la·tion (sĭm′yə-lā′shən) *n.* **1.** The act or process of simulating. **2.** An imitation. **3.** The assumption of a false appearance.

sim·u·la·tor (sĭm′yə-lā′tər) *n.* One that simulates, esp. an apparatus that generates test conditions approximating actual or operational conditions.

si·mul·cast (sī′məl-kăst′, sĭm′əl-) *tr.v.* **-cast·ed, -cast·ing, -casts.** To broadcast simultaneously by FM and AM radio or by radio and television. —*n.* A simulcasted broadcast. [SIMUL(TANEOUS) + (BROAD)CAST.]

si·mul·ta·ne·ous (sī′məl-tā′nē-əs, sĭm′əl-) *adj.* **1.** Happening, existing, or done at the same time. **2.** *Math.* Collectively restricting the values of a set of variables: *simultaneous equations.* [Lat. *simul,* at the same time + E. *-aneous,* as in *instantaneous.*] —**si′mul·ta′ne·ous·ly** *adv.* —**si′mul·ta′ne·ous·ness, si′mul·ta·ne′i·ty** (-tə-nē′ĭ-tē, -nā′-) *n.*

sin[1] (sĭn) *n.* **1.** A transgression of a religious or moral law, esp. when deliberate. **2.** *Theol.* A condition of estrangement from God as a result of breaking God's law. **3.** An offense, violation, fault, or error. —*intr.v.* **sinned, sin·ning, sins. 1.** To violate a religious or moral law. **2.** To commit an offense or violation. [ME *sinne* < OE *synn.*]

sin[2] (sĕn, sĭn) *n.* The 21st letter of the Hebrew alphabet. See table at **alphabet.** [Heb., var. of *shīn,* the letter shin.]

sin·an·thro·pus (sī-năn′thrə-pəs, sī-, sĭ′năn-thrō′pəs, sĭn′-ăn-) *n.* An extinct manlike primate of the genus *Sinanthropus,* which includes Peking man. [NLat. *Sinanthropus,* genus name : SINO- + *anthropus,* human being.]

sin·a·pism (sĭn′ə-pĭz′əm) *n.* A mustard plaster. [Fr. *sinapisme* < LLat. *sinapismus* < Gk. *sinapismos,* use of a mustard plaster < *sinapizein,* to apply a mustard plaster < *sinapi,* mustard.]

since (sĭns) *adv.* **1.** From then until now or between then and now: *He left town and hasn't been here since.* **2.** Before now; ago: *long since forgotten.* —*prep.* From a specified time in the past: *He has not been home since Easter.* —*conj.* **1.** During the time after which: *He hasn't been home since he graduated.* **2.** Continuously from the time when: *He hasn't spoken since he sat down.* **3.** As a result of the fact that; inasmuch as: *Since you're not interested, I won't tell you about it.* —See Usage notes at **ago** and **because.** [ME *sinnes,* contraction of *sithenes* < OE *siððan.*]

sin·cere (sĭn-sîr′) *adj.* **-cer·er, -cer·est. 1.** Not feigned or affected; true: *a sincere apology.* **2.** Presenting no false appearance; honest: *a sincere believer.* **3.** *Archaic.* Pure; unadulterated. [Lat. *sincerus.*] —**sin·cere′ly** *adv.* —**sin·cere′ness** *n.*

Synonyms: *sincere, natural, unaffected, unfeigned, wholehearted, hearty, heartfelt.* These adjectives describe what is genuine and free from dissimulation or artifice. *Sincere* emphasizes honesty of expression or behavior. It implies freedom from hypocrisy and usually a disposition to be constructive. *Natural* and *unaffected* stress absence of artificiality. *Natural* usually applies to appearance or behavior thought to express one's true nature, whereas *unaffected* may imply genuineness where the opposite could be expected. *Unfeigned* especially suggests freedom from falseness or deceit. *Wholehearted* and *hearty* imply not only genuineness of feeling but also its expression in convincing terms. *Wholehearted* suggests total commitment and unstinting devotion to a cause or the like. *Hearty* especially stresses convincing expression of feeling openly displayed. *Heartfelt,* in contrast, emphasizes depth of feeling rather than its display.

sin·cer·i·ty (sĭn-sĕr′ĭ-tē) *n.* The quality or condition of being sincere.

sin·ci·put (sĭn′sə-pət) *n., pl.* **sin·ci·puts** or **sin·cip·i·ta** (sĭn-sĭp′ĭ-tə). **1.** The upper half of the cranium, esp. the anterior portion above and including the forehead. **2.** The forehead. [Lat. : *semi-,* half + *caput,* head.] —**sin·cip′i·tal** (-sĭp′ĭ-tl) *adj.*

Sin·dhi (sĭn′dē) *n., pl.* **Sindhi** or **-dhis. 1. a.** The predominantly Moslem people of Sind. **b.** A member of this people. **2.** The Indic language of Sind. [Ar. *Sindi.*] —**Sin′dhi** *adj.*

sine (sīn) *n.* **1.** The ordinate of the endpoint of an arc of a unit circle centered at the origin of a Cartesian coordinate system, the arc being of length x and measured counterclockwise from the point (1, 0) if x is positive or clockwise if x is negative. **2.** In a right triangle, the function of an acute angle that is the ratio of the opposite side to the hypotenuse. [Med. Lat. *sinus* < Lat., curve.]

si·ne·cure (sī′nĭ-kyŏŏr′, sĭn′ĭ-) *n.* **1.** An ecclesiastical benefice not attached to the spiritual duties of a parish. **2.** A position or office that requires little or no work but provides a salary. [< Med. Lat. *sine cura,* without cure of souls.] —**si′ne·cur·ism** *n.* —**si′ne·cur·ist** *n.*

sine curve *n.* The graph of the equation $y = \sin x$.

si·ne di·e (sī′nī dī′ē, sĭn′ā dē′ā′) *adv.* Without a day specified for a future meeting; indefinitely: *Parliament was dismissed sine die.* [Lat., without a day.]

si·ne qua non (sĭn′ī kwā nŏn′, nōn′, sī′nī kwā nōn′) *n.* An essential element or condition. [Lat., without which not.]

sin·ew (sĭn′yōō) *n.* **1.** A tendon. **2.** Vigorous strength; muscular power. **3.** Often **sinews.** The source or mainstay of vitality and strength: *"Good company and good discourse are the very sinews of virtue"* (Walton). [ME *sinewe* < OE *sinu.*]

sine wave *n. Physics.* A waveform with deviation that can be expressed as the sine or cosine of a linear function of time or space or both.

sin·ew·y (sĭn′yōō-ē) *adj.* **1.** Like or consisting of sinew. **2.** Lean and muscular. **3.** Strong; vigorous.

sin·ful (sĭn′fəl) *adj.* Marked by or full of sin; wicked. —**sin′ful·ly** *adv.* —**sin′ful·ness** *n.*

sing (sĭng) *v.* **sang** (săng), **sung** (sŭng), **sing·ing, sings.** —*intr.* **1.** To utter a series of words or sounds in musical tones. **2.** To vocalize songs or musical selections. **3.** To give or have the effect of melody; lilt. **4.** To produce musical sounds when played. **5.** To make a high whine or hum: *The machine sang.* **6.** To be filled with a buzzing sound. **7.** To proclaim or extol something in verse. **8.** *Slang.* To give information or evidence against someone. —*tr.* **1.** To render in tones with musical inflections of the voice: *She sang the message.* **2.** To produce the musical sound of. **3.** To intone; chant. **4.** To proclaim or extol, esp. in verse: *sang his praises.* **5.** To bring to a specified state by singing: *sang the baby to sleep.* —***phrasal verb.*** **sing out.** To call out loudly. —*n.* A gathering of people for group singing. [ME *singen* < OE *singan.*] —**sing′a·ble** *adj.*

sing-a-long (sĭng′ə-lông′, -lŏng′) *n.* A songfest.

singe (sĭnj) *tr.v.* **singed, singe·ing, sing·es. 1.** To burn superficially; scorch. **2.** To burn the ends of. **3.** To burn off the feathers or bristles of by subjecting briefly to flame. —*n.* A scorch. [ME *sengen* < OE *sengan.*] —**sing′er** (sĭn′jər) *n.*

sing·er (sĭng′ər) *n.* **1.** A person who sings, esp. a trained or professional vocalist. **2.** A poet. **3.** A songbird.

Sin·gha·lese (sĭng′gə-lēz′, -lēs′) also **Sin·ha·lese** (sĭn′-

poem is based. **b.** A rhythmic system constituting a section of a poem, typically consisting of a series of asymmetric lines. **2.** The first division of the triad (strophe, antistrophe, and epode) constituting a section of a Pindaric ode. **3. a.** The movement of the chorus in classical Greek drama while turning from one side of the orchestra to the other. **b.** The part of a choral ode sung while this movement is executed. [Gk. *strophē,* movement of the chorus < *strephein,* to turn.] —**stro'phic** (strō'fĭk, strŏf'ĭk) *adj.*

stro·phoid (strō'foid') *n.* A plane curve generated by a point that maintains a distance from the y-axis along a straight line equal to the y-intercept. [Gk. *strophos,* twisted (< *strephein,* to twist) + -OID.]

stroph·u·lus (strŏf'yə-ləs) *n.* A disease, esp. common among children, sometimes associated with intestinal disturbances and characterized by a papular eruption of the skin. [NLat. < Gk. *strophos,* twisted cord < *strephein,* to turn.]

stroud (stroud) *n.* A coarse woolen cloth or blanket. [After *Stroud,* England.]

strove (strōv) *v.* A past tense of **strive.**

struck (strŭk) *v.* Past tense and a past participle of **strike.** —*adj.* Affected or shut down by a labor strike.

struck jury *n. Law.* A jury, esp. a special jury, selected from an original panel of 48 members from which each party strikes off names until the list is reduced to 12.

struck measure *n.* A dry measure having the contents leveled off and not heaped.

struc·tur·al (strŭk'chər-əl) *adj.* **1.** Of, relating to, having, or characterized by structure. **2.** Used in or necessary to construction. **3.** *Geol.* Of or pertaining to the structure of rocks and other aspects of the earth's crust. **4.** *Biol.* Of or relating to organic structure; morphological. —**struc'tur·al·ly** *adv.*

structural formula *n.* A chemical formula that represents the configuration of atoms and bonds in a molecule.

structural gene *n.* A gene that determines the amino acid sequence of a protein.

struc·tur·al·ize (strŭk'chər-ə-līz') *tr.v.* **-ized, -iz·ing, -iz·es.** To incorporate into a structure. —**struc'tur·al·i·za'tion** *n.*

structural steel *n.* Steel shaped for use in construction.

struc·ture (strŭk'chər) *n.* **1.** Something made up of a number of parts that are held or put together in a particular way. **2.** The way in which parts are arranged or put together to form a whole. **3.** The interrelation of parts or the principle of organization in a complex entity. **4.** Relatively intricate or extensive organization: *an elaborate electric structure.* **5.** Something constructed, esp. a building or part. —*tr.v.* **-tured, -tur·ing, -tures.** To give form or arrangement to. [ME < OFr. < Lat. *structura* < *struere,* to construct.]

struc·tured (strŭk'chərd) *adj.* **1.** Highly organized: *a structured environment.* **2.** *Psychol.* Having a limited number of correct or nearly correct answers. Used of a test.

stru·del (strōōd'l, shtrōōd'l) *n.* A kind of pastry made with fruit or cheese rolled up in a thin sheet of dough and then baked. [G. < MHG, whirlpool.]

strug·gle (strŭg'əl) *v.* **-gled, -gling, -gles.** —*intr.* **1.** To exert muscular energy, as against a material force or mass; grapple. **2.** To be strenuously engaged with a problem, task, or undertaking. **3.** To make a strenuous effort; strive: *struggling to be polite.* **4. a.** To contend against: *"the human being struggles with his environment"* (Karl A. Menninger). **b.** To compete with. **5.** To progress or penetrate with difficulty. —*tr.* To move or place (something) with an effort: *struggle a trunk into a car.* —*n.* **1.** An act of struggling. **2.** Strenuous effort. **3.** Combat; strife. [ME *struglen.*] —**strug'gler** *n.* —**strug'gling·ly** *adv.*

strum (strŭm) *v.* **strummed, strum·ming, strums.** —*tr.* To play idly on or as if on (a stringed musical instrument) by plucking the strings with the fingers. —*intr.* To play an instrument by strumming. —*n.* The act or sound of strumming. [Perh. blend of STRING and THRUM¹.] —**strum'mer** *n.*

stru·ma (strōō'mə) *n., pl.* **-mae** (-mē') or **-mas. 1.** *Pathol.* **a.** Scrofula. **b.** Goiter. **2.** *Bot.* A cushionlike swelling at the base of a moss capsule. [Lat.] —**stru·mat'ic** (-măt'ĭk), **stru'mose'** (-mōs'), **stru'mous** (-məs) *adj.*

strum·pet (strŭm'pĭt) *n.* A whore. [ME.]

strung (strŭng) *v.* Past tense and past participle of **string.**

strung-out (strŭng'out') *adj. Slang.* **1. a.** Addicted to a drug. **b.** Stupefied from ingestion of a drug. **2.** Physically or emotionally debilitated from or as if from long-term drug use.

strut (strŭt) *v.* **strut·ted, strut·ting, struts.** —*intr.* To walk with pompous bearing; swagger. —*tr.* To brace with a supporting bar or rod. —*n.* **1.** A stiff, self-important gait. **2.** A bar or rod used to brace a structure against forces applied from the side. [ME *strouten,* to stand out < OE *strūtian,* to stand out stiffly.] —**strut'ter** *n.* —**strut'ting·ly** *adv.*

stru·thi·ous (strōō'thē-əs, -thē-əs) *adj.* Of, pertaining to, or resembling the ostrich or a related bird. [< LLat. *struthio,* ostrich < Gk. *strouthion* < *strouthos.*]

strych·nine (strĭk'nīn', -nĭn, -nēn') *n.* An extremely poisonous white crystalline alkaloid, $C_{21}H_{22}N_2O_2$, derived from nux vomica and related plants, used as a poison for rodents and other pests and medicinally as a stimulant for the central nervous system. [Fr. < NLat., *Strychnos,* genus of tropical trees and vines < Lat. *strychnos,* a kind of nightshade < Gk. *strukhnos.*]



strut
The Hermes of Praxiteles

strych·nin·ism (strĭk'nī-nĭz'əm, -nĭ-, -nē-) *n.* Chronic strychnine poisoning.

stub (stŭb) *n.* **1.** The usually short end remaining after something has been used up: *a pencil stub.* **2. a.** The part of a check or receipt retained as a record. **b.** The part of a ticket returned as a voucher of payment. —*tr.v.* **stubbed, stub·bing, stubs. 1.** To pull up (weeds) by the roots. **2.** To clear (a field) of weeds. **3.** To strike (one's toe or foot) against something. **4.** To snuff out (a cigarette butt) by crushing. [ME *stubbe* < OE *stybb.*]

stub·ble (stŭb'əl) *n.* **1.** The short, stiff stalks of a grain or hay crop remaining on a field after the crop has been harvested. **2.** Something resembling stubble, esp. a short stiff growth of beard. [ME *stuble* < OFr. *estuble* < Lat. *stupla,* var. of *stipula,* straw.] —**stub'bly** *adj.*

stub·born (stŭb'ərn) *adj.* **1. a.** Unduly determined to exert one's will; refractory. **b.** Not easily persuaded; obstinate. **2.** Characterized by perseverance; persistent. **3.** Difficult to handle or work; resistant: *stubborn soil.* [ME *stuborn.*] —**stub'born·ly** *adv.* —**stub'born·ness** *n.*

stub·by (stŭb'ē) *adj.* **-bi·er, -bi·est. 1.** Having the nature of a stub; short and stocky. **2.** Covered with or made of stubs. **3.** Short and bristly. —**stub'bi·ly** *adv.* —**stub'bi·ness** *n.*

stub nail *n.* A short, thick nail.

stuc·co (stŭk'ō) *n., pl.* **-coes** or **-cos. 1.** A durable finish for exterior walls, applied wet and usually composed of cement, sand, and lime. **2.** A fine plaster for interior wall ornamentation, such as moldings. **3.** A plaster or cement finish for interior walls. —*tr.v.* **-coed, -co·ing, -coes** or **-cos.** To finish or decorate with stucco. [Ital., of Germanic orig.]

stuck (stŭk) *v.* Past tense and past participle of **stick.**

stuck-up (stŭk'ŭp') *adj. Informal.* Snobbish; conceited.

stud¹ (stŭd) *n.* **1.** An upright post in the framework of a wall for supporting sheets of lath, wallboard, or similar material. **2.** A small knob, nail head, or rivet fixed in and slightly projecting from a surface. **3. a.** A small ornamental button mounted on a short post for insertion through an eyelet, as on a dress shirt. **b.** A buttonlike earring. **4.** Any of various protruding pins or pegs in machinery. **5.** A metal crosspiece used as a brace in a link, as in a chain cable. —*tr.v.* **stud·ded, stud·ding, studs. 1.** To provide with or construct with a stud or studs. **2.** To set with a stud or studs: *stud a bracelet with rubies.* **3.** To be dotted about on, esp. ornamentally; strew: *Daisies studded the meadow.* [ME *stode* < OE *studu.*]

stud² (stŭd) *n.* **1. a.** A group of animals, esp. horses, kept for breeding. **b.** A stable or farm where they are kept. **2.** A stallion or other male animal kept for breeding. **3.** Stud poker. **4.** *Slang.* A virile man. —*idiom.* **at stud.** Available or offered for breeding. [ME *stod* < OE *stōd.*]

stud·book (stŭd'bŏŏk') *n.* A book registering the pedigrees of thoroughbred animals, esp. of horses.

stud·ding (stŭd'ĭng) *n.* **1. a.** The wood framework of a wall or partition. **b.** Lumber cut for studs. **2.** Something with which a surface is studded.

stud·ding·sail (stŭn'səl, stŭd'ĭng-sāl') *n. Naut.* A narrow rectangular sail set from extensions of the yards of square-rigged ships. [Orig. unknown.]

stu·dent (stōōd'nt, styōōd'-) *n.* **1.** One who attends a school, college, or university. **2. a.** One who makes a study of something. **b.** An attentive observer: *a student of world affairs.* [ME < Lat. *studens,* pr.part. *studēre,* to study.]

student teacher *n.* A college student who practices teaching under supervision.

student union *n.* A building on a college campus with facilities for social and organizational activities.

stud·fish (stŭd'fĭsh') *n., pl.* **studfish** or **-fish·es.** Either of two small, brightly colored freshwater fishes, *Fundulus catenatus* or *F. stellifer,* of the southeastern United States.

stud·horse also **stud horse** (stŭd'hôrs') *n.* A stallion.

stud·ied (stŭd'ēd) *adj.* **1. a.** Carefully prepared or considered: *a studied effect.* **b.** Lacking spontaneity; contrived: *a studied smile.* **2.** Learned; knowledgeable. —**stud'ied·ly** *adv.* —**stud'ied·ness** *n.*

stu·di·o (stōō'dē-ō, styōō'-) *n., pl.* **-os. 1.** An artist's workroom. **2.** A photographer's establishment. **3.** An establishment where an art is taught or studied: *a dance studio.* **4. a.** A room or building for motion-picture, television, or radio productions. **b.** A room or building where tapes and records are recorded. [Ital. < Lat. *studium,* eagerness.]

studio apartment *n.* A small apartment consisting of one main living space, a small kitchen, and a bathroom.

studio couch *n.* A couch that can be made to serve as a double bed by sliding the frame of a cot from beneath it.

stu·di·ous (stōō'dē-əs, styōō'-) *adj.* **1.** Devoted to study. **2.** Earnest; diligent: *made a studious effort.* **3.** Giving or evincing careful attention; heedful: *"the major . . . was very studious of his appearance"* (H. E. Bates). **4.** Deliberate. **5.** Conducive to study. [ME < Lat. *studiosus* < *studium,* eagerness.] —**stu'di·ous·ly** *adv.* —**stu'di·ous·ness** *n.*

stud poker *n.* Poker in which the first round of cards (and often the last) is dealt face down and the others face up.

stud·work (stŭd'wûrk') *n.* **1.** Work ornamented or covered with studs. **2.** The supportive framework of a wall or partition.

stud·y (stŭd'ē) *n., pl.* **-ies. 1.** The act or process of studying; the pursuit of knowledge, as by reading, observation, or

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place. —*v.* **stied, sty·ing, sties.** —*tr.* To shut up in a sty. —*intr.* To live in a sty. [ME < OE *stig.*]

sty² (stī) *n., pl.* **sties.** Inflammation of one or more sebaceous glands of an eyelid. [Short for dial. *styan* < ME **styan* < OE *stīgend* < *stīgan,* to rise.]

