MISSION PLANNING TABLET - A NEW CONCEPT FOR THE TRAINING INSTRUCTOR

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1. INTRODUCTION

A number of devices such as tablets, joysticks, and light-pens are presently available for the input of graphic information to a computer (1). These devices make it possible to interact very effectively with a computer program.

This report describes a specific method using one such device for data input from an instructor's console. The method allows the instructor to insert geographic mission parameters directly from a graphic data tablet. This is considerably more convenient and less time consuming than data entry through punched cards or alphanumeric teletypewriter-type keyboards.

A prototype Mission Planning Tablet has been demonstrated in the Computer Laboratory of the Naval Training Equipment Center. The tablet was utilized to draw and input preprogrammed flight paths, terrain contours, boundaries, and emitter positions directly from an Operational Navigation Chart. The tablet was utilized to draw and input preprogrammed flight paths, terrain contours, boundaries, and emitter positions directly from an Operational Navigation Chart. The format of the command language was identical to the instructor's language in Device 15E22, EA-6B Team Tactics Trainer. The capability of data input through a Mission Planning Tablet can form a part of an on-line capability to interactively construct and modify a mission or scenario.

2. BACKGROUND

The objective of the research task on Computer Generated Visual Displays for Training includes the development of improved graphic input-output techniques for future training device procurements. A computer generated display system, the IDIIOM (Information Displays Inc. Input Output Machine) has been utilized in developing in-house program designs for more effective man-machine communications. Previous work was reported in references (2) through (6).

3. STATEMENT OF THE PROBLEM

Users of Device 15E22, EA-6B Team Tactics Trainer, have identified the existence of a major problem: the large amount of time required to prepare a mission. The preparation of a single training exercise may require hundreds of hours of work on the part of the instructor.

The planning of a mission in an electronic warfare training situation is a complex and time-consuming task. Using geographic charts of the operational area, dividers, a protractor, and a straight edge the instructor will layout the mission, including mission objectives, radar/electronic order of battle, a mission timetable, significant terrain blocks, landmass features, ownship and strike group flight paths, and airborne interceptor events. The instructor will then, in some manner, insert these parameters into the trainer computing system.

Next, with the aid of a Cathode Ray Tube (CRT) situation display, the instructor will verify the accuracy and intent of the mission plan. He will need to determine that terrain blocks are properly located, that the electronic order of battle appears as it was expected to appear, and that all aircraft flight paths are correct and coordinated with one another. To evaluate all mission parameters on a real-time basis, the instructor will "fly" the mission in the operational mode, and using the geographic displays in real-time, he will evaluate the physical location and real-time parameters of the system. If errors or inconsistencies are found, new mission data will have to be entered into the computer, following which the instructor will again review the correctness of the plan.

Typically, the scenario or plan for a training mission is prepared off-line. In preparing a mission, the instructor will need to code the specific mission characteristics in a special programming format, transfer the data to punched cards, and load the resulting mission card deck into the computer.

Device 15E22 contains an optional on-line capability for constructing a mission (7). In the PLAN mode of operation, the Device 15E22 VISTA system displays the alphanumeric data used by the instructor to program and correct a mission. The instructor may insert specific mission characteristics through an alphanumeric keyboard at the instructor's console. Modification of any characteristics which have already been entered can be made through the same keyboard. The instructor's entries are constantly updated on the VISTA display.

Once the scenario has been loaded into the computer system of Device 15E22, the mission can be preflown by the instructor to assure that the training objectives are met. This is done in the TACT mode, the real-time operational mode. Using the geographical display in real-time of the TACT mode, and alphanumeric displays associated with the PLAN mode, the instructor can evaluate the physical location and real-time parameters of the system.

If errors or inconsistencies are found, they can be noted for later correction (punching new cards off-line and feeding them into the computer), or the mission can be frozen, the trainer placed in the PLAN mode, and the error can be rectified on the spot. However, if the second alternative is chosen and the trainer is then returned to the TACT mode, the mission will not resume where it left off, but will start at the beginning. For this reason, error correction in Device 15E22 is normally performed off-line.

