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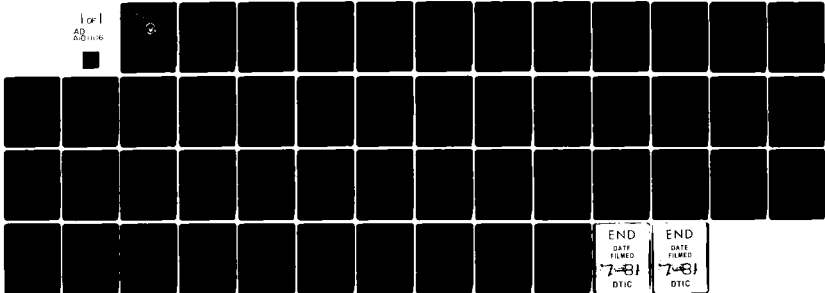
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THESIS

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A GRAPHIC TUTORIAL AND DECODING PROGRAM
FOR
NAVY SIGNAL FLAGS AND PENNANTS

by

Jay Kent Bien

March 1981

Thesis Advisor:

W.P. Hughes, Jr.

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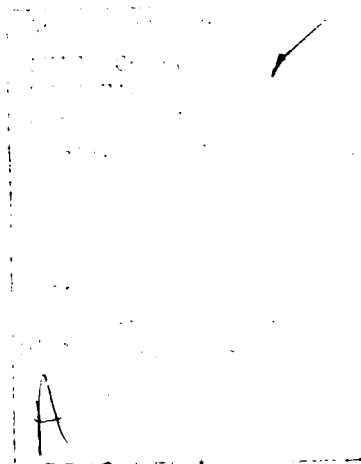
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learning requirements. The program is also capable of graphically displaying any grouping of flags and pennants chosen by the user in flaghoist order. When the flags and pennants are arranged in accordance with the procedural doctrine set forth in the ALLIED MARITIME TACTICAL SIGNAL BOOK, ATP 1(B), Volume II, the program demonstrates the capability of decoding the displayed signal into its predetermined meaning. The current program is resident in the Secure Command, Control and Communications Exercise Laboratory (C3 Lab) at the Naval Postgraduate School.



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A Graphic Tutorial and Decoding Program
for
Navy Signal Flags and Pennants

by

Jay Kent Bien
Lieutenant Commander, United States Navy
B.S., Purdue University, 1971

Submitted in partial fulfillment of the
requirements for the degree of

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from the

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ABSTRACT

This is a highly graphic user-oriented interactive software product which will assist the user to become more proficient at recognizing and employing Navy signal flags and pennants which are used for visual communications between naval vessels of all types. A tutorial portion of the program has been designed with a number of options, thereby allowing a user to tailor a recognition program to satisfy specific learning requirements. The program is also capable of graphically displaying any grouping of flags and pennants chosen by the user in flaghoist order. When the flags and pennants are arranged in accordance with the procedural doctrine set forth in the ALLIED MARITIME TACTICAL SIGNAL BOOK, ATP 1(B), Volume II, the program demonstrates the capability of decoding the displayed signal into its predetermined meaning. The current program is resident in the Secure Command, Control and Communications Exercise Laboratory (C3 Lab) at the Navy Postgraduate School.

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I. INTRODUCTION

A. BACKGROUND

Most visual communications systems presently in use on board United States Navy ships have been employed in much the same manner for centuries. Their continued use is evidence of their utility and significance. Of the visual systems incorporated today, "flaghoist" is the one most frequently used, even though its use is limited to the hours of daylight. Flaghoist is commonly used for close-in communications in the fleet.

Flaghoist involves the use of coded flags and pennants. Usually these flags and pennants are displayed prominently on a hoist running up to a yardarm on the ship's mast. Each "flag" (to include pennants) represents a letter, a numeral, or a designated special meaning. One flag or a grouping of flags in a prescribed order constitute a signal. In general, a flaghoist signal ensures a more uniform execution of a maneuver than any other system of visual communications.