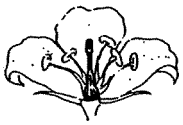
styg·i·an also **Styg·i·an** (stĭj'ē-ən) *adj.* **1.** Of or pertaining to the river Styx. **2. a.** Gloomy and dark. **b.** Infernal; hellish. [Lat. *Stygius* < Gk. *Stugios* < *Stux,* Styx.]

styl– *pref.* Variant of **stylo-.**

sty·lar (stī'lər, -lär') *adj.* **1.** Of, pertaining to, or resembling a stylus. **2.** *Biol.* Of or pertaining to a style.

sty·late (stī'lāt') *adj.* Having a style or styles.

style (stīl) *n.* **1.** The way in which something is said, done, expressed, or performed: *a style of speech and writing.* **2.** The combination of distinctive features of literary or artistic expression, execution, or performance characterizing a particular person, group, school, or era. **3.** Sort; type: *a style of furniture.* **4.** A quality of imagination and individuality expressed in one's actions and tastes. **5. a.** A comfortable and elegant mode of existence: *living in style.* **b.** A particular mode of living: *the style of a gentleman.* **6. a.** The fashion of the moment, esp. of dress; vogue: *out of style.* **b.** A particular fashion: *the style of the 1920s.* **7.** A customary manner of presenting printed material, including usage, punctuation, spelling, typography, and arrangement. **8.** Form of address; title. **9.** A slender, pointed writing instrument used by the ancients on wax tablets. **10.** An implement used for etching or engraving. **11.** The needle of a phonograph. **12.** The gnomon of a sundial. **13.** *Bot.* The usually slender part of a pistil, rising from the ovary and tipped by the stigma. **14.** *Zool.* A slender, tubular, or bristlelike process. **15.** *Obs.* A pen. **16.** A surgical probing instrument; stylet. —*tr.v.* **styled, styl·ing, styles. 1.** To call or name; designate: *George VI styled his brother the Duke of Windsor.* **2.** To make consistent with rules of style: *style a manuscript.* **3.** To give style to: *style hair.* [ME < OFr. < Lat. *stilus.*] —**styl'er** *n.*



style

style book *n.* A book giving rules and examples of usage, punctuation, and typography, used in the preparation of copy for publication.

sty·let (stī-lĕt', stī'lĭt) *n.* **1.** A slender, pointed instrument or weapon, such as a stiletto. **2.** A surgical probe. **3.** *Zool.* A small, stiff, needlelike process in some invertebrates. [Fr. < Ital. *stiletto,* stiletto. —see STILETTO.]

sty·li (stī'lī') *n.* A plural of **stylus.**

styli– *pref.* Variant of **stylo-.**

sty·li·form (stī'lə-fôrm') *adj.* Having the shape of a style.

styl·ish (stī'lĭsh) *adj.* Conforming to the current fashion; modish. —**styl'ish·ly** *adv.* —**styl'ish·ness** *n.*

styl·ist (stī'lĭst) *n.* **1.** A writer or speaker who cultivates an artful literary style. **2.** A designer of or consultant on styles in decorating, dress, or beauty.

sty·lis·tic (stī-lĭs'tĭk) *adj.* Of or relating to style, esp. literary style. —**sty·lis'ti·cal·ly** *adv.*

sty·lite (stī'līt') *n.* One of a number of early Christian ascetics who lived unsheltered on the tops of high pillars. [LGk. *stulitēs* < Gk. *stulos,* pillar.] —**sty·lit'ic** (-lĭt'ĭk) *adj.* —**sty'lit·ism** (stī'lĭt'ĭz-əm) *n.*

styl·ize (stī'līz') *tr.v.* **-ized, -iz·ing, -iz·es. 1.** To conform or restrict to a particular style. **2.** To represent conventionally; conventionalize: *"An air of fastidious, stylized melancholy"* (Elizabeth Bowen). —**styl'i·za'tion** *n.* —**styl'iz'er** *n.*

stylo– or **styli–** or **styl–** *pref.* Style: *stylograph.* [< Lat. *stilus,* stake, stem, style.]

sty·lo·bate (stī'lə-bāt') *n. Archit.* The immediate foundation of a row of classical columns. [Lat. *stylobata* < Gk. *stulobatēs* : *stulos,* pillar + *bainein,* to walk.]

sty·lo·graph (stī'lə-grăf') *n.* A fountain pen having a tubular writing point instead of a nib.

sty·log·ra·phy (stī-lŏg'rə-fē) *n.* The art or a method of etching, engraving, or writing with a style. —**sty'lo·graph'ic** (-lə-grăf'ĭk), **sty'lo·graph'i·cal** *adj.*

sty·loid (stī'loid') *adj.* Slender and pointed.

sty·lo·lite (stī'lə-līt') *n.* A small columnar rock development in limestone and other calcareous rocks that is at right angles to the bed, of irregular cross section, and has striated sides. [Gk. *stulos,* pillar + -LITE.]

sty·lo·po·di·um (stī'lə-pō'dē-əm) *n., pl.* **-di·a** (-dē-ə). An enlargement at the base of the style of certain flowers.

sty·lus (stī'ləs) *n., pl.* **-lus·es** or **-li** (-lī'). **1.** A sharp, pointed instrument used for writing, marking, or engraving. **2.** A phonograph needle. **3.** A sharp, pointed tool used for cutting record grooves. [Lat. *stilus.*]

sty·mie also **sty·my** (stī'mē) —*tr.v.* **-mied, -mie·ing, -mies** also **-mied, -my·ing, -mies.** To block; thwart. —*n.* **1.** An obstacle or obstruction. **2.** A situation in golf in which an opponent's ball obstructs the line of play of one's own ball on the putting green. [Orig. unknown.]

styp·sis (stĭp'sĭs) *n.* The action or application of a styptic. [LLat. < Gk. *stupsis* < *stuphein,* to contract.]

styp·tic (stĭp'tĭk) also **styp·ti·cal** (-tĭ-kəl) *adj.* **1.** Contracting the tissues or blood vessels; astringent. **2.** Tending to check bleeding; hemostatic. —*n.* A styptic drug or substance. [ME *stiptik* < LLat. *stypticus* < Gk. *stuptikos* < *stuphein,* to contract.] —**styp·tic'i·ty** (-tĭs'ĭ-tē) *n.*

styptic pencil *n.* A short medicated stick, often of alum, applied to a cut to check bleeding.

sty·rax (stī'răks) *n.* A storax (senses 2, 3).

sty·rene (stī'rēn') *n.* A colorless oily liquid, C_8H_8, the monomer for polystyrene. [< Lat. *styrax,* storax. —see STORAX.]

Sty·ro·foam (stī'rə-fōm'). A trademark for a light, resilient polystyrene plastic.

Styx (stĭks) *n. Gk. Myth.* One of the rivers of Hades, across which the souls of the dead are ferried. [Lat. < Gk. *Stux.*]

su·a·ble (sōō'ə-bəl) *adj.* Legally subject to a court suit. —**su'a·bil'i·ty** *n.*

sua·sion (swā'zhən) *n.* Persuasion: *moral suasion.* [ME < Lat. *suasio* < *suadēre,* to persuade.] —**sua'sive** (-sĭv, -zĭv) *adj.* —**sua'sive·ly** *adv.* —**sua'sive·ness** *n.*

suave (swāv) *adj.* Smoothly gracious in social manner; urbane. [OFr., agreeable < Lat. *suavis.*] —**suave'ly** *adv.* —**suave'ness, suav'i·ty** (swăv'ĭ-tē) *n.*

Synonyms: *suave, smooth, urbane, diplomatic, politic.* These adjectives refer to a controlled or refined manner. *Suave* suggests a polished exterior and outward sophistication. *Smooth* stresses conscious, sometimes excessive effort to avoid conflict with others. *Urbane* implies a high degree of refinement together with the assurance that comes from wide social experience. *Diplomatic* especially suggests tact in handling difficult situations, and *politic* adds to this the implication of artful management, sagacity, or shrewdness in gaining an end.

sub (sŭb) *n. Informal.* **1.** A submarine. **2.** A substitute. **3.** *Regional.* A hero (sense 5). —*intr.v.* **subbed, sub·bing, subs.** To act as a substitute.

sub– *pref.* **1.** Below; under; beneath: *subsoil.* **2. a.** Subordinate; secondary: *subplot.* **b.** Subdivision: *subregion.* **3.** Less than completely or normally; nearly; almost: *subhuman.* [Lat. < *sub,* under, below.]

sub·ab·dom·i·nal (sŭb'ăb-dŏm'ə-nəl) *adj.* Located or occurring below the abdomen.

sub·a·cute (sŭb'ə-kyōōt') *adj.* Somewhat acute. Used of a disease. —**sub'a·cute'ly** *adv.*

sub·ad·dress (sŭb'ə-drĕs') *n.* A section of a computer input/output device accessible through an order code.

sub·aer·i·al (sŭb'âr'ē-əl) *adj.* Located or occurring on or near the surface of the earth.

sub·al·pine (sŭb'ăl'pīn') *adj.* **1.** Of or pertaining to regions at or near the foot of the Alps. **2.** Of, designating, or growing or living in mountainous regions just below the timberline.

sub·al·tern (sŭb'ôl'tərn, sŭb'əl-tûrn') *adj.* **1.** Lower in position or rank; secondary. **2.** *Chiefly Brit.* Holding a military rank just below that of captain. **3.** *Logic.* In the relation of a particular proposition to a universal with the same subject, predicate, and quality. —*n.* **1.** A subordinate. **2.** *Chiefly Brit.* A subaltern officer. **3.** *Logic.* A subaltern proposition. [LLat. *subalternus* : Lat. *sub-,* below + Lat. *alternus,* alternate < *alter,* other.]

sub·al·ter·nate (sŭb'ôl'tər-nĭt) *adj.* **1.** Subordinate. **2.** Arranged in an alternating pattern but tending to become opposite. Used of leaves. —**sub·al'ter·na'tion** *n.*

sub·ant·arc·tic (sŭb'ănt-ärk'tĭk, -är'tĭk) *adj.* Of or resembling regions just north of the Antarctic Circle.

sub·a·pi·cal (sŭb'ā'pĭ-kəl) *adj.* Located below or near an apex. —**sub'a'pi·cal·ly** *adv.*

sub·a·que·ous (sŭb'ā'kwē-əs, -āk'wē-) *adj.* **1.** Formed or adapted for underwater use or operation; submarine. **2.** Found or occurring under water.

sub·arc·tic (sŭb'ärk'tĭk, -är'tĭk) *adj.* Of or resembling regions just south of the Arctic Circle.

sub·ar·id (sŭb'ăr'ĭd) *adj.* Somewhat arid; moderately dry.

sub·a·tom·ic (sŭb'ə-tŏm'ĭk) *adj.* **1.** Of or pertaining to the constituents of the atom. **2.** Having dimensions or participating in reactions characteristic of the constituents of the atom.

sub·au·di·tion (sŭb'ô-dĭsh'ən) *n.* **1.** The act of understanding and mentally supplying a word or thought that has been implied but not expressed. **2.** A word or thought supplied by subaudition. [LLat. *subauditio,* supplying a missing word < *subaudire,* to supply an omitted word : Lat. *sub-,* below + Lat. *audire,* to hear.]

sub·base (sŭb'bās') *n.* The lowermost front strip or molding of a baseboard.

sub·base·ment (sŭb'bās'mənt) *n.* A story or floor beneath a main basement of a building.

sub·bass (sŭb'bās') *n. Mus.* A pedal stop on an organ that produces the lowest tones, having 16 or 32 feet.

sub·cal·i·ber (sŭb'kăl'ə-bər) *adj.* **1.** Smaller in caliber than the barrel of the gun from which it was fired. Used of projectiles. **2.** Of or pertaining to subcaliber projectiles.

sub·car·ri·er (sŭb'kăr'ē-ər) *n.* A section of a transmitted wave used to modify the information-carrying section of the wave.

sub·car·ti·lag·i·nous (sŭb'kär-tə-lăj'ə-nəs) *adj.* **1.** Located beneath a cartilage. **2.** Partly cartilaginous.

sub·ce·les·tial (sŭb'sĭ-lĕs'chəl) *adj.* **1.** Lower than celestial; terrestrial. **2.** Mundane.

sub·chas·er (sŭb'chā'sər) *n.* A submarine chaser.

sub·class (sŭb'klăs') *n.* **1.** A subdivision of a class. **2.** A taxonomic category ranking between a class and an order.

sub·cla·vi·an (sŭb'klā'vē-ən) *adj. Anat.* **1.** Situated beneath the clavicle. **2.** Of or relating to a subclavian part. **3.** Of or

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EXHIBIT D

Computer Dictionary & HANDBOOK

Charles J. Sippl

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rier locates the equipment which interconnects subscribers and circuits.

central processing element (bit slices) — Each central processing element (CPE) represents a 2-bit or 4-bit slice through the data-processing section of a computer. In some systems, several CPEs may be arrayed in parallel to form a processor of any desired word length. The microprocessor, which together with the microprogram memory controls the step-by-step operation of the processor, is itself a powerful microprogrammed state sequencer.

central processing unit — Abbreviated CPU. The unit of a computing system that contains the circuits that control and perform the execution of instructions.

central processing, unit loop — The main routine or a control program and that which is associated with the control of the internal status of the processing unit, in contrast to those control programs of routines developed with terminals and file storage input-output.

central processing unit, microcomputer — The CPU is the primary functioning unit of any computer system. Its basic architecture consists of storage elements called registers, computational circuits designated as the arithmetic-logic unit (ALU), the control block, and input-output ports. A microprocessor built with LSI technology often contains a CPU on a single chip. Because such a chip has limited storage space, memory implementation is added in modular fashion on associated chips. Most microcomputers consist of a CPU chip and others for memory and i/o.

central processor — *See* central processing unit.

central processor organization — The computer can be divided into three main sections: arithmetic and control, input/output, and memory. The arithmetic and control section carries out the directives of the program. The calculations, routing of information, and control of the other sections occurs in this part of the central processor. All information going in and coming out of the central processor is handled by the input/output section. It also controls the operation of all peripheral equipment. The memory section is the heart of the central processor; it provides temporary storage for data and instructions. Because of its importance, the total cycle time of the memory is the main determining factor in the overall speed of the processor.

central scanning loop — A loop of instructions which determines which task is to be performed next. After each item of work is completed, control is transferred to the central scanning loop which searches for processing requests in order to determine the next item to be processed. The computer may cycle idly in the central scanning loop if no item requires its attention, or it may go into a wait state which is interrupted if the need arises. The central scanning loop is the nucleus of a set of supervisory programs.

central terminal unit — Abbreviated CTU. This unit supervises communication between the teller consoles and the processing center. It receives incoming messages at random intervals, stores them until the central processor is ready to process them, and returns the processed replies to the teller consoles which originated the transactions (bank application).

cerdip — Abbreviation for Ceramic Dual In-line Package.

certified tape — Computer tape that is machine checked on all tracks throughout each roll and is certified by the supplier to have less than a specific total number of errors or to have zero errors.

certifier, tape — A peripheral device or unit designed to locate defects in magnetic tape before use, such as oxide emissions, unevenness, bubbles, etc.

CF — *See* control footing.

CH — *See* control heading.

chain — 1. Any series of items linked together. 2. Pertaining to a routine consisting of segments which are run through the computer in tandem, only one segment being within the computer at any one time and each segment using the output from the previous program as its input.

chain additions program — An instruction set that will permit new records to be added to a file.

chain, binary — A series of flip-flops (binary circuits) which exist in either one of two states, but each circuit can affect or change the following circuit.

chain code — An arrangement in a cyclic sequence of some or all of the possible

concurrent operation — This term is used to refer to various methods in electronic data processing in which multiple instructions or operations of different instructions are executed simultaneously. Concurrent operation refers to computers working as contrasted to computer programming. This concept is one of the basic tenets of time-sharing, priority processing, etc.

concurrent processing — The operation of a computer which has some or all of the program for more than one run stored simultaneously in its memory, and which executes these programs concurrently by time-shared control. *See* multiprogramming.

concurrent processing, peripheral — *See* peripheral processing, concurrent.

concurrent real-time processing — To close the gap in time between the actual transaction and its recognition by the processing system, a new concept has been devised, real-time processing. A real-time system is a combined data-processing and communications system which involves the direct communication of transaction data between remote locations and a central computer, via communication lines, and allows the data to be processed while the business transaction is actually taking place. A real-time system may be thought of as a communications-oriented data-processing system which is capable of performing batch-processing functions while concurrently processing inquiries or messages, and generating responses in a time interval directly related to the operational requirements of the system.

concurrent working — This term is used to refer to various methods in electronic data processing in which multiple instructions or operations of different instructions are executed simultaneously. Concurrent working refers to computer operation as contrasted to computer programming. This concept is one of the basic tenets of time-sharing, priority processing, etc.

condition — In the COBOL system one of a set of specified values that a data item can assume; the status of a switch as specified in the special-names paragraph of the environment division; a simple conditional expression. *See* conditional expression.

conditional — Subject to various constraints, i.e., the result of a comparison made during the program or subject to human intervention.

conditional branch — *See* branch, conditional.

conditional breakpoint — A breakpoint at which the routine may be continued as coded if desired conditions are satisfied.

conditional-breakpoint instruction — A conditional-jump instruction which, if some specified switch is set or situation exists, will cause the computer to stop, after which either the routine may be continued as coded, or a jump may be forced.

conditional dump — *See* branch, conditional.

conditional expression — In the COBOL language, an expression which has the particular characteristic that, taken as a whole, it may be either true or false, in accordance with the rules.

conditional instructions — A group of instructions that can take more than one course of action (go to different memory locations) based on the condition of a status flag at the time a particular type of conditional instruction is executed.

conditional jump — An instruction to a computer that will cause the proper one of two (or more) addresses to be used in obtaining the next instruction, depending on some property of one or more numerical expressions of other conditions. Also referred to as conditional transfer of control.

conditional macroexpansion — *See* macroexpansion, conditional.

conditional transfer — *See* branch, conditional.

conditional transfer instruction — *See* branch, conditional.

conditional transfer of control — *Same as* branch.

condition, compound — A number of simple logic conditions such as AND, NOT, or logic gates that can be combined to form compound logic operations.

condition, entry — A necessary and specified requirement, in computer programming, that must be met before a subroutine can be entered; for example, the use of a counter.

conditioning, signal — To process the form or mode of a signal so as to make it intelligible to, or compatible with, a given device, including such manipula-

however, the terminals share the same data link. The data link comes from the computer, goes to the first terminal, comes out of the first terminal and on to the second terminal, etc. All terminals share the same data link and the same computer port.

DAS — Abbreviation for digital-analog simulator.