Training scenarios are thus presently loaded into the trainer computing system in one of two ways: either by means of a card reader device, or through alphanumeric keyboard entries. Each method has been found slow and somewhat cumbersome. The need exists for more effective and convenient methods of data entry into mission scenario programs. The interactive nature of graphic input/output techniques offers the promise of much more effective instructor program communication for this type of operation. A number of devices are presently available for the input of graphic information to a computer. Used with a display, these devices make it possible to interact very effectively with a program.

A light-pen, for example, offers a convenient method of pinpointing information being displayed, to signal the computer that further processing of a particular item is desired. This pinpointing capability was described in reference (4).

A tablet offers a convenient method of pinpointing geographical coordinate data on maps, and digitizing that coordinate information for direct entry into the computer. Using a stylus, the operator may select any geographical location on a map which has been placed on the writing surface of the tablet.

4. TECHNICAL OBJECTIVE

The instructor's command language for Device 15E22 requires a two-part entry at the teletypewriter. The first part is a command field, while the second part is the data field. A data item is always preceded by an appropriate command word. An example of such a command word is M009FPL035LA, which sets the following routine into the computer: Maneuverable Emitter 009 Flight Path, Leg 035 Latitude. This code is then followed by the actual data information; for example N04030, which represents North 40° 30'.

One problem with this conventional method is the requirement to key in numerous characters. In the preceding example, the instructor would have to depress 18 keys to insert the latitude; that is, the character string M009FPL035LAN04030. Since each single data item requires a unique command word, the lengthy process of typing in characters is repeated for each new entry.

Reducing the typing load would definitely ease the instructor's task. The planning of each new mission and the associated input process demand many hours of the instructor's time; in some cases several hundred hours. An objective of this project was to drastically reduce that time.

5. COMPUTER HARDWARE

The approach was to develop the program design on the in-house IDIIOM display system. The IDIIOM uses a Varian DATA 620/i minicomputer, a special display processor, vector and character generators, and display consoles. Each console is provided with a light-pen, 32 function buttons with programmable lamp indicators, and an ASR-35 teletypewriter for input/output to the display computer.

The Mission Planning Tablet is a S.A.C. *Graf/Pen sonic digitizer manufactured by* Science Accessories Corporation. It consists of a tablet, stylus, control unit, and a special interface to the IDIIOM (see Figure 1).