Flaghoist signaling provides a rapid and accurate system of passing tactical and administrative information. Flaghoist is rapid because, by hoisting and displaying one or more flags that have a predetermined meaning, a ship can communicate simultaneously with all ships in company. It is

an accurate system for the reason that the receivers of the signal are required to repeat the signal, flag for flag, allowing the originator to immediately confirm that those sent the signal received it correctly. In addition, flaghoist signaling aptly meets many security provisions, which can be considered a prime requisite for naval communications. Not only is the range limited, the meaning of the signal itself can only be found in a classified signal publication. Finally, flaghoist signaling may be the only means of expeditious tactical communications during emergency conditions when any sort of electronic emissions from a ship may be prohibited for the very safety of that ship.

In flaghoist signaling, the U. S. Navy uses 68 flags. These include the international alphabet flags (26), numeral pennants (10), and a Code/Answer pennant; a set of numeral flags (10), special flags and pennants (17); and four substitutes, or repeaters. Each alphabet flag has the phonetic name of the letter it represents. A numeral FLAG takes the name of the numeral it represents; numeral PENNANTS are only used in call signs. Special flags and pennants are used in tactical maneuvers to direct changes to speed, position, course, and formation, to indicate and identify units, and for specialized purposes. In addition to the flags used for signaling, there is the tackline or "tack". The tackline is used to separate flags or groups of flags which, if not separated, could convey another meaning from that intended.

In most cases the tack is included in the signal to avoid any ambiguity.

A flaghoist signal (message) consists of two parts: heading and text. The heading may be specified by hoisting a visual call sign; numerals in the "call" of the heading are numeral pennants. More frequently, the heading is implied, and all that is hoisted is the text portion of the signal. The text usually is made up of flag combinations extracted from the ALLIED MARITIME TACTICAL SIGNAL BOOK, ATP 1(B), Volume II. A signal is "read" by noting the flag positions starting from the top most outboard flag down the halyard to the bottom flag, then to the next most outboard top flag down to the bottom, etc., etc. A "display" is a complete signal, whether on one halyard or on two or more.

ATP 1(B), Vol. II is the origin of most tactical communications between allied naval units. The signal vocabulary of this publication is collected into chapters and arranged under headings for ease of reference. Chapter 1 contains general instructions for use of the book. Chapter 2 contains single flag and pennant signals. Chapter 3 contains emergency alarm and emergency action signals. Chapters 4 through 9 contain maneuvering signals which utilize a special pennant. Chapters 10 through 31 contain the main signal vocabulary, which consists of operational and administrative signals arranged in alphabetical order under appropriate headings. Chapter 32 consists of supplementary tables which are used

to augment and modify the meaning of certain basic groups. The signal vocabulary chapters are followed by an extensive signal index provided to assist the user in finding the desired groups when encoding signals. The overall security classification of ATP 1(B), Vol. II is NATO-CONFIDENTIAL, which requires a NATO special clearance (for confidential material) in order to be able to view its contents.

Due to the classification of the ALLIED MARITIME TACTICAL SIGNAL BOOK and the sheer number of possible combinations of messages that can be formulated, all enlisted personnel and officers responsible for decoding flaghoist signals are actively discouraged from trying to memorize any signal contained in the publication. Even if an individual "thinks he knows" the meaning of a group of flags, there is a standing requirement to look the signal up in the publication before reporting the meaning to a senior.

The enlisted rating which is responsible for visual communications on board a ship is that of Signaller. Besides other duty responsibilities Signaller personnel are required to acquire and maintain a solid background and knowledge in procedures, methods, and rules pertaining to flaghoist communications. Fundamental to this tasking is a proficiency in readily identifying all signal flags and pennants used. Signaller "A" School presently devotes five hours of instructional time to the learning of the signal flags. Within the officer ranks, every prospective Surface Warfare

Naval Officer receives a minimum of four hours of formal classroom instruction and practice in signal flag recognition. Besides the time set aside in the classroom to learn the identity of all the flags and pennants most individuals (enlisted and officers) who have to learn them require an additional minimum of seven to ten hours to become "moderately proficient" with a "fair" amount of retention capability.

The primary aid currently used by an individual in learning and studying the flags outside the classroom is the "Navy and International Code Flag Cards", device number SLE2; this is a product of the U.S. Naval Training Device Center produced by Brown and Bigelow (FSN:22-6910-514-2233). The "flash-cards" device consists of 75 playing-card-sized cards with a color picture of a flag or pennant on one side, and the name of the flag or pennant on the other.