DASD (direct access storage devices) — *See* storage, direct access.

data — 1. A general term used to denote any or all facts, numbers, letters and symbols that refer to or describe an object, idea, condition, situation, or other factors. It connotes basic elements of information which can be processed or produced by a computer. Sometimes data are considered to be expressible only in numerical form, but information is not so limited. (Related to information.) 2. Plural of the term datum. Collectively used to designate alphabetic or numeric material serving as a basis of discussion.

data above voice (DAV) — A transmission system which carries digital data on a portion of the microwave radio spectrum above the frequency used for voice transmission.

data acquisition — Process data are acquired by the data acquisition (DA) system, converted into digital information, and printed to provide: (a) operating records for accounting and supervisory purposes, or (b) a record of experimental data.

data acquisition and control system (DAC) — The system is designed to handle a wide variety of real-time applications, process control, and high-speed data acquisition. Each system is individually tailored with modular building blocks that are easily integrated to meet specific system requirements. A large family of real-time process input/output (i/o) devices is included, such as analog input, analog output, contact sense, and contact operate, as well as data processing i/o units, such as magnetic tape, disk storage, line printer, graph plotter, card, and paper tape input and output. Data are received and transmitted on either a high-speed cycle-steal basis or under program control, depending on the intrinsic data rate of the i/o device.

data acquisition, cycle-stealing — The display receives data and control words from the memory unit via the data-break channel. The data-break channel is a high-speed, direct-access channel that passes words to the program in execution.

data-acquisition system — A system designed to gather data from multiple remote locations at a certain computing facility.

data-adapter unit (communications) — The data-adapter unit greatly expands the input/output capabilities of the system. It provides direct connection of a variety of remote and local external devices to a system. These devices include the data-collection system, the data-communication system, process-communication system, telegraph terminals, telemetry terminals, and control and data-acquisition equipment.

data administrator — A high ranking member of management responsible for future information needs. The data administrator is not responsible for the design or maintenance of any particular data base, but is more concerned with the purity and quality as well as the value of the information as a corporate resource.

data, analog — The physical representation of information so that the representation bears an exact relationship to the original information. The electrical signals on a telephone channel are an analog-data representation of the original voice.

data array — A representation of data in the form of signs and symbols as recorded on tape, cards, etc.

data bank — A collection of data pertaining to a given subject or application. Many data banks are organized by and manipulated through data base management systems, but this is not necessarily the true use.

data base — A typical data base is a vast and continuously updated file of information, abstracts, or references on a particular subject or subjects. On-line data bases are designed so that by using subject headings, key words, key phrases, or authors, users can quickly and economically search for, sort, analyze and print out data on their terminal.

data base administrator — An individual who is in charge of controlling the content, design, and use of one or more data bases to avoid uncontrolled redundancies and to enhance development.

admissible. An exact solution or other termination to this problem is furnished by the simplex method or one of its variants.

inequality — A proposition (or relation) which relates the magnitudes of two mathematical expressions or functions A and B. Inequalities are four types; A is greater than B ($A > B$); A is less than B ($A < B$); A is greater than or equal to B ($A \geq B$); A is less than or equal to B ($A \leq B$). The first two types are called strict, and the last two are relaxed or weak. The process of identifying a functional argument or range of arguments which makes the proposition true is called solving the inequality, or obtaining a feasible solution to the inequality.

infinite-pad method — A procedure or method of measuring reflectiveness of paper stock used in optical character recognition. A doubling of the number of backing sheets of the same paper, however, does not appreciably change the measured reflectiveness.

infinity — Any number larger than the maximum number that a given computer is able to store in any register.

infix notation — A method of forming one-dimensional expressions (e.g., arithmetic, logical, etc.) by alternating single operands and operators. Any operator performs its indicated function upon its adjacent terms which are defined, subject to the rules of operator precedence and grouping brackets which eliminates ambiguity.

information — 1. Knowledge that was not previously known to its receiver. Information can be derived from data only to the extent that the data are accurate, timely, unexpected, and relevant to the subject under consideration. 2. Aggregation of data that are presented in various forms. Sets of symbols that specifically indicate one out of a number of alternatives. 3. The meaning assigned to data by the known conventions used in its representation.

information, administrative — Information of a textual nature, originated and prepared by one person for scrutiny by another.

information bearer channel — A channel provided for data transmission which is capable of carrying all the necessary information to permit communication including users' data synchronizing sequences, control signals, etc. It may, therefore, operate at a greater signaling rate than that required solely for the users' data.

information bits — Those bits which are generated by the data source and that are not used for error-control by the data transmission system.

information channel — The transmission and intervening equipment involved in the transfer of information in a given direction between two terminals. An information channel includes the modulator and demodulator, and any error-control equipment irrespective of its location, as well as the backward channel when provided.

information, communication — The physical means of connecting one location to another for the purpose of transmitting information.

information efficiency — A ratio of the actual negative entropy to the maximum possible entropy, using the same set of signs.

information-feedback system — An error-control system using message feedback with reception of the erroneous group from the sending station.

information flow analysis — The development of organizing and analyzing techniques to obtain facts and information about the organization, initialization, and flow to the final users of reports throughout the enterprise or organization.

information, machine-sensible — Information in a form that can be read by a specific machine.

information marker, beginning of — A reflective spot on the back of a magnetic tape, 10 feet from the physical beginning of the tape, which is sensed photoelectrically to indicate the point on the tape at which recording may begin.

information processing — The processing of data representing information and the determination of the meaning of the processed data.

information processing system — A system that receives and delivers information, changing the information in the process.

information rate — The product of the average information content per symbol and the average number of symbols per second.

EXHIBIT E

BOX AF

- PATENT -
- Atty. Dkt. 0867/50841 -

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Eric R. Hamilton
Title: COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM
Serial No.: 07/510,141
Filed: April 17, 1990
Examiner: D. Crosby
Art Unit: 3302

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on this date.

Date MAY 20, 1992

Express Mail Label No. TB086122575US

AMENDMENT B
AFTER FINAL REJECTION

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

This communication is responsive to the Office Action dated February 20, 1992, concerning the above-referenced application.

Please amend the application as follows:

In the Specification:

Please refer to the Substitute Specification (without claims) enclosed with this Amendment. In addition to those changes listed in Amendment A, mailed August 5, 1991, the following changes have already been incorporated into the Substitute Specification (page and line numbers corresponding to original Specification):

Page 6, line 9, change "Fig. 1" to --Figure 1--;

060 MC 05/28/92 07510141 1 203 80.00 CK

-1-

D020199 06/11/92 07510141 23 0920 020 203 10.00CH

EXHIBIT E
PAGE 1

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Page 6, line 11, change "Fig. 2 is an overall" to
--Figures 2A-2C represent an overall--;

Page 6, line 16, change "Fig. 3A" to --Figure 3A--;

Page 6, line 23, change "Figures 5A and 5B" to
--Figures 5A-5C--;

Page 6, line 26, change "Figure 6 depicts" to
--Figures 6A-6B depict--;

Page 6, line 32, change "Figure 8 depicts" to
--Figures 8A-8B depict--;

Page 8, line 2, change "Fig. 1" to --Figure 1--;

Page 9, line 11, change "Figure 2," to
--Figures 2A-2C,--;

Page 9, line 11, change "provides" to --provide--;

Page 9, line 26, change "Figure 2)" to
--Figure 2A)--;

Page 11, line 1, after "(104)" insert --)--;

Page 11, line 5, change "Fig. 2 more fully depicts" to
--Figures 2A-2C more fully depict--;

Page 11, line 6, change "Figure 2," to
--Figures 2A-2C,--;

Page 13, line 3, change "Figure 2 depicts" to
--Figures 2A-2C depict--;

Page 14, line 5, insert a comma after "Inc."

Page 15, line 16, change "(Fig. 7" to --(Figure 7--;

Page 15, line 28, change "Fig. 5 depicts" to
--Figures 5A-5C--depict--;

EXHIBIT E
PAGE 2

Page 16, line 4, change "311" to --311B--;

Page 16, line 11, change "328" to --328C--;

Page 16, line 11, change "327" to --327C--;

Page 16, line 13, change "395" to --395D--;

Page 16, line 13, change "396" to --396D--;

Page 16, line 18, change "Figure 6)" to
--Figures 6A-6B),--;

Page 17, line 3, change "Figure 6 notes," to
--Figures 6A-6B note,--;

Page 17, line 11, change "308" to --308A--;

Page 17, line 11, change "323" to --323A--;

Page 17, line 11, change "325" to --325A--;

Page 17, line 11, change "350" to --350A--;

Page 17, line 13, change "300" to --300A--;

Page 17, line 17, change "326" to --326B--;

Page 17, line 17, change "330" to --330B--;

Page 17, line 18, change "324" to --324B--;

Page 17, line 18, change "331" to --331B--;

Page 17, line 18, change "In" to --in--;

Page 17, line 19, change "329" to --329B--;

Page 17, line 22, change "checknet" to --check_net--;

Page 17, line 22, change "Figure 5)" to
--Figures 5A-5C)--;

Page 17, line 29, change "397-399" to --397-398--;

Page 18, line 6, change "Figure 2," to --Figure 2A,--;

Page 18, line 10, change "simply" to --simplify--;

Page 19, line 10, change "443" to --443A--;

Page 19, line 11, change "400" to --400A--;

Page 19, line 19, change "Figure 2)." to
--Figure 2A).--;

Page 20, line 13, change "bottom" to --button--;

Page 21, line 3, delete new paragraph indent before
"(Figures";

Page 21, line 3, change "(Figures" to --Figures--;

Page 21, line 5, change "469" to --469C--;

Page 21, line 5, change "444" to --444C--;

Page 21, line 6, change "442" to --442D--;

Page 21, line 6, change "441" to --441D--;

Page 21, line 15, change "Figure 6)," to
--Figures 6A-6B),--;

Page 21, line 18, change "checknet" to --check_net--;

Page 21, line 19, change "Figures 5A and 5B," to
--Figures 5A-5C,--;

Page 21, line 26, change "446 through 468" to
--445 through 446, 448 through 449, 451 through
468--;

Page 21, line 27, change "Figures 5A and 5B" to
--Figures 5A-5C--;

Page 21, line 28, change "checknet" to --check_net--;

Page 21, line 29, change "Checknet" to
--The check_net function--;

Page 22, line 6, change "checknet" to --check_net--;

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Page 22, line 8, change "Checknet" to
--The check_net function--;

Page 22, line 22, change "Checknet" to
--The check_net function--;

Page 23, line 10, change "(532A" to --(Path 532A--;

Page 23, line 11, change "(562)" to
--(515B) where the exit path continues to off-page connector 539B in Figure 5C, leading to a return (562).--;

Page 23, line 12, change "(515 in Figure 5A and 539 in Figure 5B.)" to
--515B in Figure 5B and 539B in Figure 5C--;

Page 23, line 12, after "Figure 5B.)" insert --)--;

Page 23, line 15, change "Figures 5A and 5B" to
--Figures 5A-5C--;

Page 23, line 25, change "checknet" to --check_net--;

Page 24, line 9, change "539" to
--513, leading to connector 515B, where the exit path continues to connector 539B in Figure 5C, leading to a return (562).--;

Page 24, line 15, change "onto to" to --onto--;

Page 25, line 1, change "teacher" to --teacher's--;

Page 25, line 17, change "Figure 6" to --Figure 6A--;

Page 25, line 18, change "(554 in" to --554C in--;

Page 25, line 19, change "Figure 5A and 555 in Figure 5B)" to --Figure 5B and 555C in Figure 5C--;

Page 28, line 1, change "Figures 5A and 5B," to --Figures 5A-5C,--;

Page 28, line 4, change "530 through 553" to --530 through 538, 540 through 553--;

Page 28, line 5, begin a new paragraph before "Figure 6";

Page 28, line 5, change "Figure 6 diagrams" to --Figures 6A-6B diagram--;

Page 29, line 4, change "checknet" to --check_net--;

Page 29, line 4, change "Figure 5)" to --Figures 5A-5C)--;

Page 29, line 14, change "checknet" to --check_net--;

Page 29, line 15, change "Figure 5B" to --Figure 5C--;

Page 29, line 20, change "checknet" to --check_net--;

Page 30, line 3, change "checknet" to --check_net--;

Page 30, line 16, change "checknet" to --check_net--;

Page 30, line 20, change "651 through 668" to --651 through 663B, 665A, 665B, 667A, and 667B--;

Page 30, line 24, begin a new paragraph before "Figure 7";

Page 30, line 26, change "(p." to --(page--;

Page 32, line 4, change "i.e." to --i.e.,--;

Page 32, line 18, change "Figure 8 diagrams" to --Figures 8A-8B diagram--;

Page 33, lines 16-17, change "On-page connector A (823)" to --Off-page connector 823A--;

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Page 33, line 28, change "Figure 8" to

--Figures 8A-8B--.

In the Claims:

Please amend the claims as follows:

Claim 1. (Twice Amended) A computer assisted [instructional] electronic information [delivery] communication system comprising:

at least two stations;

at least two monitor means, one associated with each of said two stations, for displaying [instructional] electronic information in visual form;

at least two input means, one associated with each of said two stations, for entering said electronic [handwritten instructional] information in handwritten freehand form to display on at least its associated monitor means; and

communication means for virtually simultaneously transmitting [instructional] said electronic information being entered simultaneously at either of said two input means from either station to the other station, and for enabling the virtually [simultaneously displaying] simultaneous display of said transmitted [instructional] information on both of said monitor means associated with both of said stations such that electronic information being entered at a first input means appears on both of said monitor means at substantially the same time while under the independent control of said first input means.

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Claim 2. (Once Amended) The system of Claim 1, wherein one of said stations is adapted for an instructor and ~~one or more~~ the other of said stations are adapted for students.

Claim 4. (Twice Amended) The system of Claim 2, wherein said communication means selectively affords said instructor's station to selectively view [instructional] said electronic information displayed at any of said monitor means at any of said students' stations virtually simultaneously to the time said information is being handwritten at said students' stations.

Claim 8. (Twice Amended) A computer assisted [instructional] electronic information [delivery] communication system, comprising:

at least two stations, each of said stations having:

at least one monitor having a display surface on which an image appears;

input means for inputting [instructional] electronic information in graphical form into said monitor by a user drawing or writing directly on said display surface;

peripheral interface means for accepting [the instructional] said electronic information from said input means and for providing [instructional] image information to said monitor;

central processing unit means for controlling said peripheral interface means; and

said electronic information communication system further comprising:

communication network means for communicating information in real time between the peripheral interface means of each of said two stations in order to virtually simultaneously display the [instructional] electronic information being input independently and simultaneously [on said monitors] by said input means at either of said two stations such that substantially the same image is displayed on the monitors of both stations at virtually the same time and such that each user has independent control of that portion of the image drawn or written by that user.

Claim 9. (Twice Amended) The system of Claim 8, wherein said system is comprised of more than two stations, and wherein the same image [instructional information] is virtually simultaneously displayed on said monitors [at each of said] of more than two stations as it is being [simultaneously] input at [each] any of said [two] stations.

Claim 10. (Twice Amended) The system of Claim 8, wherein one of said two stations is adapted for an instructor and one of said two stations is adapted for one or more students.

Claim 11. (Twice Amended) The system of Claim 10, wherein said instructor's station selectively controls the display of the [instructional] electronic information on said monitors of said students' station.

Claim ~~12~~ 13. (Twice Amended) The system of Claim ~~8~~, wherein said input means is comprised of a user controlled hand-held stylus, stylus sensor, and stylus interface means for communicating handwritten [instructional] or hand-drawn information from said stylus sensor to said peripheral interface means.

Claim 15. (Twice Amended) The system of Claim 12, wherein said handwritten [instructional] or hand-drawn information inputted via said input means is selectively and simultaneously displayed on said monitors of more than two of said stations.

Claim 16. (Twice Amended) An instructional information system for use in an educational classroom, said system comprising:

at least two remotely-located user stations in which one station is an instructor station and one or more stations are student stations, said instructor station including means for controlling said instructional information system;

interactive monitor means, located in each of said user stations, for visually displaying instructional information to the user of that station and for accepting freehand inputted instructional information from the user of that station; and

network communication means, connected to each user station, for communicating said inputted and displayed instructional information between said interactive monitor means of all user stations, said network communication means controlled by said instructor station controlling means to selectively and simultaneously display instructional information input and displayed at said instructor's station on said interactive monitor means of any of said student stations at virtually the same time as and without interfering with the control of inputted instructional information [is] being accepted from the user of that student station.

Claim 22. (Once amended) The system of Claim 21, wherein said system includes more than two remotely-located stations, and wherein said [communication means] system further includes more than two input means for entering handwritten [instructional] information in freehand form from more than two stations at substantially the same time.

Claim 23. (Once amended) The system of Claim 2, wherein said communications means selectively affords said instructor's station to ~~virtually simultaneously transmit~~ virtually simultaneously and concurrently transmit said [instructional] ~~educational~~ information being handwritten at said instructor's station to all of said monitor means at all of said students' stations.

Claim 26. (Once amended) The system of Claim 10, wherein said instructor's station selectively controls the input means [of the instructional information on said monitors] of said students' station.

Sub C1

Claim 27. (Once amended) A method for providing [instructional] educational information from a first station to a second remotely-located station of a computer assisted [instructional delivery] communication system, each of said first and second stations having an input device for directly inputting hand-drawn graphical information from a user of that station, and having a display monitor for displaying an image of said graphical information to the user of that station, the [delivery] communication system including a computer network for transferring said graphical information between said first and second stations at virtually the same time as it is being input, the method comprising the steps of:

inputting primary hand-drawn graphical information into said system by a user at said first station;

displaying an image of said primary information to the user of said first station at virtually the same time as it is being input by the user of said first station;

transferring said primary information from said first station to said second station over said computer network;

displaying an image of said primary information to the user of said second station at virtually the same time as it is being input by the user of said first station;

inputting secondary hand-drawn graphical information into said system by a user at said second station [, said secondary information based upon said primary information] at the

same time as primary hand-drawn graphical information is being input into said system by the user at said first station;

transferring said secondary information from said second station to said first station over said computer network; and

displaying an image of said secondary information to the user of said first station along with said displayed image of said primary information at virtually the same time as said secondary information is being input by the user of said second station and with independent control of that portion of the primary or secondary information being input.

Claim 28. (Once amended) The method according to Claim 27, wherein said computer assisted [delivery] communication system includes a third station, and wherein the method further comprises the step of displaying an image of said primary information to the user of said third station at virtually the same time as it is being input by the user of said first station.

Please add the following new dependent claims:

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Claim ~~34~~. The system of Claim 1, wherein said communication means includes means for transmitting one pixel of said ~~electronic~~ information being entered simultaneously and concurrently at either of said ~~two~~ input means from either station to the other station on a pixel-by-pixel basis from alternating stations.

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Claim ~~35~~. The system of Claim 1, wherein said communication means includes means for enabling the display of one pixel of said ~~electronic~~ information being entered simultaneously and concurrently at either of said ~~two~~ input means from either station to the other station on a pixel-by-pixel basis from alternating stations.

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Claim ~~36~~. The system of Claim 1, wherein said communication means includes means for queuing said ~~electronic~~ information being simultaneously and concurrently transmitted from either station to the other station.

23 13

Claim ~~37~~. The system of Claim ~~8~~, wherein said communication network means includes means for simultaneously and concurrently communicating one pixel of said information in real time between the peripheral interface means of ~~two~~ said stations on an alternating-station pixel-by-pixel basis during the time the information is being entered simultaneously and concurrently at all ~~of both~~ said stations.

Claim 38. The system of Claim 16, wherein said network communication means includes means for communicating said inputted and displayed instructional information between said interactive monitor means of all user stations in a pixel-by-pixel format, and for queuing each pixel of said instructional information at each station during the time information is being simultaneously entered at each station.

Claim 39. The method according to Claim 27, wherein the method further comprises the step of storing said primary information from said first station in said second station at virtually the same time that secondary hand-drawn graphical information is being input into said system by a user at said second station.

Claim 40. The method according to Claim 27, wherein said primary and secondary information inputting, displaying, and transferring steps are performed on a pixel-by-pixel basis.