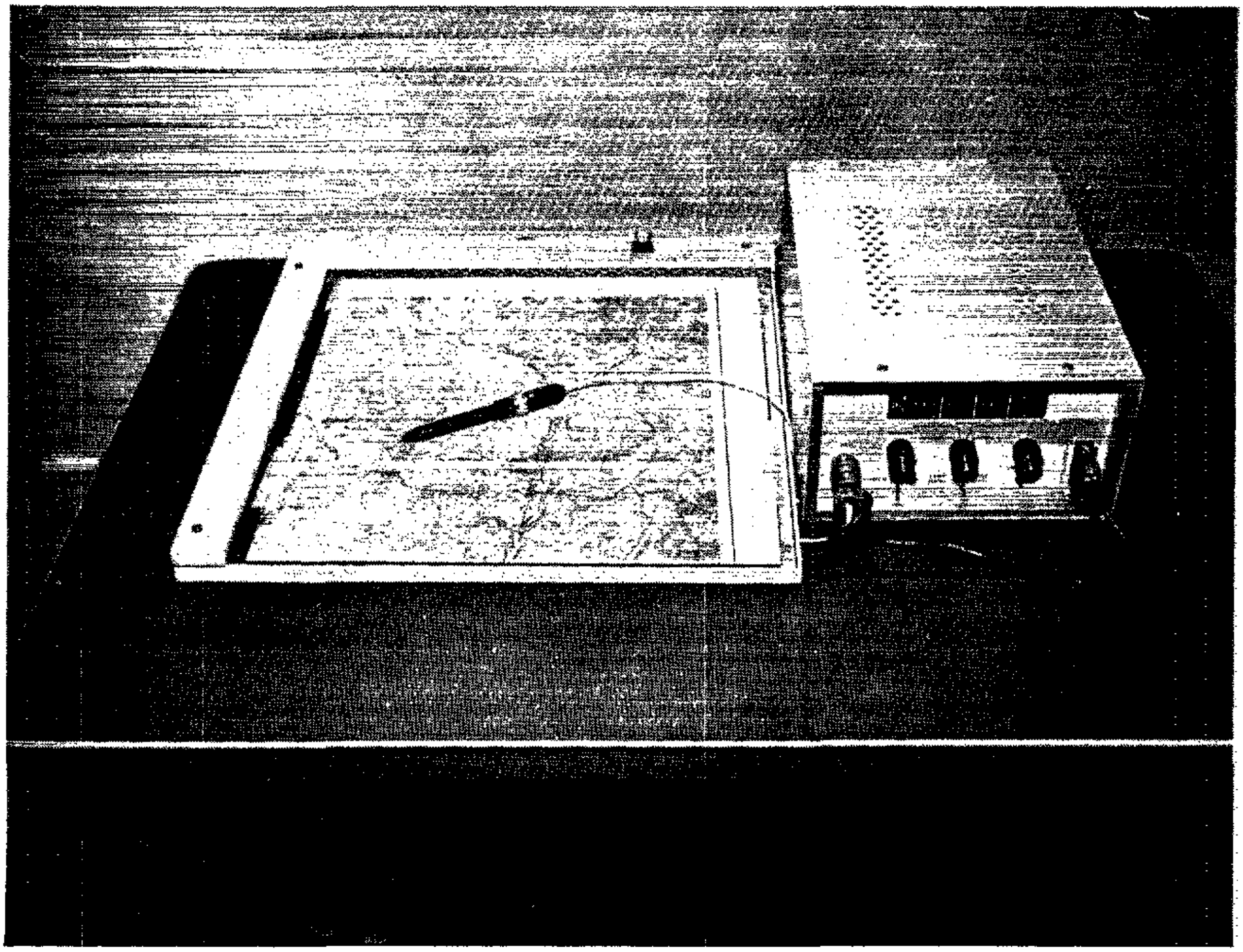

Figure 1. GRAF/PEN Acoustic Tablet.

The term "tablet" is used to describe a flat surface on which the user draws with a stylus, as if using paper and pencil. The S.A.C. Graf/Pen is an acoustic type tablet that uses strip microphones mounted along two adjacent edges of the tablet to detect the sound generated by the stylus.

The tablet has an active area 14-by-14 inches. The stylus has a small piece of ceramic mounted close to its tip, and a small spark can be generated across the surface of the ceramic, between two electrodes. The microphones detect the pulse of sound generated by the spark, and two counters record the delay between creating the spark and detecting the sound. These two delays are proportional to the stylus' distance from the two edges of the tablet where the microphones are mounted. They may therefore be used as X and Y values. The control unit interprets the information from the sensors indicating the position of the stylus on the X and Y axes of the tablet, and discriminates against ambient noise. The interface permits standard program controlled input/output operations between the Graf/Pen and the IDIIOM.

6. METHOD

Device 15E22, EA-6B Team Tactics Trainer, served as the model for defining the mission characteristics, which include a 600 x 600, 300 x 300, 150 x 150, or 75 x 75 nautical mile gaming area; a geographic environment consisting of LOSTB and terrain contours; movable objects consisting of an ownship, three friendly strike groups and ten maneuverable emitters; and initial conditions of 32 emitters and of the movable objects. The format of the Device 15E22 instructor language was made part of the program.

The first phase of the work plan provided the capability to insert coordinates of mission parameters through the alphanumeric keyboard. Latitude and longitude information were input through the ASR-35 teletypewriter. This involved the following parameters:

a. Ownship flight path

b. Strike group flight paths

c. Maneuverable emitters flight paths

d. Emitter locations

e. LOSTB fences

f. Terrain contours.