E. OBJECTIVE

The main objective of this study was to produce a simple, user oriented, yet all inclusive and foolproof computer program routine which would be able to "teach" a user the signal flags and pennants, and in addition, have the capability to "decode" such flags and pennants displayed in groups in accordance with standard procedures delineated in ATP 1(B), Vol. II.

In striving to realize the above stated objective other less significant objectives were achieved in the process. Among these objectives were:

- (1) To incorporate the C3 Laboratory--its assets and inherent capabilities--as an integral and major part of the thesis itself;
- (2) To actively apply various programming techniques and design principles expounded in various academic courses to a specific real-world and Service related topic of interest; and,
- (3) To create a product which has the potential to be a meaningful contribution to the U.S. Navy.

II. PROGRAMMING OBJECTIVES AND DESIGN PRINCIPLES

The graphic tutorial and decoding program for Navy signal flags and pennants which satisfies the above objective was designed to be used on a PDP 11/70 computer located in the Secure Command, Control and Communications Exercise Laboratory (C3 Lab), at the Navy Postgraduate School. The C3 Lab was developed for use as a research, test and evaluation, and experimentation facility. Designated a Remote Site Module (RSM), the C3 Lab is part of a secure computer network which also includes the Naval Ocean Systems Center (NOSC), in San Diego, California, Commander-in-Chief, U.S. Pacific Fleet, in Pearl Harbor, Hawaii, and the Fleet Numerical Oceanographic Center, located in Monterey, California. This secure network is referred to as the Advanced Command and Control Architectural Testbed (ACCAT), and is certified to be able to handle and store classified material up to and including SECRET. A UNIX operating system is resident in the C3 Lab's PDP 11/70, and provides an on-line (time-sharing) computing system capability. In addition to Ann Arbor CRT terminals for entry/retrieval (I/O), the system supports color graphics on Genisco display terminals.

By understanding and taking advantage of the close interactive relationship between user and computer which is engendered by an on-line system, an effective user-oriented

program can be realized. To assemble and collocate such a user-oriented program was the primary programming objective. To this end, the final criteria used to determine whether code was to be incorporated or rejected in the tutorial and decoding program was if the inclusion of some particular code contributed in making the program more user-oriented.

In the design of a program where there is a high degree of interaction anticipated, perhaps the most important consideration is the "appearance" of the program to the user ("the man-machine interface"). A program must be appealing for a user to want to use it more than once. And if the program is to be utilized by a variety of individuals having varied levels of expertise or experience, it has to be designed and formatted in such a manner so that ANY user can understand what is expected at each point. Consequently, the more "advanced" user may have to accept and be tolerant of this possible inconvenience although there are design options that could be incorporated which have the potential to alleviate this problem to a great degree. Such "human engineering" considerations within a program can be some of the most time consuming and troublesome to resolve in creating a program.

There are a number of generally accepted "design principles" that should be considered when creating a user oriented interactive program. All the following design principles were utilized in the tutorial and decoding program.

- (1) Self-explanatory.
- (2) Self-helping.
- (3) Simple interface with user.
- (4) Interaction by anticipation.
- (5) Optional verbosity.
- (6) Echoing

Although more "transparent" to a user than those above, the following are also considered as necessary elements for a truly successful user oriented interactive program.

- (7) The exiting from a program should be a "reversible request".
- (8) The program should be able to accept direct comment from the user.
- (9) The user should never be embarrassed, belittled or chastised.

Each one of the above listed design principles is described more fully in the following remaining paragraphs.

A "self-explanatory" program is one which presents the user sufficient tutorial information about the program itself to enable the user to proceed without reference to some

external source of explanation (a separate user's manual for example). This is accomplished by presenting certain necessary and basic items and allowing the user to opt for additional supplementary or tutorial material if desired.

A "self-helping" program provides checking of user inputs to the program and provides reminders or advisories when the user requests help. This is accomplished by checking the input for validity or reasonableness, and if appropriate, sending a diagnostic message. This message might inform the user that the last entered input is incorrect either in format (usually a typing error), or content. When a user specifically requests assistance, the program should be structured to respond in some manner providing the user with enough helpful information to resolve, hopefully to the user's satisfaction, the apparent predicament the user is experiencing.