Claim 41. The method according to Claim 31, wherein said primary and secondary information inputting, displaying, and transferring steps are performed on a pixel-by-pixel basis.

REMARKS

Applicant respectfully requests favorable reconsideration of the present application in light of the above amendments and in view of the reasons which follow. Upon review of the preceding Office Action, it is believed that the amended claims are now in proper condition for allowance.

After entry of the above amendments, claims 1-5 and 7-41 are pending in this application.

Applicant sincerely thanks Examiner Crosby for his time and helpful suggestions in amending the claims of this application during the telephone interviews of March 18 and 25, 1992.

Applicant assumes that Applicant's Proposed Amendment B, which was transmitted via facsimile to Examiner Crosby on March 19, 1992, has not been entered. Accordingly, Applicant includes herewith substantially the same amendments to the claims as previously set forth. The above changes to claims 1-33 are exactly the same as those set forth in Applicant's Proposed Amendment B, except for the following changes (which have been indicated above using double underlining):

Claim 1, line 14, "simultaneously" has been added after "entered" to further clarify that the present invention has the capability to process information from both input stations while both users are writing at exactly the same time;

Claim 8, line 23, "and simultaneously" has been added after "independently" for the same reason;

Claim 27, lines 25-27, "at the same time as primary hand-drawn graphical information is being input into said system by the user at said first station" has been added for the same reason; and

Claim 27, lines 35-36 were changed as discussed with Examiner Crosby on March 25.

New dependent Claims 34-41 have been added to further define specific features of the invention.

In response to the Examiner's objection to the specification, Applicant has included with this response a Substitute Specification (without claims) which includes all the changes set forth in Applicant's Amendment A, dated August 5, 1991, as well as those amendments to the specifications set forth above. No other changes to the specification have been made. All amendments to the specification are of a minor formal or technical nature. No new matter has been added to the specification.

Regarding the drawings, Applicant has included new formal drawings with this Amendment.

In the previous Office Action, the Examiner has rejected claims 1-33 under 35 U.S.C. § 103 as being unpatentable over Abrahamson et al. (U.S. Patent No. 5,002,491) in view of

Shapiro (U.S. Patent No. 4,785,472). Applicant respectfully traverses this rejection.

The teachings of these references were discussed during the telephone interviews with Examiner Crosby, and it was agreed that any combination of these references could not perform the functions of Applicant's invention, and that Applicant's claims should be amended to clarify these distinctions. Accordingly, the claims were amended in Proposed Amendment B to more particularly point out and distinctly claim the subject matter of the invention. Applicant believes that the claims, as amended, properly distinguish over the prior art of record.

More specifically, Abrahamson does not provide for the ability to input handwritten or freehand or graphical information into the system, as required by Applicant's claims. Although Shapiro teaches the use of a graphics tablet at the teacher's station, there is no teaching or suggestion to provide one at the student's station in accordance with Applicant's claims. Moreover, the use of a graphics tablet (or mouse) requires a substantially different kind of hand-eye coordination than the use of a pen or stylus for writing on the surface on which an image appears, as required by claim 8 and other claims. Therefore, the combination of Abrahamson and Shapiro cannot simulate two users writing on the same sheet of "electronic paper" from different workstations.

Even if the proposed combination of Abrahamson and Shapiro were modified to provide for the ability to input

handwritten information at both the teacher and student stations, the proposed combination would not include any communication means for virtually simultaneously transmitting the electronic information being simultaneously entered at either station to the other station, and for enabling the virtually simultaneous display of the transmitted information at both of the stations such that electronic information being entered at a first station appears at both stations at substantially the same time while under the independent control of the first station. In other words, the proposed combination could not provide real-time, simultaneous, two-way communication of handwritten information between the interactive monitors of two or more stations.

Applicant respectfully traverses the Examiner's rejection of claims 1-2, 4-27, and 31-33 under 35 U.S.C. § 103 based upon the combination of a remote controlling program such as Carbon Copy, PC Anywhere, or EasyLan with a painting or drawing program such as PC paint, Dr. Halo, or AutoCad. Applicant submits that these programs, even if they were found to be prior art, cannot virtually simultaneously transfer graphical information generated at one PC station in freehand form, e.g., using a stylus or a mouse, to the display screen of another PC station, and vice-versa, with independent control of the single image appearing on each display, i.e., one mouse would fight with the other mouse for control of the cursor. Hence, the electronic information entered by one user of the proposed system would not be under the independent control of that user and, thus, could

not simulate two users writing on the same sheet of "electronic paper" from different workstations.

Applicant has recently been made aware of U.S. Patent No. 5,073,926, (Suzuki et al.), of which a copy is enclosed and listed on the Supplemental Information Disclosure Statement, also enclosed. A Petition and Certification under 37 C.F.R. § 1.97(e) is also enclosed, along with a check for the $130.00 Petition Fee. The Examiner is requested to consider the Suzuki reference and make it of record in the subject application.

Suzuki et al., U.S. Patent No. 5,073,926, describes a two-way picture communication system having a telephone, a video camera, and video display monitor at each terminal to provide both digital video and audio communications. Suzuki also describes a line drawing apparatus, including a writing tablet using a liquid crystal display, for generating line drawings to be transmitted with the video signals. However, Suzuki's use of "relative coordinate areas" (regions of proximate stylus inputs accumulated prior to transmission to the remote station) severely limits the simultaneity and accuracy of a line drawing appearing on the remote station -- particularly in the event that more than one station is simultaneously receiving stylus input. Hence, as explained below, Suzuki does not teach or suggest Applicant's claimed method and means for virtually simultaneously transmitting information being entered simultaneously at either station to the other station, and for enabling the virtually simultaneous display of the transmitted information at both

stations such that it appears on both monitors at substantially the same time while under the independent control of each user. In other words, like the combination of the other art discussed above, Suzuki cannot simulate two users writing simultaneously and independently on the same sheet of "electronic paper" from different workstations.

More specifically, the teachings of Suzuki provide inadequate means to manage the more complex requirements for simultaneously displaying electronic information which is being simultaneously input at each station, since the electronic information entered by one user of the Suzuki system would not be under the independent control of that user. Using the "relative coordinate area" scheme (which Suzuki describes in Figures 9-12 and at column 10, lines 44-45, et seq.), if a set of line drawing data (consisting of possibly twelve to fifteen or more pixel identifiers connected by a single straight line, e.g., Figure 12) arrives from the remote station to be displayed at the local station while the local stylus is in use, that remote station input data cannot be displayed until the local stylus has been moved out of a relative coordinate area (i.e., while LOOP1 of Figure 9 is iterating). Under numerous common circumstances of freehand writing (such as when the pen tip is indefinitely or momentarily at rest on the surface, or when it is slowing to a stop, or when it is making a small mark like dotting an "i", or when it is moving in a continuous lateral motion), the LOOP1 iteration continues indefinitely (such as in the example Suzuki

describes at column 11, lines 10-16) and thus any input from the remote station is blocked (column 12, lines 22-28). Accordingly, the display at the local station is not under the independent control of the user at the remote station until such time as the local stylus actually moves out of its relative coordinate area. This prevents the simultaneous display of electronic information input from the remote station while the local station information is being processed. Moreover, the Suzuki technique produces an even more undesirable effect in that subsequent remote input (i.e., input arriving from the remote station while a set of line drawing data is already waiting) could be lost when both styluses are in simultaneous use. Thus, Suzuki places severe limits on the practicability of the system when both users are drawing at the same time.

The present invention, however, is adapted to handle more complex traffic management requirements for the unimpeded displaying of both inputs -- even while both styluses are in simultaneous use. As depicted in Applicant's Figure 3A (and described at page 12, line 10 et seq.), three communication sub-systems are concurrently operating, whereby line drawing data is displayed every time the stylus crosses a new pixel. (See page 13, line 17- page 14, line 9; page 14, line 19; page 15, line 1; and page 19, lines 3-17.) This pixel-by-pixel basis of transmitting and displaying information produces a much truer "simultaneity of display" than the prior art technique of accumulating pixels in relative coordinate areas prior to

transmission. Furthermore, in the present invention, pixel-by-pixel data is queued for immediate and independent display at each station -- even when the stylus at both stations are simultaneously in use. (See page 14, lines 14-21 which references the queuing system, and page 25, line 31- page 27, line 6 which discusses the queuing system of Figure 7.)

In review, the prior art does not teach or suggest the unimpeded real-time simultaneous two-way communication of handwritten electronic information while both styluses are in simultaneous use. Accordingly, the prior art systems could not realistically simulate two users writing at the same time on the same sheet of "electronic paper" from different workstations. Hence, the present invention uniquely provides real-time, simultaneous, two-way communication of handwritten instructional information between the interactive monitors of two or more stations.

Applicant believes that the present application is now in condition for allowance. Favorable consideration of the amended claims is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required to this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 23-0920. Should no proper payment be enclosed

herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 23-0920. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

WELSH & KATZ, LTD.

Date: 5/20/92

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Sub. Spec. 6-10-92 ## prf of 10/E

-SUBSTITUTE SPECIFICATION-
Attorney Docket No. 0867/50841

Entered JK 8/11/92

COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM

Inventor: Eric R. Hamilton, Ph.D.

As part of the specification hereto is a Microfilm Appendix as Computer-Output-Microfilm output affixed to 26 paper cards.

This invention relates to a computer-mediated communication system, the primary application of which is intended to be classrooms or other training or learning environments. More particularly, this invention relates to a configuration of computer hardware and software which enables two or more users (typically an instructor and student) at different stations to share what will be called electronic sheets of paper.

B1

Background of the Invention

A genre of training software that simulates simultaneous two-way communication has emerged in recent years. Such software typically involves an operator at one terminal taking control of an application at another station. Although control of the application reverts back and forth between operators at different stations, three critical differences distinguish such systems from the present invention. First, such prior systems always require a basic platform application, such as a word processor or spreadsheet. The present invention does not require such a platform application. Second, the present invention does not involve one operator taking control of an application. Two users may simultaneously control the application. Third, such applications do not contemplate free-hand writing or drawing to simulate paper and pencil writing and drawing as the principal means of effecting the shared communication.

Although some video instructional systems enable teachers to transmit images created by one student to appear at the stations of a full classroom in a single manner similar to this invention, these prior systems do not entail simultaneous and interactive communication between the teacher and student, either on a one to one or one to a selective group.

Prior instruction systems, such as that shown in U.S. Patent No. 3,401,469 to Shaver and U.S. Patent No. 4,486,180 to Riley are severely limited in their flexibility and interaction capabilities. In Shaver, the interaction between student and a control center is over different channels in which the instructional material is prepared in advance, unlike the present invention in which the instructional material is constructed extemporaneously. The invention disclosed in Shaver is not interactive, in that the present invention affords the ability for the material being presented to the student to change on the basis of a teacher's response to the student's input. In Riley, no simultaneous and interactive communication is contemplated, because the system is intended for standardized tests. The present invention provides a medium of simultaneously written interactions between teacher and student.

Other known systems involve the use of predefined still video information such as U.S. Patent No. 4,052,798 to Tomita, et al. The present invention disseminates information interactively by the teacher as the student works. There is no need to predefine information, and it is not "still" in that the video image seen by the student is always subject to change by the teacher.

Many prior systems are not applicable to written textual communication which is the most effective manner to teach grammar or mathematics, etc. U.S. Patent No. 3,233,346 to Cornberg involves the use of a telephone system for the student to communicate to the teacher while

the student views a video display of the teacher. The invention disclosed in Cornberg is severely limiting in that it does not allow one of the most fundamental means of communication, that being the writing mode, in which student and instructor can communicate.

Even currently known software products such as "Carbon Copy" made by Meridien Technology, a subsidiary of Microcom, Inc., do not allow interaction based on extemporaneous freehand input and rely on the use of pre-existing application software rather than the application-free context that the present invention provides. Of all known computer assisted instructional systems, none provide interactive freehand input in an application-free context.

Numerous other advantages and features of the invention will become readily apparent from the detailed description of the preferred embodiment of the invention, from the claims, and from the accompanying drawings, in which like numerals are employed to designate like parts throughout the same.

Summary of the Invention

The invention in its simplest form is a computer assisted instruction system for a classroom which allows a teacher to share an electronic sheet of paper with one or more students in the classroom, enabling both teacher and student to write on the same "sheet" virtually simultaneously from different parts of the room. At her choice and at her pace, the teacher can switch among students, observing and sharing their work space as their needs require.

The inventive concept consists in the preferred embodiment of the following. Each student's desk is equipped with a 14" monitor (i.e. "screen" or "display"). The monitor surface lies flat on the desk, flush with the desk's surface, and it is equipped with an attached stylus that looks much like a fiber-tipped pen, but with a hard

tip. The teacher's station is equipped with a monitor as well (and may also be connected to a bank of small monitors). All of the student computers are linked to the teacher's station. As a student physically writes on the surface of his monitor with the stylus, the image that is written not only appears on that student's display, but is also transmitted simultaneously to the teacher's station. The teacher can passively observe the student's work, or actually interact with the student by writing on her own station at the front of the class, with the image moving back to the student on their display. In effect, the teacher and the student are sharing an electronic sheet of paper. Both can actually work with several electronic sheets of paper, and can "shuffle them" as one might shuffle loose pages taken from a notebook. The teacher can transmit the image from one student, to the whole class, or to a subset of the entire class. With a scanner, the teacher can send images from problem sheets, practice sheets, or even tests to all of the students, virtually copying them directly off of paper and onto the students' displays. Students can, when appropriate, get actual printed copies of their work, or save their work from one class to the next. The desk housing the student monitor will include a sliding cover, to protect the monitor when not in use.

If the teacher's station is equipped with a single monitor, she would be able to select which student's work to view just by touching an image (or "icon") on her monitor from the front. Because all student activity is transmitted to the teacher's station as that activity occurs, the image of the newly selected student's work will immediately appear at the teacher's display.

In a mathematics classroom, for example, a teacher and a student may work together on the same problem from different locations within a classroom. The teacher, more particularly, can watch a student work, and jot down

suggestions or comments on the student's sheet. The student may similarly pose questions to the teacher.

The teacher may also elect to transmit back to all students simultaneously. For example, if the teacher poses a geometry problem that she transmits to all of the students, she can wait for a few minutes, observing them and helping them as they work, and then send all of them some further information to help in the next step of the problem.

When equipped with a monitor of sufficient resolution, split screen capability, or when equipped with more than one monitor, the teacher may view the work of and communicate with several students simultaneously.

It is an object of this invention to enable a student and a teacher to share an electronic sheet of paper from remote locations, where the term "share" means that both teacher and student may write or draw on that electronic sheet of paper simultaneously from remote locations with the image produced by one appearing on screen of the other or both.

It is further an object of this invention to enable a student and a teacher to share an electronic sheet of paper from remote locations, where the term "share" also means that both teacher and student may type on that paper simultaneously from remote locations with the text produced by one appearing on screen of the other.

It is further an object of the invention that a teacher may monitor the written work of students by electronically selecting which student's paper will appear at the teacher's station. For example, by activating an icon (appearing in the teacher's monitor) corresponding to a particular student, the current image for that student then appears on the teachers monitor, and the teacher and the student may continue to work on the image together.

It is further the object of this invention that the teacher may transmit to a group of two or more individuals the same image, and the teacher would be able to write on his/her screen, with the result appearing

simultaneously at all of the stations sharing that image. In fact, an entire group may work on the same electronic sheet simultaneously.

It is yet another object of the invention that students may discretely communicate with teachers by signaling to the teacher in a means that only the teacher and student can see that the student would like to pose a question. The student may jot down questions to the teacher on their display and the teacher's display without the rest of the class being privy to that communication.

The attainment of the foregoing and related objects, advantages, and features of the invention should be more readily apparent to those skilled in the art after review of the following more detailed description of the invention.

Brief Description of the Drawings

Figure 1 is an external perspective view of a classroom system in accordance with the present invention.

Figures 2A-2C represent an overall schematic diagram identifying the hardware components and connections of the present invention.

Figures 3A and 3B provide flow diagrams identifying the general operation of the present invention in which Figure 3A emphasizes the three communication systems (from the pen, from the network, and to the network), and Figure 3B depicts the background operation, primarily of the graphical user interface (GUI).

Figures 4A and 4B depict in flow chart form the specific flow of operations of the first communication system (from the pen).

Figures 5A-5C depict in flow chart form the actual content of the second and third communication systems (to and from the network).

Figures 6A-6B depict in diagram form the principal routine that integrates the first communication system with the second and third communication systems.

Figure 7 depicts in diagram form how the implementation of the present invention manages network transmissions as they are requested in rapid succession.

Figures 8A-8B depict in diagram form the source file SLATE.C, which includes the start-up main function, and the initialization of the system until the program is taken over by the graphical user interface (GUI).

Brief Description of the Tables

Tables 1 and 2 each list the source code routines and .C files of the present invention, identifying in both Tables the page number in the Microfilm Appendix of each routine or file. Table 1 lists the routines and files in order of page number, and Table 2 lists the routines and files in alphabetical order.

Table 3 identifies key routines as they correspond to the processes depicted in Figures 3A and 3B.

The Microfilm Appendix includes two documents. The first, pages H1-H20, provides the actual list for the project (.PRJ) file and header (.H) files in the current implementation of the invention. The second part of the Appendix, pages C1-C133, provides the actual source code listing, arranged in alphabetical order by .C file name, and referenced in Tables 1 through 3.

With the Microfilm Appendix, Version 2.0 of the Turbo C Professional by Borland International of Scotts Valley, CA, with the LITECOMM standard terminal software package referenced on page C25 of the Microfilm Appendix, and with the screen writing system identified in the next section, this implementation may be readily reconstructed and utilized in performing the novel features of the invention.

Detailed Description of the Preferred Embodiment of the Invention

While the invention is susceptible of embodiment in many different forms, there is shown in the drawings, tables, Microfilm Appendix, and will be described herein in

detail, a preferred embodiment of the invention. It should be understood, however, that the present disclosure is to be considered an exemplification of the principles of the invention and is not intended to limit the spirit and scope of the invention and/or claims of the embodiments illustrated.

Turning now to the drawings, more particularly to Figure 1, there is depicted a facsimile of a classroom with the present invention implemented therein. A representative desk (101) houses the software and computer hardware for either teacher or pupil. A computer (100) is connected to a monitor (102) whose display (e.g., Cathode Ray Tube (CRT) or Liquid Crystal Display Type (LCD)) is flush against the surface of the desk. In the Figure, 102 illustrates the surface of the monitor. An optional keyboard (103) may also be connected to the computer (100). A conventional network bus (112) connects all of the individual desks (101, 106 and 151 through 161). Such a network bus 112 may be effectuated by what is known as serial communication, but more typically will be effective using network protocols that operate at higher speeds (greater than 1.0 megabits per second) than typically available under serial protocols. Commonly used standard protocols for such networks are produced by Novell, Inc. (e.g., "Netware") and by International Business Machines (IBM) (e.g., "NetBIOS"). These conventional networks provide the means for computers to communicate with one another. The software component of the invention may be stored in a disk drive or in "read-only memory" at each station (i.e., inside the computer depicted in 100) or at the central teacher station (106). In the preferred embodiment, the software is stored in a disk drive (not shown) at the teacher station. When the pupil at a student station uses the software, a copy of it is sent over the network bus (112) and stored in the "random access memory" (or "RAM") of the user's computer (101), and is run by that computer.

It is possible, in an alternative embodiment, that the student stations (101 and 151-161) do not actually house computers with "central processing units," but instead derive not only their disk storage from the teacher's station (106) but also derive their RAM storage and computing power from the computer at the teacher stations. In this case, each student station would function as a so-called "terminal," and would not include a computer (100). Figures 2A-2C, discussed below, provide a schematic of the network bus 112 connections.