Reference (7) gives the format of the instructor's standard command language. This format is illustrated in Figure 2, which lists a portion of the data base for a hypothetical training problem. As in Device 15E22, there are up to 14 separate flight paths, 32 emitter sites, 16 LOSTB fences, and 16 contour lines. Each flight path requires an initial position and a maximum 36 fly-to points. Each LOSTB fence and each contour line requires two coordinate pair entries (two latitudes and two longitudes), since each is defined by two endpoints.

In addition, the operator could request the output of data information via the teletypewriter. He could request the print-out of any mission coordinate in the data base and he could also ask for a complete listing of all coordinates in the data base.

The second phase of the work plan provided the capability to insert coordinates of mission parameters directly on a geographic map area. Through the use of a graphic data tablet, the program enabled the operator to specify the geographic location of the various mission parameters. These parameters are the same as in the first phase. The operator inputs their coordinates by positioning the stylus on the tablet. A stylus tip contact with the tablet creates a coordinate par in the computer.

Under this second phase, both the Graf/Pen and the ASR-35 teletypewriter are used to input coordinate information. Through the teletypewriter, the operator specifies the scale of the map area and the coordinates of the lower left corner of the map. Possible scales vary from 1 by 1 to 9999 by 9999 nautical miles. He will next, through the Graf/Pen, input the location of the lower left and upper right corners of the map. (For the Western Hemisphere, it is the lower right and upper left corners.) These inputs must coincide with the given scale; i.e., the vertical and horizontal distances between the two corner locations (in nautical miles) must equal the specified scale. The operations described are illustrated in Figure 3.

The program is now ready for use. The sequence of operations for entering a single mission coordinate are as follows:

a. Specify the parameter through the teletypewriter.

b. Input the coordinate by pointing the stylus.

```
0000LA? N040 04                 Ownship initial location.
0000LO? E079 01
0000FPL000LA.
#
0000FPL000LA N041 01            Ownship flight path.
0000FPL000LO E079 00
0000FPL001LA N041 12
0000FPL001LO E076 23
0000FPL002LA N041 46
0000FPL002LO E075 15
0000FPL003LA N042 37
0000FPL003L9 E075 15
0000FPL004LA N043 24
0000FPL004LO E077 14
0000FPL005LA N044 43
0000FPL005LO E079 33
0000FPL006LA N047 29
0000FPL006LO E078 58
0000FPL007LA N046 11
0000FPL007LO E077 20
0000FPL008LA N048 55
0000FPL008L9 E076 13
0000FPL009LA N049 17
0000FPL009LO E075 03
0000FPL010LA N046 42
0000FPL010LO E074 19
0000FPL011LA N047 55
0000FPL011LO E072 51
0000FPL012LA N044 41
0000FPL012LO E072 47
0000FPL013LA N046 23
0000FPL013LO E071 24
0000FPL014LA N047 51
0000FPL014LO E070 32
0000FPL015LA N042 57
0000FPL015LO E071 54
0000FPL016LA N044 19
0000FPL016LO E072 46
0000FPL017LA N041 41
0000FPL017LO E070 51
0000FPL018LA N042 22
0000FPL018LO E070 33
0000FPL019LA N041 40
0000FPL019LO E071 36
0000FPL020LA N040 59
0000FPL020LO E072 23
0000FPL021LA N042 54
0000FPL021LO E072 36
0000FPL022LA N044 53
0000FPL022LO E072 38
```