"Simple interface with user" is accomplished by ensuring that the actions and inputs required by the user are short, simple, and obvious. One aspect of the interface is the grouping of options presented within the program. For example, if many options are available, it is probably easier for an on-line user to make his choice if the options can be presented in subgroups of six or fewer items. More than this amount can become "mind boggling" and is, therefore, counterproductive.

"Interaction by anticipation" is achieved by anticipating all possible desires a user may have and presenting the user with choices which include all of those possibilities. This method enables the user to SELECT (by letter/number/or short phrase) rather than SPECIFY (type out in entirety) a desired option.

"Optional verbosity" allows for two (or more) levels of detail to occur in the interface with the user. For the novice or first-time user, the interface should contain detailed explanations in order to insure that the user completely understands what is expected, and what the program is capable of performing. On the other hand, an experienced user familiar with the program or subject matter might want to choose a mode of operation with few or no explanations and abbreviated communications (terse messages). A verbosity option can resolve the problem between presenting too much or too little.

"Echoing" (which could be a verbosity option itself) allows the user instant feedback in order to verify that the input entered (which may even be used or enacted upon at a later time) has been accepted and that it indeed was the correct option/input desired in the first place.

A "reversible request" provides the user "one last chance" to consider the consequences of the most recently entered action without any dire consequences occurring. In the exiting of a program, the user is asked if termination

is actually desired. If termination is indeed desired (reconfirmed), the user is thanked, and then allowed exit (gracefully) from the program. If, on the other hand, the user wishes to return to the program and continue, the program returns the user to the point in the program previously located.

A program is only useful if it can satisfy a user's needs and requirements. Since many of these desires are not fully known until the user is actually using it, a built-in feature to accept "keyed in" comments, criticism, or suggestions can be extremely worthwhile. Not only will it permit the user to vent possible anger, the comments, where feasible, can be invaluable in developing improvements to the existing program thereby enhancing the overall man-machine interface appearance of the program itself.

Finally, a program is a tool. If it somehow conveys an attitude of "superiority" to the user, the user may be inclined not to employ it. Therefore, a conscientious and deliberate effort must be made on the part of the creator of a program to treat the user with respect and courtesy. No other approach toward the user can be as effective.

III. PROGRAM DESCRIPTION

The graphic tutorial and decoding program for Navy signal flags and pennants that was created consists of 12 separately compiled programs which have been structured to interact with one another. Certain values are carried between various programs to maintain continuity among all of the programs. Memory space limitations during the compilation of a program, and the conscientious effort, in keeping with good programming practices, to "modularize" the program into a number of less cumbersome programs was the rationale behind breaking up the program into the 12 separate programs. Any one of the 12 programs can virtually "stand alone" and, therefore, each can be considered as an independent program. However, these independent programs when discussed in this thesis will be referred to as "subprograms"; when the subprograms are considered all together, they make up the graphic tutorial and decoding "program".

A. OVERVIEW

This program provides a structure designed to assist an individual in learning to recognize the Navy signal flags and pennants and, secondly, to assist in decoding visual flaghoist signals in accordance with the ALLIED MARITIME TACTICAL SIGNAL BOOK.

The graphics contained in the program are used to portray and display: the twenty-six International alphabet flags, the ten numeral pennants, and a code/answer pennant; a set of the numeral flags; seventeen special flags and pennants; four substitute pennants; and a tackline or "tack". In the tutorial portion, these flags and pennants are shown individually; in the display/decode portion, they are displayed in any number up to 32 on "halyards" in order to simulate signal flags and pennants as they would be used to send a message from a ship. There are also graphics presentations which depict the program framework in which the user will be working. In each case the user's present location in the program is identified, thereby giving a visual perspective of where the user is in relationship to the rest of the program.

B. STRUCTURE

The structure of the program consist of two main PORTIONS; the tutorial PORTION, and the display/decode PORTION. The tutorial PORTION has been divided into three SECTIONS, and each SECTION has three SEGMENTS. Each SEGMENT (within a tutorial SECTION) is further subdivided into either three or four graphic tutorial SESSIONS where the flags and pennants are actually presented. The display/decode PORTION has one SECTION. Figure 1, on the next page, depicts this structure.