Also connected to the computer is a free-style handwriting system (104) to simulate to the user the ability to "write," either on the monitor or on a glass or glass-like sensor plate (105) resting above the monitor, just as one would "write" on a piece of paper with a pen or pencil. Thus, the display from the monitor (102) is directly beneath and is seen through the glass sensor (105). Figure 1 depicts one possible writing configuration, namely the appearance of the same image on all desks if the teacher transmits the same image to all students. The handwriting system may consist of a corded or cordless light pen, in which the pen translates video signals and is so integrated with an interface card (207 of Figure 2A) to send coordinates of the pen's position on the screen to the computer's central processing unit. Alternatively, the monitor itself may be so constructed as to allow the interception of coordinates as a pen-like object moves across its surface, as done by so-called touch screens. Finally, the system may also consist of a pen-like object and glass plate or glass-like plate, positioned directly above the monitor's surface, which are interfaced with the hardware in such a way that as the stylus moves across the surface of the plate, coordinate positions are relayed to the computer.

The preferred embodiment implementation, however, does not involve a light pen or touch screen. Instead, as mentioned, a sensor plate (105) is mounted above the monitor (102), and it is the combination of the sensor

plate and stylus, rather than monitor and light pen, that produces the signals.

The housing and computer for the teacher's station (106) may be physically identical to that of any individual student station, although it is likely that a teacher's station may have an optional printer attachment (110). Any student station may also have such an optional printer attachment.

The teacher's display may also, at the teacher's option, include "icons" (111) appearing within the display. An "icon" is a small graphic symbol which, when referenced by the user, provides the user with access to the information or processes that the symbol represents. Under this implementation, each student at stations 101 and 151 through 161 are represented by a separate icon. When the teacher touches the screen where an icon for a student appears, the teacher and that student can begin hand-written screen-sharing communication. That is, both may write (using the pen system (104)) at his or her own station, and the image created by the writing of each user appears not only at that user's station, but at the other user's station as well.

Figures 2A-2C more fully depict the physical components of the system. In Figures 2A-2C, three separate and identical user or student/teacher stations are depicted (270, 271, 272). Only one of these stations 270 will be described herein, it being understood that the other two stations are identical (except as noted). The central processing unit with bus interface (213) is connected via a data bus (214) to the computer's remaining systems (209), including storage (212), (i.e., primary storage, or "RAM"; secondary storage, such as disk drive; or "read-only memory" ("ROM")), peripheral interface (217) (e.g., serial and parallel ports), auxiliary chips (210) (such as the standard "8259" interrupt controller, which prioritizes external interrupts (such as issued by a serial interface) to a central processing unit, and the network interface (208), which provides the computer with the physical means

to communicate with other stations over the network bus. The central processing unit with bus interface (213) and communication lines to other components (212, 217, 210, 208), and internal communications (215 and 216) comprise the computer system (100) of Figure 1.

Under the preferred embodiment implementation, the computer (comprised of blocks 260 and 209) may involve an IBM-compatible system with a conventional Intel 80386 processor (included as part of 213), with a standard interrupt controller (included in 217), serial port (included in 210), and "Invisible Network" Novell NetBIOS-compatible network system (with interface card depicted as 208) from Invisible Software, Inc., Foster City, CA. In the preferred embodiment, the central processing unit (253) at the teacher's station is significantly enhanced by the processing power of at least an 80386 chip with the capacity to access large blocks of random-access memory (greater than 640 kilobytes) as well as the capacity to use large blocks of RAM as a high speed substitute for secondary (e.g., disk) storage, although a less sophisticated chip (e.g., 8088) may be used at student stations.

The handwriting system is shown here as 204, consisting of the pen or stylus (206), (104 of Figure 1), a sensor (205) that rests above the monitor (203), and the interface system (207) (out of view in Figure 1, but housed in the desk (101)) that translates the pen strokes on the sensor into event codes and coordinate positions for transmission via a data bus (218) back to the peripheral interface system. Under the preferred embodiment implementation, this transmission occurs via serial cabling. Such a handwriting system (204) is available as the Screenwriter™ system, from Microtouch Systems, Inc., 55 Jonspin Road, Wilmington, MA 01887. When a system such as the Screenwriter is the input medium for the three-communication system depicted in 301, 332, and 333 of Figure 3A and the graphical user interface depicted in Figure 3B, the shared screen writing of this invention is

effected. The individual stations are connected to one another via the network cabling (273, 274).

Figures 2A-2C depict two student stations (270 and 271) and one teacher station (272). Student station 271 and teacher station 272 include the same components (except for the aforementioned central processor unit 253 at the teacher's station.) Thus, identifiers 221 through 238 correspond identically with identifiers 201 through 218, as do identifiers 241 through 258.

Figure 3A identifies the three concurrently operating communication systems at a single user's station (either teacher or student) under this implementation of the invention, shown as enclosures within the three dotted boxes (301, 332, 333) in Figure 3A. The first (301) involves the free-hand pen input, from a user. The second (332) involves transmissions sent over the network to the user from other stations. The third (333) involves transmissions sent from this station over the network to other stations.

Table 3 identifies the key functions in the source code for each process in both Figures 3A and 3B, with a page number reference to the Microfilm Appendix. (Figures 4-7 diagram the most important of these functions with respect to the critical simultaneous communication systems that effect a shared writing surface.)

Figure 3B identifies the "background" system, including the graphical user interface (GUI), that displays to the user the user's input or the input from other stations in the network.

The implementation begins execution with initialization of all of the communication systems, the GUI management system, and other features of the execution environment (312). (The GUI system in this implementation was developed by Richard Tom of TEGL Systems, Inc., Vancouver, BC, as a graphical toolbox. Source code for the TEGL portion of the implementation, as it has been adapted for use here, appears between pages C74 and C133 of the Microfilm Appendix.)

The software application itself then proceeds as a continuous interaction of four systems: the three communication systems (from the pen to the software application (301), from the software application out to other stations in the network (333), and to the software application from other stations in the network (332)) and the GUI management system (Figure 3B).

At the beginning of the program, the pen is assumed to be off of the input surface (303). The user holding the pen (302) can keep the pen off the surface, touch the pen on the surface (305), or move the pen over the surface in a writing or drawing fashion (306). From either a touch down or a moving position, the user may lift the pen off of the surface (304). An interrupt is issued whenever the pen's status changes (353, 357 and 355 lead to interrupt 354; 352, 358, and 356 lead to interrupt 397; 359 and 361 lead to interrupt 360). The interrupt handler receives the interrupt and begins processing five bytes of information from it: the command field, and two coordinates for each of the x- and y- coordinates identifying the location of the pen on the sensor when the interrupt occurred. The principal routine to perform the interrupt handling is int_getxy, diagrammed in Figures 4A and 4B, and beginning on line 72 of page C35 of the Microfilm Appendix.

The lower right dotted rectangle (333) of Figure 3A depicts the second of the three concurrent communication systems. As coordinates are processed by the int_getxy routine, an evaluation of whether the input is to be transmitted is made at lines 88 through 94 of page C36 of the Microfilm Appendix, corresponding to 334 of Figure 3A. If the data is to be transmitted, it is sent to the sending queue for transmission to appropriate other stations via the send_que routine (line 70 of page C31 of the Microfilm Appendix). This communication system involves transmission of a data packet which includes the coordinate and event information. (Figure 7 diagrams the send_que routine.)

The lower left dotted rectangle (332) of Figure 3A depicts the third communication system, namely incoming

transmissions. Because transmission speeds over a network (e.g., over Ethernet) are typically faster than the signals from an input device (e.g., under serial protocols), it is actually possible that of two or more individuals sharing the same screen, a "remote" writer's input may appear on the screen more quickly than the "local" writer. The software application processes incoming coordinates from the pen or from remote sites on an interrupt-management basis, and gives to users the appearance of simultaneity. (Figures 5A-5C depict the network communication process in greater detail.)

A remote station sends a network transmission with a packet containing coordinate and event information (311, 365) to the user's station. When the packet arrives at the local station, a network interrupt is issued (311B), which, when serviced, places the packet onto a receiving queue (rec_int, on line 8 of page C31 of the Microfilm Appendix).

The data is copied out of the queue (310) and the coordinate values are computed (309) for use as if they were derived from the input device. Thus on-page connector C (328C) leads to on-page connector C (327C) for processing by the GUI (Figure 3B) on the same path (off-page connectors D (395D in Figure 3A and 396D in Figure 3B)) as the pen input (372 and 367). Once coordinates are available from either a network transmission or from an interrupt from the pen, different GUI functions, especially including drawmouse (page C69 in the Microfilm Appendix and more fully diagrammed in Figures 6A-6B), process the coordinates to update to user's viewing area. Thus, if the pen (at either the local or remote station) is depressed (315), the location of the depressed area must be evaluated. If the (local) user is attempting to access a "drop-down" menu or is trying to access an option by touching a "button" on the screen (316) (for example, to change the pen from writing mode to erasing mode), the choice is processed (320-321). If the (local or remote) user is instead continuously depressing the pen in a

writing area (317), a line is drawn to connect the location of that depression with the most previous one (318). (These "lines" are extremely short, and give the appearance of smooth, continuous drawing or writing.) As the drawmouse diagram of Figures 6A-6B note, this "connecting the dots" activity may constitute erasing parts of the screen if the user is in the erasure mode. If the depression of the pen (317) is actually a "touch down" rather than a "continued draw," the coordinates are stored for subsequent connection. The drawing routine then checks to determine whether the (local or remote) user is continuing to write or has lifted the pen off of the surface of the screen.

Off-page connectors A (308A, 323A, 325A, and 350A in Figure 3B) represent a flow of control back to off-page connector A in Figure 3A (300A), to the routines that evaluate the status of the pen. However, this flow of control only occurs if pen activity has produced an interrupt of the GUI to indicate that the pen status or pen position has changed. Off-page connectors B (326B, 330B, 324B, and 331B in Figure 3B) represent a similar flow of control to off-page connector B in Figure 3A (329B) to determine whether network transmissions are available, although the GUI checks in a systematic fashion (with the check_net function of Figures 5A-5C) to determine whether network interrupts have left any coordinate data from a remote user available in the network "queue."

In Figures 3A and 3B, a number of marked connections identify the sequence of the aforementioned operations and evaluation of command field. These marked connections include 351 - 353, 355 - 359, 361 - 364, 366 - 367, 370 - 382, 384 - 387, 389 - 394, and 397 - 398. All of these connections represent standard flow of control pathways.

Figures 4A and 4B diagram the function int_getxy (beginning on line 61 of page C35 of the Microfilm Appendix), which processes interrupts issued by the pen interface (207 of Figure 2A, and 354, 360, 397 of Figure

3A). Significant portions of this routine are written as in-line assembler (lines 74-95 of page C35, lines 99-102 of page C36, and lines 1-7 of page C37 of the Microfilm Appendix) to simplify the view of the register-level activity of this function. The function (401) begins by enabling the type of maskable interrupt issued by the interface (402). The communications register that identifies whether serial data has arrived and is waiting to be latched from an input port is tested (403) for the availability of a incoming data. If not (453A), the transmit register is tested (404). If not empty, the function begins to exit by jumping (454B) to the lines which will clear the interrupt flag and exit the function. If the transmit register is empty, (454A), another test is required for this implementation for whether an XON must be issued prior to exit (406A). If not (456), the function jumps (457) to the exit lines, as it does after issuing an XON (406B) if one is necessary (455). The purpose of the int_getxy function, is to process a positive result from the (403) test for incoming data. If data is available (453B), it is read from the input port (405) and examined.

If the byte falls within a specified range, it is the first incoming byte (or header byte (407)) of a sequence of five bytes from the pen interface which identify one of three pen events (lift up, touch down, or continue draw) and the coordinate position of the reported event. If the byte is a header (439B), the reported event is recorded and a counter for the remaining four bytes is initialized (409). The communications register to signal that another byte of data has arrived and is ready to be latched is tested (408). If the result is positive (499A), flow of control returns to the code which reads the data (405), shown in the diagram by on-page connector A (443A) to on-page connector A (400A). A negative result to 408 begins the process of exiting the function (499B).

With the counter initialized, the subsequent four bytes are evaluated and processed at 410 through 413. Each time one of the four bytes is processed, the counter is

incremented and the byte is stored for translation to screen-mappable x- and y-coordinates (414 - 417). The pen interface under this implementation identifies a point on a 1024 x 1024 point grid on the sensor (205 of Figure 2A). The screen resolution may be 640 x 480. The first two bytes (410 and 411) report the horizontal position, and the second two bytes (412 and 413) report the vertical position. Thus, after the second byte is processed, the x-coordinate for the screen can be computed (418), and the y-coordinate for the screen can be computed (419) after the fourth byte. An XON is also issued at 419 to signify that the full five byte expected transmission has been received.

Once the header and the coordinates have been latched and initially processed, they are further processed so that the GUI can update the display. This involves testing the header byte for the three possible events (lift-off, touch down, or continued draw) (420, 438, and 438B).

The GUI is an adaptation of "mouse" routines, and the mouse terminology of those routines is retained in this source code. A mouse is a hand-held device connected to a computer to provide a user with a flexible means of changing the location of the "currently active" portion of a screen, or to choose to carry out commands available by pressing or "clicking" the buttons on the mouse. A "mouse routine" is one which translates activity with the mouse, such as moving it, clicking a button, or releasing a button, into the action intended to follow as a result of that activity. Thus, a lift-off corresponds to a mouse button release (421) whereas a touch down or a continued draw correspond to depressing a mouse button (434 and 435). Once the "release" or "depress" flags are set, the "release" or "depress" variables are updated with the new coordinates (422, 436, and 437), before an evaluation of whether the pen event involves a draw (423) or an erasure (425).

In either event, the coordinates are recorded for possible transmission to other stations in the network (424

and 426), to which they are sent via the send_que function (432, 431, 430), diagrammed in Figure 7. Figure 4B diagrams the testing of the flags to indicate whether a transmission of the header and coordinates should be issued to the teacher, to all of the stations, or to a student station (427-429). Figures 4A and 4B, which together diagram the int_getxy function, are joined by the two off-page connectors C (469C in Figure 4A and 444C in Figure 4B) and by the two off-page connectors D (442D in Figure 4A and 441D in Figure 4B.

Once the new coordinates have thus been processed, and the available data register shows no new data, the function is exited. When the GUI detects that the interrupt from the pen to its background activity has produced a flag showing that a "mouse" button is depressed (i.e., that the pen is pressed against the surface of the sensor above the monitor), the GUI calls the "drawmouse" function (page C66 of the Microfilm Appendix that is diagrammed in Figures 6A-6B), and the coordinates of the drawing are placed on the screen. It is during the drawmouse function that the check_net function (page 60 of the Microfilm Appendix), diagrammed in Figures 5A-5C, is called to see if any network interrupts from a remote station have placed coordinate drawing data from that station to also be included in the drawing on the screen.

The lines in Figures 4A and 4B depict the flow of control from one process or test within the function to the next. These lines are referenced by identifiers 439A, 439B, 445 through 446, 448 through 449, 451 through 468, and 470 through 499.

Figures 5A-5C together diagram the flow of control for the check_net function, on pages C69-C70 of the Microfilm Appendix. The check_net function is the communication handler that translates network communications between stations into information that the GUI can use to produce the shared screen effect of the invention. This function runs in the GUI background (Figure 3B) and is also called at various points when

update values are expected from network interrupts. In particular, check_net is called by the drawmouse function as shown in Figure 7.

The check_net function begins by reading the network queue (502) via the read_que function (page C31 of the Microfilm Appendix) to determine if any transmissions await processing. A transmission, except when involving a full screen of graphical data, occurs in increments of PACKETs, defined on line 50 of page H10 of the Microfilm Appendix. When presented in upper case letters, PACKET refers to a specific variable to be transmitted over the network. A packet includes a one byte command field, a name field to transmit a student's name, a table entry field to identify a student by code, a character field when passing typed characters (or the eraser radius during erasures), a font identifier, and the x and y coordinates identifying the location of the event being shared by the screens.

The check_net function is the conversation between stations. The "first word" of every communication between stations is the command field, and it identifies how the receiving station should interpret the "rest of the conversation." The current implementation at the source level allows these command fields: ACK_CALL, ASK_HELP, ON_LIST, BEING_HELPED, NOT_ALLOW, CALL_TEACHER, DROP_NAME, SEND_COPY, STOP_SEND, SCREEN_COPY, KBRD_INPUT, ABS (for touch down of the pen at remote station), REL (to signify continued writing after a touch down), and ERASER.

The polling (503) to determine whether an interrupt was previously issued resulting a PACKET being stored on the queue is effected by returning a zero if there was none (532A) (which simply produces a return to the calling function) or a non-zero (i.e., "true" or "yes" condition) pointer to a copy of the PACKET (532B), at which point a case statement evaluates the command field of the PACKET. (Path 532A leads to an exit diagrammed in Figure 5B (515B) where the exit path continues to off-page connector 539B in Figure 5C, leading to a return (562).

The exit path in the diagram leads through off-page connectors B (515B in Figure 5B and 539B in Figure 5C.)) The flow-of-control arrows 533B, 534B, 535B, 542, 543B, 544B, 545B, 578, 579A, 580A, 581A, 582A, 583A, and 584A of Figures 5A-5C all signify that the test to identify the command in the PACKET has not yet succeeded. Only student stations under this implementation will receive the ACK_CALL command (504, line 51 of page C69 of the Microfilm Appendix), signifying that the teacher has acknowledged that the student has logged onto the system and has returned an identifier for an internal table at the teacher station for that student. The student station then stores the identifier (508) and the routine then exits (i.e., flow of control returns to the instruction immediately after the one that called the check_net function.) Only teacher stations will receive requests for help commands (505, line 55 of page C69 of the Microfilm Appendix) which are followed by examining whether questions are being allowed (509). If not (536A), a transmission is sent back to the student with the command field set to DISALLOW. Otherwise, the command field is set (511) to tell the student s/he is on the list for help (line 61 of page C69 of the Microfilm Appendix) or to remind the student s/he is already being helped (line 69 of page C69), and that command is sent back to the student (513) prior to exit (541). Thus, these newly set command fields (to signify "no help allowed," "already being helped," or "on list to be helped") are transmitted back to the student (512 or 513, leading to connector 517B, where the exit path continues to connector 539B in Figure 5C, leading to a return (562)). If the student station receives one of these responses (506), the appropriate message is displayed (510), and the function exits (536).

When a new station physically logs onto the network at the time it is booted, an identifier is issued by the network software. When a student first logs onto this software implementation, it issues a call to the teacher for an identifier. This is the identifier the

student stores (508) when it receives an acknowledgement (504) of this call to the teacher. The call itself (517, line 91 of page C69 of the Microfilm Appendix) is received by the teacher's station, which looks up the student's identifier issued by the network (520), and returns it to the student (525) with the command field of the outgoing PACKET set to ACK_CALL (523). Next, the GUI displays the name on the teacher's screen before restoring the screen to its appearance before the name display (526). Control then returns to the calling function (552).

A DROP_NAME command field (518, line 2 of page C70 of the Microfilm Appendix) will result when the student logs off the system; when the teacher's station receives a PACKET with this command field, the student's name is dropped (521) from the table position it took when the teacher's station received the first PACKET from the student, containing the CALL_TEACHER command (517). Once the name is dropped, control returns to the calling function (547).

If the command field requests a copy of the screen 519, (line 5 of page C70 of the Microfilm Appendix), a large transmission of a window takes place (522) from student to teacher (in contrast to the small transmission of a PACKET). Under this implementation, only teachers can request screens, and, if transmission of the screen (522) is successful (524), a flag at the student's station is turned on (527) to signify that all subsequent events are to be transmitted. This flag is evaluated by the drawmouse function, diagrammed in Figure 6A (604).