Figure 2. Partial Listing of Data Base

```
SCALE0600.          <------------  Input of scale.
G000LAN04000.
G000LOE07000.       <------------  Input of lower left corner.
000304
003500              <------------  Lower left corner input using
                                                         GRAF/PEN.

G001LA.
003200
000611              <------------  Upper right corner input with GRAF/PEN.

M008LA.
M008LA N040 04
M008LO E076 36      <------------  Input of initial location, Maneuverable
M008FPL000LA.                      Emitter 008, with GRAF/PEN
M008FPL000LA N040 57
M008FPL000LO E076 37
M008FPL001LA N041 10
M008FPL001LO E076 24
M008FPL002LA N041 25
M008FPL002LO E075 44
M008FPL003LA N041 54
M008FPL003LO E075 35
M008FPL004LA N042 10
M008FPL004L) E076 10
M008FPL005LA N042 30 <-----------  Maneuverable Emitter 008 flight path
M008FPL005LO E076 43               input with GRAF/PEN.
M008FPL006LA N043 04
M008FPL006LO E076 53
M008FPL007LA N043 21
M008FPL007LO E077 43
M008FPL008LA N044 10
M008FPL008LO E077 37


Ii
LA N044 44
LO E073 18          <------------
                                   Map location interrogated.
```

Figure 3. Typical Tablet Operations.

c. Corresponding coordinate information is then printed on the teletypewriter.

The input of a series of mission coordinates is also possible. This requires the following operational sequence:

a. Specify the first parameter in the series through the teletypewriter. For example, M008FPL000, which corresponds to Maneuverable Emitter 008 Flight Path, Leg 000.

b. Point the stylus to the desired location on the map. The location will be read into the computer data base.

c. The corresponding coordinate information (latitude and longitude) is output on the teletypewriter.

d. Point the stylus to desired location of the next parameter in the series. Continuing the example in paragraph a., this would be M008FPL001 (Manueverable Emitter 008 Flight Path, Leg 001).

e. Corresponding coordinate information is output via the teletypewriter.

f. Continue pointing the stylus to desired parameter locations in sequence (legs 002, 003, 004, etc.). These are input into the computer, with corresponding printouts on the teletypewriter.

Any map location may be interrogated through the tablet in the following manner:

a. Operator inputs on the teletypewriter the letter I followed by a period.

b. Operator points Graf/Pen stylus at any map location.

c. Corresponding latitude and longitude is then provided via teletypewriter output.

These operations are illustrated in Figure 3. The teletypewriter printout shows the input of the scale (in nautical miles) of the coordinates of the lower left and upper right corners of the map of the initial location of Maneuverable Emitter 008, and of the flight path of the same maneuverable emitter. It also shows, as the last item, the interrogation of a map location.

7. RESULTS

Preprogrammed flight paths can be drawn and entered into the computer directly from a navigation chart using a graphic data tablet. The tablet can also be used to draw and input terrain contours, boundaries and emitter positions directly from a chart, map or other such sheet. The flight paths, etc., can be modified through the acoustic tablet or alternatively, through a teletypewriter.

The teletypewriter is used to input the instructor's command language as well as for outputs of mission data. The format of the command language is identical to the instructor's language in Device 15E22. Through the teletypewriter, the operator may request the output of such information as the scale of the map area, a mission coordinate, and a typewritten list of all coordinates in the data file.

The computer program occupies 1,730 words in the IDIIOM core memory. The data file requires an additional 1,228 words. Up to 614 coordinate points will be stored in the data file, each requiring two 16-bit computer words in memory. Program documentation is available for inspection in the Computer Laboratory, Code N-214, Naval Training Equipment Center, Orlando, Florida.

8. CONCLUSIONS

In the case of large and complex command languages, the Mission Planning Tablet offers a faster means of communication between an instructor and a computer system. The requirement to type in large numbers of alphanumeric characters in the on- or off-line preparation and modification of training parameters is a time-consuming, distracting, and error-prone chore, which may be minimized through the tablet input/output technique described herein. The method permits the instructor to insert geographical mission parameters directly from a tablet, which is more convenient and less time-consuming than data entry through punched cards or teletypewriter. In a pioneering dissertation on computer graphics (8), Ivan E. Sutherland noted in 1963 that "heretofore, most interaction between men and computers has been slowed down by the need to reduce all communication to written statements that can be typed; in the past, we have been writing letters to rather than conferring with our computers. For many types of communication, ..., typed statements can prove cumbersome."

9. REFERENCES

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