Continuing from off-page connectors C (554C in Figure 5B and 555C in Figure 5C), if either a student or teacher receives a full copy of a remote screen, a PACKET is sent with the SCREEN_COPY value in the command field (556, line 12 of page C70 of the Microfilm Appendix). The receiving station must have screen space available (563). If such space is not available, an empty screen is created (577) and the screen can be received (576) before the function is exited.

If the teacher terminates communication with a student, the teacher's station will send a STOP_SEND PACKET to the student 557, (line 9 of page C70 of the Microfilm Appendix) which will turn off the "send to teacher flag" (564) prior to exiting (597).

Under this implementation, with an optional keyboard, users can type on one another's screen simultaneously. If the PACKET specifies keyboard input (KBRD_INPUT) (558, line 18 of page C70 of the Microfilm Appendix) and an available drawing area (565), a temporary font value is recorded (575) from the PACKET (implying that two different fonts, one for each person sharing the drawing or typing area may be used simultaneously). The PACKET includes a character value for transmission in keyboard mode, which is then displayed by the GUI (574), which will also restore any drop-down menu information that is sharing the same space as the keystroke from the remote station (also 574). (If necessary, a drawing area is established to receive the input (566)).

Of the aforementioned commands, only SEND_COPY, SCREEN_COPY, and KBRD_INPUT produce changes in the user's writing area. The next two command fields, ABS and REL, produce the actual shared drawing on a screen. When an ABS is received (559, line 35 of page C70 of the Microfilm Appendix), the user at the sending station has just pressed the pen to the sensor (305 of Figure 3A), and the absolute coordinates of the touch down are recorded (573) so that, unless the pen is immediately lifted, a connection can be made between the point at these absolute coordinates and the point at the coordinates where the next interrupt is issued by the pen's serial interface at the remote station. At that next interrupt, a new PACKET is sent by the remote station, with the command field set to REL (560, line 40 of page C70 of the Microfilm Appendix), and the relative position from the last touch down or drawing interrupt (whichever is more recent) is included in the PACKET. A line is drawn (572) from the point at the last pair of coordinates to the point at this new set of coordinates.

The value of the coordinates is then saved for use when a subsequent PACKET arrives with the command field set to REL. Control then returns to the calling function (593).

The final communication mode that occurs under this implementation is the ERASER mode. If the command specifies that the remote sharing user is using an eraser (561, line 63 of page C70 of the Microfilm Appendix), a white "fillbar" (i.e., a small rectangle of blank space that can be positioned anywhere on a screen to "white out" or "erase" anything that is at that position) is set up by the GUI, which also determines whether the eraser, perhaps being at the edge of the drawing area, must be truncated (508) (and so it prepares to restore information that overlaps with the eraser (570)). The white bar (i.e., eraser) is then moved across the drawing area by the GUI (571). The size of the white bar is passed in the PACKET through the character field, which is otherwise used for transmitting keystrokes in keyboard mode (574). The center of the eraser is given by the x and y coordinates passed by the PACKET. After the GUI places the eraser with a white fillbar over the desired area, and restores any menu areas with which it overlapped, control passes back to the calling function (594).

In Figures 5A-5C, the lines identify the sequence of the aforementioned operations and evaluation of command field. These marked connections include all of connections from 530 through 538, 540 through 553, and 578 through 597.

Figures 6A-6B diagram the drawmouse function, as it appears beginning on line 65 of page C66 of the Microfilm Appendix. The function (601) begins with GUI calls (lines 72 through 77 on page C66 of the Microfilm Appendix) which set up the active drawing area. The current active point is set to the x- and y- coordinates (603, line 78 of page C66 of the Microfilm Appendix) originally assigned in the int_getxy function which processes interrupts from the pen interface. Thus, the x- and y- coordinates that are critical to this drawmouse routine are those assigned in the int_getxy function on

lines 53-54, 62-63, and 70-71 on page C36 of the Microfilm Appendix), and these are the same coordinates within this function on the aforementioned line 78 of page C66 of the Microfilm Appendix. If a mouse rather than a pen is the input device and if the coordinates are to be sent to the teacher (604) or to the entire class (605), a call to the function send_pt is issued with either the TEACHER or ALL_STUDENTS as a destination parameter. send_pt is a short function (line 3 on page C32 of the Microfilm Appendix) which prepares the data for transmission through the network via the send_que function which it calls (Figure 7).

The evaluation of whether the pen is depressed within the "frame" or "drawing area" leads to, on positive result, the execution of a loop beginning its iteration at 656A and ending its iteration at 659. The loop stops executing once the pen is no longer being depressed within the frame. The most important points in the loop are the check_net calls (609 and 612, diagrammed in Figures 5A-5C) to determine whether a transmission should be processed, and the draw line (or erasure) instructions at 614.

One of the most important features of this invention involves effecting simultaneous shared drawing. The draw line instruction within this loop (614) connects points whose coordinates were produced after the pen interface interrupts the application with pen signals. This draw line instruction appears on line 29 of page C67 of the Microfilm Appendix. Within the same loop, the check_net function is given two opportunities (609 and 612) to draw on the screen, corresponding to 572 of Figure 5C and to line 62 of page C70. Within a high speed loop which captures incoming coordinate data generated by both the serial (local) or network (remote) interrupts, points can be displayed to effect the simultaneous and shared drawing.

After the initial check_net call (609) to process simultaneous remote activity, the local user's mode is evaluated as either keyboard input (610) or drawing or erasure (611) mode. If the user is in keyboard mode, the

function waits for the pen to be lifted from the sensor (613). When the pen is being depressed, the user is identifying the location on the sensor where typed input should appear. Thus, once the pen is released (and the "mouse_buttons" flag (line 99 of page C66) of the mouse-based GUI is set to zero) the keystroke may be displayed (615) and the iteration of the main loop of this Figure 7 function may start again, following another check_net call (612) to determine if any remote activity needs to be reported on the local screen.

Similarly, if the user is in a drawing or erasure mode (611), the line is drawn or erasure effected (with a white fillbar) (614). An evaluation of whether the communication is being shared with the teacher (616) (if this is a student station) or with other students (618) (if this is a teacher station) results in those coordinates with destination being sent (if a mouse rather than a pen is used) to the aforementioned sent_pt function (617 and 619), which prepares them for transmission to the appropriate destination via the send_que function diagrammed in Figure 7. Whether or not the local user is sending data at the time that keyboard, writing, or erasing activity occurs locally, a check_net call is issued (612) to determine if any remote activity needs to be updated on the local screen, before the iteration begins again (606).

All of identifiers 651 through 663B, 665A, 665B, 667A, and 667B refer to lines that depict the flow of control in the drawmouse function. The function is exited (620) when there is no further local or remote mouse activity within the frame or drawing area.

Figure 7 diagrams the send_que function, as it appears beginning on line 69 of page C31 of the Microfilm Appendix. The send_que issues the Net_Send_Datagram call (page C29 of the Microfilm Appendix) that transfers packet information into a network control block ("ncb") before issuing the NetBIOS(ncb) call (line 11 of page C23 of the Microfilm Appendix) that physically transfers the ncb to a remote station.

The send_que thus manages the traffic of outgoing messages to the network. An evaluation of whether the most previous send was completed (703) is followed, upon positive result, with an evaluation of whether the sending queue is now empty. If not (754A), the packet that accompanied the call to the function is prepared for transmission. The packet is copied into a transmission packet that the aforementioned Net_Send_Datagram receives when it is called to prepare a network control block for transmission via a NetBIOS call (705). The Net_Send_Datagram call also updates the network for the next transmission (706) before the function terminated.

If the evaluation of the most recent transmission (703) shows that it is still in progress, the current packet cannot go out immediately (753A), at which point its identifier is recorded in a queue table (707), the packet is copied into the head of the queue (708) (which, in the terminology of the source code here implies that it will be the "last" out), and the appropriate queue pointer is updated (709).

If the most recent transmission is completed but the queue is not empty (754A), the new packet will still have to enter the queue rather than get sent out right away. The same instructions are followed in this case, with one noted exception: the packet identifier is stored in a queue table (712) and then the packet itself is copied into position (713), as when the packet goes into a queue while another packet is still in transmission (707 and 708). In this case, however, because the most recent transmission is completed, the packet at the "tail" of the queue (i.e., first in line to go out) is transmitted (714) and the network is reset for the next send (715). Thus, transmissions occur if requested when either there is an empty queue (754B) or when a subsequent request occurs (714).

The lines in Figure 7 depict the flow of control from one process or test within the send_que to the next. These lines are referenced by identifiers 751 through 763.

The implementation of this application may be reconstructed using the 29 source or object files identified in the SLATE.PRJ file on page H1 of the Microfilm Appendix. As SLATE.PRJ indicates, the flow of control begins with instructions in the SLATE.C file, which appears beginning on line 100 of page C49 of the Microfilm Appendix.

Figures 8A-8B diagram the activity within SLATE.C to begin the implementation. The main program appears at line 86 on page C71 of the Microfilm Appendix, and it completes the initialization (802), followed by a determination of whether the input device is a mouse or pen (803). Thus, the implementation may be reconstructed using a mouse instead of a pen. When the pen is used (853B), the mouse is disabled (821). Next, the environment for the application is setup by activities 804 through 809. This application requires extensive video paging which can be implemented in primary storage (804). Other initialization activities include clearing the screen (805), getting the working directory (806), setting up the serial handshake for communication with the pen or mouse (807, on line 8 of page C72 of the Microfilm Appendix), creating the menu that appears at both teacher and student stations (lines 15-26 on page C72 of the Microfilm Appendix), and creating the student-teacher interaction drop-down menus (809) that appear at both teacher and student stations (line 28 of the same page). Next, menu options that are specific to the teacher (822) or student (811) are defined after evaluation of the flag indicates whether the user is a teacher (810). This application anticipates the implementation of a set of auxiliary drawing tools, not unlike commonly available computer graphic paint programs, but also including other features such as a calculator that may be called up into the display. The SLATE.C program creates the common tools menu and defines the available options in (812). Off-page connector 823A continues by repeating the process for the general menu, namely creating teacher-specific (824) or student-specific options depending on the type of user (815). The title bar for the menus is created (816) as is

a trash can icon (817). The "click areas" that define what events occur when a given spot on the screen is touched by the pen (or mouse, when a button is depressed) are then initialized (818). Finally, the icons appearing in Figure 1 (111) that correspond to student desks, are displayed (825) at the teacher's station after the program determines that the user is a teacher (819).

The lines in Figures 8A-8B depict the flow of control from one process or test within the SLATE.C modules to the next. These lines are referenced by identifiers 851 through 871.

After the foregoing initialization of GUI, the program then transfers control to the GUI manager, called the "teglsupervisor." The GUI manager effectively updates the screen through the activities diagrammed in Figure 3B, as the screen is modified by the three concurrent and interrupt-driven communication systems of Figure 3A.

The foregoing specification describes only the preferred embodiment of the invention as shown. Other embodiments besides the one described above may be articulated as well. The terms and expressions therefore serve only to describe the invention by example only and not to limit the invention. It is expected that others will perceive differences which while differing from the foregoing, do not depart from the spirit and scope of the invention herein described and claimed.

TABLE 1
C routines and Source File Names (in CAPS)
Referenced to and Ordered By Microfilm Page Number

DEBUGUNT.C 1
showcoordinates 1
RotateStackImage 1
showbuttonstatus 1
EGAGRAPH.C 2
xorcornerbox 3
xorbox 3
setapage 3
setvpage 3
videopage 3
flipapage 3
flipvpage 3
abort_msg 4
setgraphicmode 4
vga640x480x16 4
ega640x350x16 4
egagraph_terminateexit 4
init_egagraph 4
EGAMOUSE.C 4
key 7
setshiftkeys 7
deletecapturekey 7
addcapturekey 7
teglreadkey 7
teglkeypressed 8
setmousehotspot 8
getmousesensitivity 8
setmousesensitivity 8
hidemouse 8
setmouseposition 8
cursorshape 8
showmouse 9
mouseposition 9
kbmouse 9
getbuttonpressinfo 12
getbuttonreleaseinfo 12
clearbuttoninfo 12
setmousecolor 13
controlbreakhandler 13
timerhandler 13
egamouse_terminateexit 13
checkparameters 13
timerswitch 14
swaptimerout 14
swaptimerin 14
swapegamouseoff 14
swapegamouseon 14
settimerstart 14
droptimercount 14
resettimerflag 15
setkeyboardmouse 15
setkbsteps 15
getkbsteps 15
setmouseminmax 15
frozenmouse 15
switch_t 15
ega_overlap 15
overlaps 16
freezemouse 16
unfreezemouse 16
init_egamouse 16
EMS.C 16
EMSPagesAvailable 17
AllocateExpandedMemoryPages 17
MapExpandedMemoryPages 17
GetPageFrameBaseAddress 17
DeallocateExpandedMemoryPages ... 17
GetVersionNumber 17
GetHandleCountUsed 17
GetPagesOwnedByHandle 18
EMSDRIVE.C 18
emsseek 18
emsblockwrite 19
emsblockread 19
emsclose 20
FONTTEST.C 20
closefontwindow 20
fontname 20
selectfont 20
createfontwindow 21
showonefont 22
showfonts 22
HEAPMEM.C 22
initheap 22
cgetmem 22
cmaxavail 23
showfreelist 23
fgetmem 24
cfreemem 24
LCCIO.C 25
LCFLSH.C 25
LCSETUP.C 25
NETBIOS.C 25
check_phys 25
adjust_name 25
fill_str 25
Net_Reset 25
Net_Cancel 25
Net_Adapter_Status 26
Net_Identify 26
Net_Trace 26
Net_Presence_Test 26
Net_Add_Name 26
Net_Add_Group_Name 26
Net_Del_Name 26
Net_Find_Name 27

TABLE 1
C routines and Source File Names (in CAPS)
Referenced to and Ordered By Microfilm Page Number

Net_Call 27
Net_Listen 27
Net_Hang_Up 27
Net_Send 27
Net_Chain_Send 28
Net_Incomplete_Send 28
Net_Receive 28
Net_Chain_Receive 28
Net_Receive_Any 28
Net_Status 28
Net_Send_Datagram 29
Net_Low_Overhead_Datagram 29
Net_Send_Broadcast_Datagram 29
Net_Receive_Datagram 29
Net_Receive_Broadcast_Datagrm ... 29
NETSTUFF.C 30
addto_sessionlist 30
listen_int 30
rec_int 31
interrupt send_int 31
read_que 31
send_que 31
send_pt 32
send_key 32
send_erase 32
send_screen 32
receive_screen 32
click_student 33
close_all_sessions 33
init_net 33
close_net 34
PEN_ROUT.C 35
int_getxy 35
setup_pen_int 37
close_pen_int 37
init_table 37
comm_gets 37
comm_puts 38
lc_getwait 38
pen_speed 38
set_pen 38
wait_ok 38
calibrate_left 38
calibrate_right 39
swapcommon 39
swapcommoff 39
SELECTFL.C 39
insert 40
addlistentry 40
getnumberoflogicaldrives 40
getfilelist 40
freefilelist 41
barline 41
editstring 41
listfilenames 43
showdirectorylist 44
updir 44
SENSEMS.C 47
setmousesense 48
SLATE.C 49
editchar 50
debug_info 53
beep 53
add_to_queue 53
drop_from_queue 54
clear_queue 54
find_entry 54
find_in_queue 54
print_name 54
update_name 55
drop_name 55
trunc_eraser 55
within 55
fontnum 56
askforhelp 57
viewoptiontoggle 57
toggle_copy 57
trashevent 57
fileselectionoption 58
definelongbutton 58
new_drawing 58
display 59
read_screen 59
sgetc 60
sgetw 60
save_screen 60
restore_screen 61
save_drawing 62
load_drawing 63
distrib_stud 63
distrib_every 63
deskoption 63
remove_menu 64
font_select 64
eraser_size 65
set_eraser 65
set_keyboard 65
calibrate 66
drawmouse 66
drop_fromlist 67
select_icon 67
add_to_drawlist 67
store_drawing 68
close_drawing 68
clear_pad 68
exitoption 68

TABLE 1
C routines and Source File Names (in CAPS)
Referenced to and Ordered By Microfilm Page Number

infooption 68
checknet 69
list_students 70
initialize 71
main 71
TEGL.C 74
clockupdate1 74
clockupdate2 74
viewoptiontoggle 75
creditbox 75
fileselectionoption 75
menumouseposition 76
askmousesense 76
calldosexec 76
creditoption 76
trashevent 77
trashoption 77
exitoption 78
infooption 78
main 78
TEGLGRPH.C 80
drawlongbutton 80
setshadowcolor 81
setshadowbordercolor 81
setshadowfillpattern 81
setshadowfillstyle 81
shadowbox 81
setshadowtexttype 81
setshadowtextshadow 81
setshadowtexthighlight 81
shadowtexthighlightoff 81
shadowtext 81
shadowboxtext 82
setteglbordershow 82
setteglbackcolor 82
setteglbordercolor 82
setteglfillpattern 82
setteglfillstyle 82
clearteglscreen 82
movebox 83
transformbox 83
ziptobox 84
zipfrombox 84
TEGLICON.C 84
TEGLMENU.C 97
positionmenu 97
togglecheckmark 97
toggleentrystatus 97
createoptionmenu 98
defineoptions 98
resizeoptionmenu 98
replaceoptiontext 99
listoptionmenu 99
setoptionmenubordercolor 102
setoptionmenucolors 102
baroptionmenu 102
resetoptionmenuevents 103
defineoptionclickarea 103
createbarmenu 104
outbaroption 104
setbarmenucolor 104
setbartextcolor 104
setbarbordercolor 104
setbarborderoff 104
setbarfillstyle 104
setbarshadowtext 105
TEGLUNIT.C 105
keybrdnextclick 105
crclickpress 106
crclickrelease 106
pageoutstatus 107
pageoutfs 107
pageoutimagestack 107
pageinfs 108
useimage 108
unuseimage 108
unlockimage 108
setimagecoordinates 108
putpartialimage 108
getpartialimage 108
linkfs 109
linkunderfs 109
unlinkfs 109
switcht 109
overlap 109
overlaparea 110
insertneworerlap 110
mergepartialimage 112
preparepartialimage 112
pushimage 112
popimage 112
prepareforpartialupdate 113
prepareforupdate 113
prepareupdatemsclick 113
commitupdate 113
commitimageupdate 113
hideimage 113
showimage 114
rotatestackimage 114
rotateunderstackimage 114
moveframe 115
setmoverestrictions 116
setframemobility 116
setmoveframecallproc 116
movestackimage 116
dropstackimage 116

TABLE 1
C routines and Source File Names (in CAPS)
Referenced to and Ordered By Microfilm Page Number

createimagebuffer 116
freeimagebuffer 117
dropimagebuffer 117
commitimageupdate 117
getfrontimage 118
getfsimage 118
clearkeyboardbuf 118
resetmouseclicks 118
resetmsclicksense 119
resetmsclickcallproc 119
resetmsclickactive 119
definemouseclickarea 119
defineglobalkeyclickarea 119
definelocalkeyclickarea 120
dropkeyclick 120
resetkeyclickcallproc 121
cursorblock 121
toggleoptionbar 121
pressbutton 121
visualbuttonpress 122
checkctrlbreak 123
selectmenu 123
teglsupervisor 124
setctrlbreakfs 124
settimertick 124
droptimertick 124
memoryerrormessage 124
abortdiskerror 125
init_teglunit 125
TEGLWRT.C 125
setproportional 125
delete 125
teglitextwidth 126
outteglitextxy 126
VIRTDSK.C 127
vdskshowfreelist 127
checksum 127
vdskseek 127
vdskblockread 127
vdskblockwrite 128
vdskgetmem 128
vdskfreemem 129
vdskreadheapdata 129
vdskwriteheapdata 130
vdskcloseheapfile 130
VIRTMEM.C 132
freevirtual 132
movefromvirtual 132
disksize 132
movetovirtual 133

TABLE 2
Alphabetized C routines and Source File Names (in CAPS)
Referenced to Microfilm Page Number

abortdiskerror 125
abort_msg 4
addcapturekey 7
addlistentry 40
addto_sessionlist 30
add_to_drawlist 67
add_to_queue 53
adjust_name 25
AllocateExpandedMemoryPages 17
askforhelp 57
askmousesense 76
barline 41
baroptionmenu 102
beep 53
calibrate 66
calibrate_left 38
calibrate_right 39
calldosexec 76
cfreemem 24
cgetmem 22
checkctrlbreak 123
checknet 69
checkparameters 13
checksum 127
check_phys 25
clearbuttoninfo 12
clearkeyboardbuf 118
clearteglscreen 82
clear_pad 68
clear_queue 54
click_student 33
clockupdate1 74
clockupdate2 74
closefontwindow 20
close_all_sessions 33
close_drawing 68
close_net 34
close_pen_int 37
cmaxavail 23
commitimageupdate 113
commitimageupdate 117
commitupdate 113
comm_gets 37
comm_puts 38
controlbreakhandler 13
crclickpress 106
crclickrelease 106
createbarmenu 104
createfontwindow 21
createimagebuffer 116
createoptionmenu 98
creditbox 75
creditoption 76
cursorblock 121
cursorshape 8
DeallocateExpandedMemoryPages ... 17
DEBUGUNT.C 1
debug_info 53
defineglobalkeyclickarea 119
definelocalkeyclickarea 120
definelongbutton 58
definemouseclickarea 119
defineoptionclickarea 103
defineoptions 98
delete 125
deletecapturekey 7
deskoption 63
disksize 132
display 59
distrib_every 63
distrib_stud 63
drawlongbutton 80
drawmouse 66
dropimagebuffer 117
dropkeyclick 120
dropstackimage 116
droptimercount 14
droptimertick 124
drop_fromlist 67
drop_from_queue 54
drop_name 55
editchar 50
editstring 41
ega640x350x16 4
EGAGRAPH.C 2
egagraph_terminateexit 4
EGAMOUSE.C 4
egamouse_terminateexit 13
ega_overlap 15
EMS.C 16
emsblockread 19
emsblockwrite 19
emsclose 20
EMSDRIVE.C 18
EMSPagesAvailable 17
emsseek 18
eraser_size 65
exitoption 68
exitoption 78
fgetmem 24
fileselectionoption 58
fileselectionoption 75
fill_str 25
find_entry 54
find_in_queue 54
flipapage 3

TABLE 2
Alphabetized C routines and Source File Names (in CAPS)
Referenced to Microfilm Page Number

flipvpage 3
fontname 20
fontnum 56
FONTTEST.C 20
font_select 64
freefilelist 41
freeimagebuffer 117
freevirtual 132
freezemouse 16
frozenmouse 15
getbuttonpressinfo 12
getbuttonreleaseinfo 12
getfilelist 40
getfrontimage 118
getfsimage 118
GetHandleCountUsed 17
getkbsteps 15
getmousesensitivity 8
getnumberoflogicaldrives 40
GetPageFrameBaseAddress 17
GetPagesOwnedByHandle 18
getpartialimage 108
GetVersionNumber 17
HEAPMEM.C 22
hideimage 113
hidemouse 8
infooption 68
infooption 78
initheap 22
initialize 71
init_egagraph 4
init_egamouse 16
init_net 33
init_table 37
init_teglunit 125
insert 40
insertnewoverlap 110
interrupt send_int 31
int_getxy 35
kbmouse 9
key 7
keybrdnextclick 105
LCCIO.C 25
LCFLSH.C 25
LCSETUP.C 25
lc_getwait 38
linkfs 109
linkunderfs 109
listen_int 30
listfilenames 43
listoptionmenu 99
list_students 70
load_drawing 63
main 71
main 78
MapExpandedMemoryPages 17
memoryerrormessage 124
menumouseposition 76
mergepartialimage 112
mouseposition 9
movebox 83
moveframe 115
movefromvirtual 132
movestackimage 116
movetovirtual 133
NETBIOS.C 25
NETSTUFF.C 30
Net_Adapter_Status 26
Net_Add_Group_Name 26
Net_Add_Name 26
Net_Call 27
Net_Cancel 25
Net_Chain_Receive 28
Net_Chain_Send 28
Net_Del_Name 26
Net_Find_Name 27
Net_Hang_Up 27
Net_Identify 26
Net_Incomplete_Send 28
Net_Listen 27
Net_Low_Overhead_Datagram 29
Net_Presence_Test 26
Net_Receive 28
Net_Receive_Any 28
Net_Receive_Broadcast_Datagrm 29
Net_Receive_Datagram 29
Net_Reset 25
Net_Send 27
Net_Send_Broadcast_Datagram 29
Net_Send_Datagram 29
Net_Status 28
Net_Trace 26
new_drawing 58
outbaroption 104
outtegltextxy 126
overlap 109
overlaparea 110
overlaps 16
pageinfs 108
pageoutfs 107
pageoutimagestack 107
pageoutstatus 107
PEN_ROUT.C 35
pen_speed 38
popimage 112
positionmenu 97

TABLE 2
Alphabetized C routines and Source File Names (in CAPS)
Referenced to Microfilm Page Number

prepareforpartialupdate 113
prepareforupdate 113
preparepartialimage 112
prepareupdatemsclick 113
pressbutton 121
print_name 54
pushimage 112
putpartialimage 108
read_que 31
read_screen 59
receive_screen 32
rec_int 31
remove_menu 64
replaceoptiontext 99
resetkeyclickcallproc 121
resetmouseclicks 118
resetmsclickactive 119
resetmsclickcallproc 119
resetmsclicksense 119
resetoptionmenuevents 103
resettimerflag 15
resizeoptionmenu 98
restore_screen 61
RotateStackImage 1
rotatestackimage 114
rotateunderstackimage 114
save_drawing 62
save_screen 60
SELECTFL.C 39
selectfont 20
selectmenu 123
select_icon 67
send_erase 32
send_key 32
send_pt 32
send_que 31
send_screen 32
SENSEMS.C 47
setapage 3
setbarbordercolor 104
setbarborderoff 104
setbarfillstyle 104
setbarmenucolor 104
setbarshadowtext 105
setbartextcolor 104
setctrlbreakfs 124
setframemobility 116
setgraphicmode 4
setimagecoordinates 108
setkbsteps 15
setkeyboardmouse 15
setmousecolor 13
setmousehotspot 8
setmouseminmax 15
setmouseposition 8
setmousesense 48
setmousesensitivity 8
setmoveframecallproc 116
setmoverestrictions 116
setoptionmenubordercolor 102
setoptionmenucolors 102
setproportional 125
setshadowbordercolor 81
setshadowcolor 81
setshadowfillpattern 81
setshadowfillstyle 81
setshadowtexthighlight 81
setshadowtextshadow 81
setshadowtexttype 81
setshiftkeys 7
setteglbackcolor 82
setteglbordercolor 82
setteglbordershow 82
setteglfillpattern 82
setteglfillstyle 82
settimerstart 14
settimertick 124
setup_pen_int 37
setvpage 3
set_eraser 65
set_keyboard 65
set_pen 38
sgetc 60
sgetw 60
shadowbox 81
shadowboxtext 82
shadowtext 81
shadowtexthighlightoff 81
showbuttonstatus 1
showcoordinates 1
showdirectorylist 44
showfonts 22
showfreelist 23
showimage 114
showmouse 9
showonefont 22
SLATE.C 49
store_drawing 68
swapcommoff 39
swapcommon 39
swapegamouseoff 14
swapegamouseon 14
swaptimerin 14
swaptimerout 14
switcht 109
switch_t 15

TABLE 2
Alphabetized C routines and Source File Names (in CAPS)
Referenced to Microfilm Page Number

TEGL.C 74
TEGLGRPH.C 80
TEGLICON.C 84
teglkeypressed 8
TEGLMENU.C 97
teglreadkey 7
teglsupervisor 124
tegltextwidth 126
TEGLUNIT.C 105
TEGLWRT.C 125
timerhandler 13
timerswitch 14
togglecheckmark 97
toggleentrystatus 97
toggleoptionbar 121
toggle_copy 57
transformbox 83
trashevent 57
trashevent 77
trashoption 77
trunc_eraser 55
unfreezemouse 16
unlinkfs 109
unlockimage 108
unuseimage 108
update_name 55
updir 44
useimage 108
vdskblockread 127
vdskblockwrite 128
vdskcloseheapfile 130
vdskfreemem 129
vdskgetmem 128
vdskreadheapdata 129
vdskseek 127
vdskshowfreelist 127
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ABSTRACT

A computer assisted instructional information delivery system having at least two stations. One station for an instructor and one or more stations for students. An interactive monitor is positioned in each station. Each interactive monitor displays instructional information in visual form as inputted by a stylus or light pen on the interactive monitor. A network communication system operated by a central processing unit and corresponding software, communicates the instructional information from the stylus as inputted on one of the interactive monitors and selectively displays the instructional information simultaneously and concurrently onto any or all of the interactive monitors of the stations.

DAB:A:50841.008 May 20, 1992

COMMR:

BOX AF

- PATENT APPLICATION -
- Atty. Dkt. No. 0867/50841 -

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Eric R. Hamilton

Title: COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM

Serial No.: 07/510,141

Filed: April 17, 1990

rt Unit: 3302

Examiner: D. Crosby

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on this date.

Robert Smith

Date
MAY 20, 1992

Express Mail Label No.
TB086122575US

AMENDMENT TRANSMITTAL

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Transmitted herewith in the above-identified application is:

(X) Amendment B After Final Rejection.

( ) No additional fee is required.

Fee Calculation for Claims as Amended

	As Amended	Previously Paid for	Extra Present	Rate	Additional Fee
Total Claims	40	32	= 8	x $ 20.00 =	$ 160.00
Independent Claims	4	4	= 0	x $ 60.00 =	$ 0.00
Multiple Dependent Fee				x $200.00 =	$ 0.00
				Total Additional Fee	$ 160.00
(X) Small Entity (reduce fee by half)					$ 80.00

(X) A check in the amount of $ 80.00 to cover the additional fee.

( ) Charge $_____ to Deposit Account No. 23-0920.

(X) The Commissioner is hereby authorized to charge any additional fees which may be required to this application under 37 CFR §§1.16-1.17, or credit any overpayment, to Deposit Account No. 23-0920. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 23-0920. A duplicate copy of this sheet is enclosed.

Date: 5/20/92

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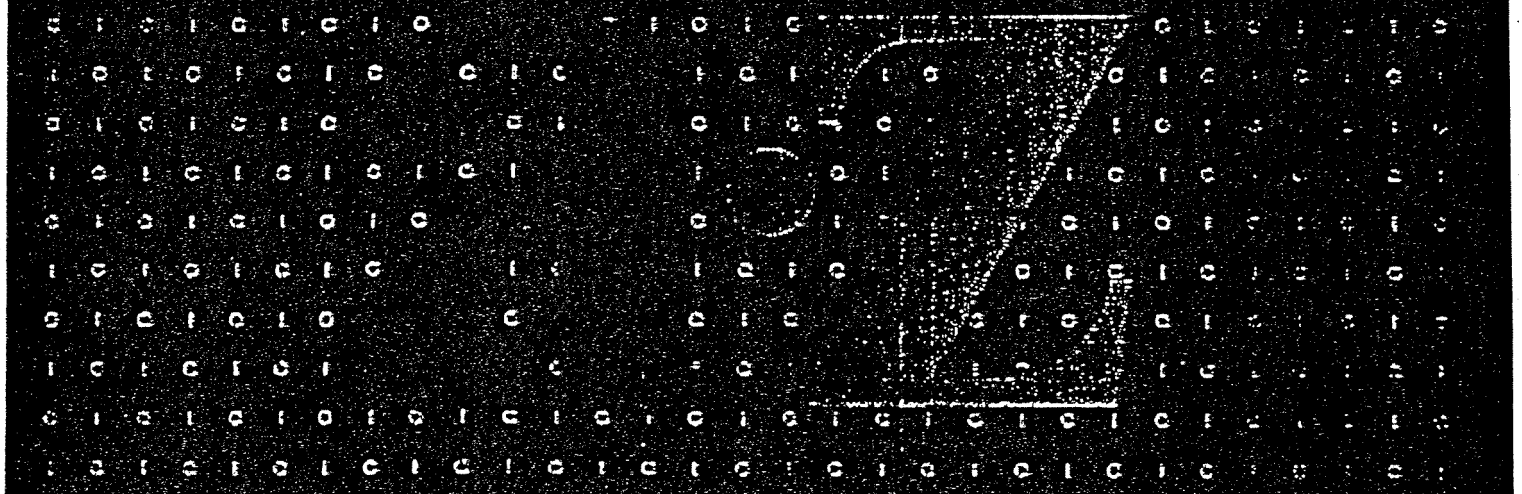
EXHIBIT F

IBM

Dictionary of Computing

Information Processing, Personal Computing, Telecommunications, Office Systems, IBM-specific Terms



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IBM

Dictionary of Computing

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Eighth Edition (March 1987)

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This publication was produced using the IBM Document Composition Facility (program number 5748-XX9).

continuous-form paper into discrete sheets. (A) *3.* See error burst.

burster A device to detach from one another previously-perforated forms or formsets of continuous stationery. (T)

burster-trimmer-stacker (BTS) A printer feature that bursts continuous forms into separate sheets, trims the carrier strip from both edges of the forms, and stacks single sheets. See also job offset.

burst isochronous transmission Synonym for burst transmission.

burst mode A mode in which data is transmitted by means of burst transmission.

burst noise In acoustics, noise characterized by acoustic impulses that significantly exceed the level of ambient noise.

burst transmission *1.* Data transmission at a specific data signalling rate during controlled intermittent intervals. (I) (A) *2.* Synonymous with burst isochronous transmission, interrupted isochronous transmission.

bus *1.* In a processor, a physical facility on which data is transferred to all destinations, but from which only addressed destinations may read in accordance with appropriate conventions. (I) *2.* A computer configuration in which processors are interconnected in series. See also hypercube. *3.* One or more conductors used for transmitting signals or power. (A) *4.* See bidirectional bus, control bus, data bus. *5.* See also bus network.

business graphics See graphics.

business graphics utility (BGU) An IBM-supplied OFFICE/38 utility that provides a menu-driven means of using the System/38 chart functions without knowledge of programming.

business machine *1.* A machine designed to facilitate clerical operations in commercial or scientific activities. *2.* Customer-provided data terminal equipment (DTE) that connects to telecommunication equipment of a communication common carrier, a Recognized Private Operating Agency, or a telecommunication Administration, for the purpose of data transfer. See also COAM equipment.

business machine clocking A time base oscillator supplied by the business machine for regulating the bit rate of transmission. Synonymous with non-data-set clocking. Contrast with data set clocking.

bus network *1.* A network configuration that provides a bidirectional transmission facility to which all nodes are attached. A sending node transmits in both directions to the ends of the bus. All nodes in the path copy the message as it passes. *2.* A local area network in which there is only one path between any two data stations and in which data transmitted by any station is concurrently available to all other stations on the same transmission medium.
Note: A bus network may be a multipoint network, star network, or tree network. In the case of a tree or star network, there is a data station at each endpoint node. There is no data station at an intermediate node, but one or more devices such as repeaters, connectors, amplifiers, and splitters are located there.

bussback The connection by a common carrier of the output portion of a circuit back to the input portion of a circuit. See also loopback test.

bust this A phrase used instead of a normal message ending to indicate that the entire message, including heading, is to be disregarded. See also CANTRAN.

busy test A test to determine whether telephone circuits are available for use.

busy token Deprecated term for frame (7).

bypass *1.* To eliminate a station or an access unit from a ring network by allowing the data to flow in a path around it. *2.* At an 8100 loop wiring concentrator, to manually disconnect a radial cable and the associated device from the loop signal flow path without physically removing the radial cable and the device. See also lobe bypass, wrapping.

byte *1.* A binary character operated on as a unit and usually shorter than a computer word. (A) *2.* String consisting of a certain number of bits, usually eight, treated as a unit, and representing a character. *3.* A group of eight adjacent binary digits representing one EBCDIC character. *4.* See n-bit byte.

byte mode Synonym for multiplex mode.

byte multiplexer channel A multiplexer channel that interleaves bytes of data. See also block multiplexer channel. Contrast with selector channel.

byte multiplexer mode A data transfer mode that permits interleaving of bytes of data. Contrast with block multiplexer mode.

byte-serial transmission Transmission in sequential bytes.
Note: The individual bits of each byte can be transmitted serially (described as serial by bit and byte) or simultaneously (described as parallel by bit, serial by byte).

byte space In VSAM, the ascending set of logical addresses (0 through $2^{32}-1$) in which a component exists; a byte space contains only one component, and a component exists in only one byte space.

intercepting trunk A trunk to which a call for a vacant number or changed number or a line out of order is connected for action by an operator.

intercept operator In intercepting, the operator who requests the number called, determines the reason for the intercept, and relays the information to the calling party.

interchange See information interchange.

interchange code See binary-coded decimal interchange code. See also ASCII, EBCDIC.

interchange group separator (IGS) In System/36, a character used to indicate that blanks have been removed from a string of data and are to be reinserted.

interchange record separator (IRS) Same as record separator.

intercharacter increment In printing, the space between character boxes.

intercharacter space Horizontal space between two adjacent capital letter matrices. See also interline space.
Note: Intercharacter space can be occupied by portions of oversized symbols.

intercommunicating system A privately owned system without a switchboard, capable of two-way communication, normally limited to a single unit, building, or plant. Stations may or may not be equipped for originating a call, but they can answer any call.

interexchange channel A channel connecting two different exchange areas.

interface *1.* A shared boundary between two functional units, defined by functional characteristics, common physical interconnection characteristics, signal characteristics, and other characteristics as appropriate. (I) *2.* A shared boundary. An interface may be a hardware component to link two devices or a portion of storage or registers accessed by two or more computer programs. (A) *3.* Hardware, software, or both, that links systems, programs, or devices. *4.* See data transmission interface, EXCP interface, physical interface, user interface.
Note: The concept involves specification of the connection of two functional units that have different functions.

interface processor A processor that acts as the interface between another processor or terminal and a network, or a processor that controls data flow in a network. (T)

interframe time-fill In data communication, the sequence of flag sequences transmitted between frames.

interior/exterior box A cable termination and lightning protection device used in loop installations that have outdoor cabling.

interleave To arrange parts of one sequence of things or events so that they alternate with parts of one or more other sequences of the same nature and so that each sequence retains its identity. (I) (A)

interleaved subscripts A subscript notation, used with subscripted qualified names, in which not all of the necessary subscripts immediately follow the same component name.

interleaving *1.* The simultaneous accessing of two or more bytes or streams of data from distinct storage units. *2.* The alternating of two or more operations or functions through the overlapped use of a computer facility. *3.* In a duplicator, the process of inserting absorbent sheets between successive sheets of the copy paper to prevent setoff. (T)

interline space On a display screen, the space between the lower print line of a row of capital letter matrices and the upper print line of the next lower row of capital letter matrices. See also intercharacter space.
Note: Interline space can be occupied by cursors, descenders, diacritical marks, intercharacter space, portions of oversized symbols, and underlines.

interlock To prevent a machine or device from initiating further operations until an operation in process is completed. See also deadlock.

intermediate In document copying, synonym for master. (T)

intermediate block check In binary synchronous communication, a check of each record in a block, rather than the contents of the complete buffer, when large blocks of text are received.

intermediate-block-check character (ITB) See intermediate-text-block character (ITB).

intermediate distributing frame (IDF) In a local central office, a distributing frame that connects subscriber lines to the subscriber line circuit. In a private branch exchange, its purpose is similar.

intermediate equipment Auxiliary equipment that may be inserted between data terminal equipment and signal conversion equipment to perform certain additional functions before modulation or after demodulation. (I) (A)

intermediate host node In ACF/TCAM, a host node on an extended route that processes messages flowing

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EXAMINER 08/24/92

ART UNIT | PAPER NUMBER
180

DATE MAILED:

NOTICE OF ALLOWABILITY

PART I.

1. ☑ This communication is responsive to The Amendment filed on May 20, 1992.
2. ☑ All the claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice Of Allowance And Issue Fee Due or other appropriate communication will be sent in due course.
3. ☑ The allowed claims are 1-5, 7-25 and 27-41.
4. ☑ The drawings filed on May 20, 1992 are acceptable.
5. ☐ Acknowledgment is made of the claim for priority under 35 U.S.C. 119. The certified copy has [_] been received. [_] not been received. [_] been filed in parent application Serial No. _____, filed on _____
6. ☑ Note the attached Examiner's Amendment.
7. ☑ Note the attached Examiner Interview Summary Record, PTOL-413.
8. ☑ Note the attached Examiner's Statement of Reasons for Allowance.
9. ☑ Note the attached NOTICE OF REFERENCES CITED, PTO-892.
10. ☑ Note the attached INFORMATION DISCLOSURE CITATION, PTO-1449.

PART II.

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE THREE MONTHS FROM THE "DATE MAILED" indicated on this form. Failure to timely comply will result in the ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

1. ☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.
2. ☐ APPLICANT MUST MAKE THE DRAWING CHANGES INDICATED BELOW IN THE MANNER SET FORTH ON THE REVERSE SIDE OF THIS PAPER.
   a. ☐ Drawing informalities are indicated on the NOTICE RE PATENT DRAWINGS, PTO-948, attached hereto or to Paper No. ____. CORRECTION IS REQUIRED.
   b. ☐ The proposed drawing correction filed on _____ has been approved by the examiner. CORRECTION IS REQUIRED.
   c. ☐ Approved drawing corrections are described by the examiner in the attached EXAMINER'S AMENDMENT. CORRECTION IS REQUIRED.
   d. ☐ Formal drawings are now REQUIRED.

Any response to this letter should include in the upper right hand corner, the following information from the NOTICE OF ALLOWANCE AND ISSUE FEE DUE: ISSUE BATCH NUMBER, DATE OF THE NOTICE OF ALLOWANCE, AND SERIAL NUMBER.

Attachments:

- ✓ Examiner's Amendment
- ✓ Examiner Interview Summary Record, PTOL-413
- ✓ Reasons for Allowance
- ✓ Notice of References Cited, PTO-892
- ✓ Information Disclosure Citation, PTO-1449
- Notice of Informal Application, PTO-152
- Notice re Patent Drawings, PTO-948
- Listing of Bonded Draftsmen
- Other

PTOL-37 (REV. 11-88)

USCOMM-DC 89-3615

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PAGE 1

1. An Examiner's Amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 C.F.R. § 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the Issue Fee.

In the specification:

Change the Title to "COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM AND METHOD".

Page 40, line 13, after "simultaneously" insert --and concurrently--.

In the claims:

Rewrite claim 1 as following:

C-1 (Amended) A computer assisted electronic educational information communication system, comprising:

at least two stations;

at least two monitor means, one associated with each of said [two] stations, for displaying electronic educational information in visual form;

at least two input means, one associated with each of said [two] stations, for simultaneously and concurrently entering said [electronic] information in handwritten freehand form from each of said stations and to display on at least its associated monitor means; and

communication means for virtually simultaneously and concurrently transmitting said [electronic] information being entered simultaneously and concurrently at either of said [two]

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input means from either station to other station, and for enabling the virtually simultaneous and concurrent display of said transmitted information on both of said monitor means associated with both of said stations such that [electronic] said information being entered at a first input means simultaneously and concurrently appears on [both] all of said monitor means [at substantially the same time] while under the independent control of said first input means.

Claim 2, line 2, change "one or more" to --the other--.

Rewrite claims 4 and 8-11 as following:

--4.(Amended) The system of claim 2, wherein said communication means selectively affords said instructor's station to selectively view said [electronic] information displayed at [any of] said monitor means [at] on any of said student's stations virtually simultaneously and concurrently to the time said information is being handwritten at said student's stations.

--8.(Amended) A computer assisted electronic educational information communication system, comprising:

at least two stations, each of said stations having:

at least one monitor having a display surface on which an image appears;

input means for inputting electronic educational information in graphic form into said monitor by a user drawing or written directly on said display surface;

peripheral interface means for simultaneously and concurrently accepting said [electronic] information from said input means and for simultaneously and concurrently providing image information to said monitor; and

central processing unit means for controlling said peripheral interface means; and

[said electronic information communication system further comprising:]

communication network means for simultaneously and concurrently communicating said information in real time between the peripheral interface means of each of said [two] stations in order to virtually simultaneously and concurrently display the [electronic] information being input independently and simultaneously and concurrently by said input means at either of said [two] stations such that [substantially the same] said image information is simultaneously and concurrently displayed on the monitors of [both] all of said stations [at virtually the same time] and such that each user has independent control of that portion of the image information drawn or written by that user.

~~9~~ 14. (Amended) The system of claim ~~8~~ 13, wherein said [system is] stations are comprised of more than two stations, and wherein the same image information is virtually simultaneously and concurrently displayed on said monitors of [more than two] said stations as it is being simultaneously and concurrently input at

any of said stations.

--~~10~~ 15. (Amended) The system of claim ~~8~~ 13, wherein one of said [two] stations is adapted for an instructor and [one] the other of said [two] stations is adapted for [one or more] students.

--~~11~~ 16. (Amended) The system of claim ~~10~~ 15, wherein said instructor's station selectively, simultaneously and concurrently controls the display of the [electronic] information on said monitors of said student's station.

Rewrite claims 15 and 16 as following:

--~~15~~ 18. (Amended) The system of claim ~~12~~ 17, wherein said handwritten or hand-drawn information inputted via said input means is selectively, simultaneously and concurrently [and simultaneously] displayed on said monitors of [more than two] any of said stations.

--~~16~~ 24. (Amended) An instructional information system for use in an educational classroom, said system comprising:

at least two remotely-located user stations in which one [station] of said stations is an instructor station and [one or more] the other of said stations are student stations, said instructor station including means for controlling said instructional information system;

interactive monitor means, located in each of said [user] stations, for simultaneously and concurrently [visually] displaying instructional information to the user of that station

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and for simultaneously and concurrently accepting handwritten [freehand inputted] instructional information inputted from the user of that station; and

network communication means, connected to each [user station] of said stations, for simultaneously and concurrently communicating said inputted and displayed instructional information between said interactive monitor means of all [user] of said stations, said network communication means controlled by said instructor station controlling means to selectively and simultaneously and concurrently display instructional information input and displayed at said instructor's station on said interactive monitor means of any of said student stations [at] virtually simultaneously and concurrently [the same time as] and without interfering with the control of inputted instructional information being accepted from the user of that student station.

Claim 18, line 3, after "storing" insert --said instructional--.

Rewrite claims 19, 20 and 22 as following:

--19.(Amended) The system of claim 18, wherein said instructor station controlling means may selectively and simultaneously and concurrently control the display of said instructional information input at said instructor station on said interactive monitor means of any [number] of said student stations.

--~~20~~ 28. (Amended) The system of claim ~~16~~ 24, wherein said simultaneous and concurrent visual display of and input acceptance of said instructional information by said interactive monitor means simulates an electronic sheet of paper which [may be] is simultaneously and concurrently communicated and interactively shared in real time between the user at said instructor station and student stations.

--~~22~~ 29. (Amended) The system of claim ~~21~~ 28, wherein said [system includes] stations include more than two remotely-located stations, and wherein said [system further includes] input means include more than two input means for simultaneously and concurrently entering said handwritten information in freehand form from said more than two stations [at substantially the same time].

Claim 23, line 3, change "virtually simultaneously transmit" to --virtually simultaneously and concurrently transmit said--;

line 4, delete "educational".

Cancel claim 26.

Rewrite claims 27-29 as following:

--~~27~~ 30. (Amended) A method for providing educational information from a first station to a second remotely-located station of a computer assisted communication system, each of said first and second stations having an input device for directly inputting hand-drawn graphical educational information from a

user of that station, and having a display monitor for displaying an image of said graphical educational information to the user of that station, the communication system including a computer network for virtually simultaneously and concurrently transferring said graphical educational information between said first and second stations [at virtually the same time] as it is being input, the method comprising the steps of:

inputting primary hand-drawn graphical educational information into said system by a user at said first station;

simultaneously and concurrently displaying an image of said primary information to the user of said first station [at virtually the same time] as it is being input by the user of said first station;

simultaneously and concurrently transferring said primary information from said first station to said second station over said computer network;

simultaneously and concurrently displaying an image of said primary information to the user of said second station at virtually the same time as it is being input by the user of said first station;

simultaneously and concurrently inputting secondary hand-drawn graphical information into said system by a user at said second station [at the same time] as said primary [hand-drawn graphical] information is being input into said system by

the user of said first station;

simultaneously and concurrently transferring said secondary information from said second station to said first station over said computer network; and

simultaneously and concurrently displaying an image of said secondary information to the user of said first station along with said displayed image of said primary information [at virtually the same time] as said secondary information is being input by the user of said second station and with independent control of that portion of the primary or secondary information being input.

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31 ~~28~~. (Amended) The method according to claim 30 ~~27~~, wherein said computer assisted communication system further includes a third remotely-located station, and wherein the method further comprises the step of simultaneously and concurrently displaying [an] said image of said primary information to the user of said third station [at virtually the same time] as it is being input by the user of said first station.

32 ~~29~~. (Amended) The method according to claim 31 ~~28~~, further comprising the step of simultaneously and concurrently selecting between said first, second and third stations before transferring said primary information.

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Claim 32, line 4, before "sharing" insert --and concurrently--.

Claim 33, line 2, delete "image".

Claim 34, line 3, delete "electronic" and before "at" insert --and concurrently--;

line 4, delete "two".

Claim 35, line 3, delete "electronic" and before "at" insert --and concurrently--;

line 4, delete "two".

Claim 36, line 2, delete "electronic";

line 3, after "being" insert --simultaneously and concurrently--.

Claim 37, line 2, after "for" insert --simultaneously and concurrently-- and after "of" insert --said--;

line 4, change "two" to --said--;

line 6, change "at both" to --and concurrently at all--.

Claim 38, line 5, after "of" insert --said--;

line 6, before "information" insert --said instructional--;

line 7, change "entered at each" to --and concurrently transmitted from either station to the other--.

Rewrite claim 39 as following:

--39 (38). (Amended) The method according to claim 27 (30), wherein the method further comprises the step of simultaneously and concurrently storing said primary information from said first

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station in said second station [at virtually the same time that] when said secondary [hand-drawn graphical] information is being input into said system by [a] said user at said second station.

2. Authorization for this Examiner's Amendment was given in a telephone ~~interview~~ with Mr. Douglas Boehm (applicant's attorney) on ~~August 13,~~ 1992.

3. ~~The prior art made of~~ record and not relied upon is ~~considered pertinent~~ to applicant's disclosure.

Sullivan et al (U.S. Pat. No. 4,659,876) - note Fig. 1 and column 1, lines 42-48 and column 4, lines 19-42;

"The Scribophone: a graphic telecommunication system" by L. Kool, Philips Telecommunication Review, Vol. 38, No. 1, Pg. 7-10, January 1980 - note Fig. 1;

"Audiographic Terminal" by M. Laube, Electrical Communication, Vol. 60, No. 1, Pg. 45-50, ~~November 1,~~ 1986 - note the telewriting terminal on Pg. 45 and Fig. 2.

8/17/92

4. The following is an Examiner's Statement of Reasons for Allowance:

None of the prior art of record shows the apparatus and method for providing education information between at least two stations of a computer assisted communication system having simultaneously and concurrently inputting and displaying the handwritten educational information and simultaneously and

concurrently communicating from either station to the other station with independent control of the portion of the education information being input.

Any comments considered necessary by applicant must be submitted no later than the payment of the Issue Fee and, to avoid processing delays, should preferably accompany the Issue Fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

5. Any inquiry concerning this communication should be directed to Joe Cheng at telephone number (703) 308-0858.

JOE H. CHENG
EXAMINER
ART UNIT 332

Joe Cheng
August 13, 1992

RICHARD J. APLEY
SPE
ART UNIT 332

TO SEPARATE: HOLD TOP AND BOTTOM EDGES, SNAP-APART AND DISCARD CARBON

FORM PTO-892 (REV. 3-78) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	SERIAL NO.	GROUP ART UNIT	ATTACHMENT TO PAPER NUMBER	
NOTICE OF REFERENCES CITED	07/510,141	3302		18
	APPLICANT(S) HAMILTON			

U.S. PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE IF APPROPRIATE
*	A	4659876	4-1987	Sullivan et al.	379	96	
	B						
	C						
	D						
	E						
	F						
	G						
	H						
	I						
	J						
	K						

FOREIGN PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUB-CLASS	PERTINENT SHTS. DWG	PERTINENT PP. SPEC.
	L								
	M								
	N								
	O								
	P								
	Q								

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

R "The Scribophone: a graphic telecommunication system" by L. Kool, Philips Telecommunication Review, Vol. 38, No 1, Pg. 7-10, Jan. 1980.

S "Audiographic Terminal" by M. Laube, Electrical Communication, Vol. 60, No. 1, Pg. 45-50, 1986.

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U

EXAMINER	DATE
Jai Chung	8/13/92

* A copy of this reference is not being furnished with this office action. (See Manual of Patent Examining Procedure, section 707.05 (a).)

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: Box ISSUE FEE
COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

WELSH & KATZ, LTD.,
135 SOUTH LA SALLE, SUITE 1625
CHICAGO, IL 60603

NOTICE OF ALLOWANCE AND ISSUE FEE DUE

Note attached communication from the Examiner
This notice is issued in view of applicant's communication filed

SERIES CODE/SERIAL NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT		DATE MAILED
07/510,141	04/17/90	039	CHENG, J	3302	08/24/92

First Named Applicant		
HAMILTON,	ERIC R.	

TITLE OF INVENTION: COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM AND METHOD (AS AMENDED)

	ATTY. DOCKET NO.	CLASS/SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
3	303950841	434-350.000	F63	UTILITY	YES	$565.00	11/24/92

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

I. Review the SMALL ENTITY Status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:
A. If the Status is changed, pay twice the amount of the FEE DUE shown above and notify the Patent and Trademark Office of the change in status, or
B. If the Status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:
A. Pay FEE DUE shown above, or
B. File verified statement of Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

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III. All communications regarding this application must give series code (or filing date), serial number and batch number. Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees.

PATENT AND TRADEMARK OFFICE COPY

PTOL-85 (REV 12-88)(OMB Clearance is pending)

#18



- PATENT -
- Atty. Dkt. 0867/50841 -

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Eric R. Hamilton

Title: COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM AND METHOD (as amended)

Serial No.: 07/510,141

Filed: April 17, 1990

Examiner: J. Cheng

Art Unit: 3302

Batch No.: F63

CERTIFICATE OF EXPRESS MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service's "Express Mail Post Office To Addressee" service under 37 C.F.R. § 1.10 on the date indicated below and is addressed to: Honorable Commissioner of Patents and Trademarks, Box ISSUE FEE, Washington, D.C. 20231.

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DOBERT SMITH
(Printed Name)

Robert Smith
(Signature)

9/16/92
(Date of Deposit)

ISSUE FEE TRANSMITTAL

Box ISSUE FEE
Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

Enclosed herewith please find Issue Fee Transmittal Forms PTOL-85 - parts (B) and (C), along with a check in the amount of $565.00 for payment of the Issue Fee for the above-captioned patent application.

The Commissioner is hereby authorized to charge any additional fees which may be required to this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 23-0920. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 23-0920. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

WELSH & KATZ, LTD.

Date 9/14/92

By Douglas A. Boehm
Douglas A. Boehm
Attorney for Applicant
Registration No. 32,014

WELSH & KATZ, LTD.
135 South LaSalle Street
Suite 1625
Chicago, Illinois 60603
(312) 781-9470

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PART B - ISSUE FEE TRANSMITTAL

MAILING INSTRUCTIONS: This form should be us or transmitting the ISSUE FEE. Blocks 2 through 5 should be completed where appropriate. All further correspondence including the Issue Fee Receipt, the Patent, advanced orders and notification of maintenance fees will be mailed to addressee entered in Block 1 unless you direct otherwise, by: (a) specifying a new correspondence address in Block 3 below; or (b) providing the PTO with a separate "FEE ADDRESS" for maintenance fee notifications with the payment of Issue Fee or thereafter. **See reverse for Certificate of Mailing.**

1. CORRESPONDENCE ADDRESS	2. INVENTOR(S) ADDRESS CHANGE (Complete only if there is a change)
MAIL ROOM SEP 16 1992 PAT. & TRADEMARK OFF. /3	INVENTOR'S NAME
WELSH & KATZ, LTD., 135 SOUTH LA SALLE, SUITE 1625 CHICAGO, IL 60603	Street Address
	City, State and ZIP Code
	CO-INVENTOR'S NAME
	Street Address
	City, State and ZIP Code
	☐ Check if additional changes are on reverse side

SERIES CODE/SERIAL NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
07/510,141	04/17/90	039	CHENG, J 3302	09/21/92

INVENTOR(S) HAMILTON, ERIC R.

TITLE OF INVENTION: COMPUTER ASSISTED INSTRUCTIONAL DELIVERY SYSTEM AND METHOD (AS AMENDED)

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
30950841	434-350.000	F63	UTILITY	YES	$565.00	11/24/92

P 30410 10/06/92 07510141 23-0920 030 561 75.00CH

3. Further correspondence to be mailed to the following:

WELSH & KATZ, LTD.
135 South LaSalle Street, Suite 1625
Chicago, Illinois 60603

4. For printing on the patent front page, list the names of not more than 3 registered patent attorneys or agents OR alternatively, the name of a firm having as a member a registered attorney or agent. If no name is listed, no name will be printed.

1 WELSH & KATZ, LTD.
2
3

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070 AA 10/05/92 07510141 1 242 565.00 CK

5. ASSIGNMENT DATA TO BE PRINTED ON THE PATENT (print or type)

(1) NAME OF ASSIGNEE:

(2) ADDRESS: (City & State or Country)

(3) STATE OF INCORPORATION, IF ASSIGNEE IS A CORPORATION

A. ☒ This application is NOT assigned.

☐ Assignment previously submitted to the Patent and Trademark Office.

☐ Assignment is being submitted under separate cover. Assignments should be directed to Box ASSIGNMENTS.

PLEASE NOTE: Unless an assignee is identified in Block 5, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the PTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

6a. The following fees are enclosed:

☒ Issue Fee ☐ Advanced Order - # of Copies _____ (Minimum of 10)

6b. The following fees should be charged to:

DEPOSIT ACCOUNT NUMBER 23-0920 (Enclose Part C)

☐ Issue Fee ☒ Advanced Order - # of Copies 25 (Minimum of 10)

☒ Any Deficiencies in Enclosed Fees

The COMMISSIONER OF PATENTS AND TRADEMARKS is requested to apply the Issue Fee to the application identified above.

(Signature of party in interest of record)	(Date)
Douglas A. Boehm	9/14/92

NOTE: The Issue Fee will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the Patent and Trademark Office.

TRANSMIT THIS FORM WITH FEE-CERTIFICATE OF MAILING ON REVERSE

PTOL-85B (REV 12-88)(OMB Clearance is pending)

EXHIBIT G
PAGE 16

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Robert Smith
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Robert Smith
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This form is estimated to take 20 minutes to complete. Time will vary depending upon the needs of the individual applicant. Any comments on the amount of time you require to complete this form should be sent to the Office of Management and Organization, Patent and Trademark Office, Washington, D.C. 20231 and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503.

REVERSE PTOL-85B (REV 12-88)(OMB Clearance is pending)