* Main Selection Level Menu choice

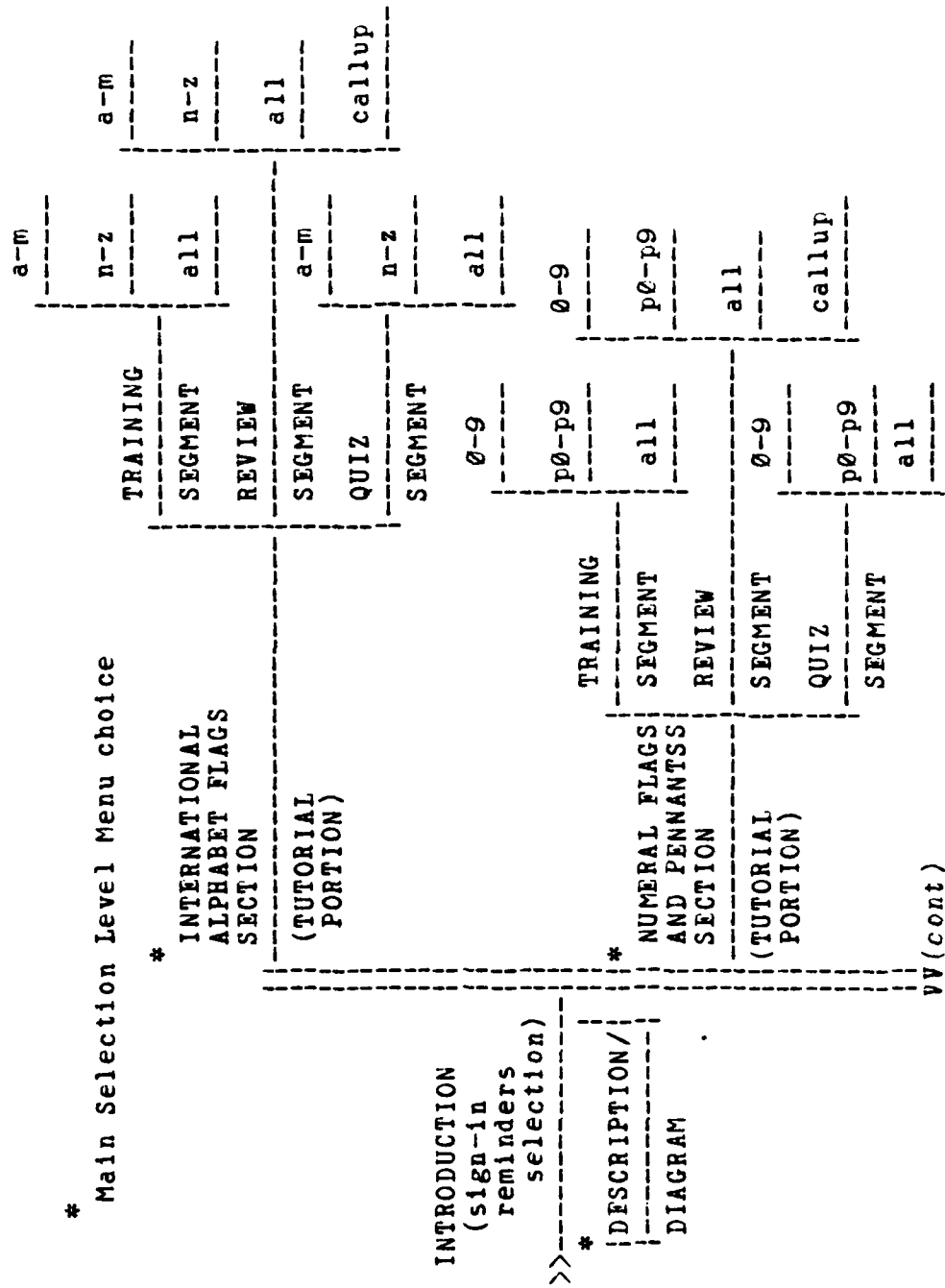


Fig 1. Diagram Depicting Program Sequence (Flow) and User Options Available (Continued on next page)

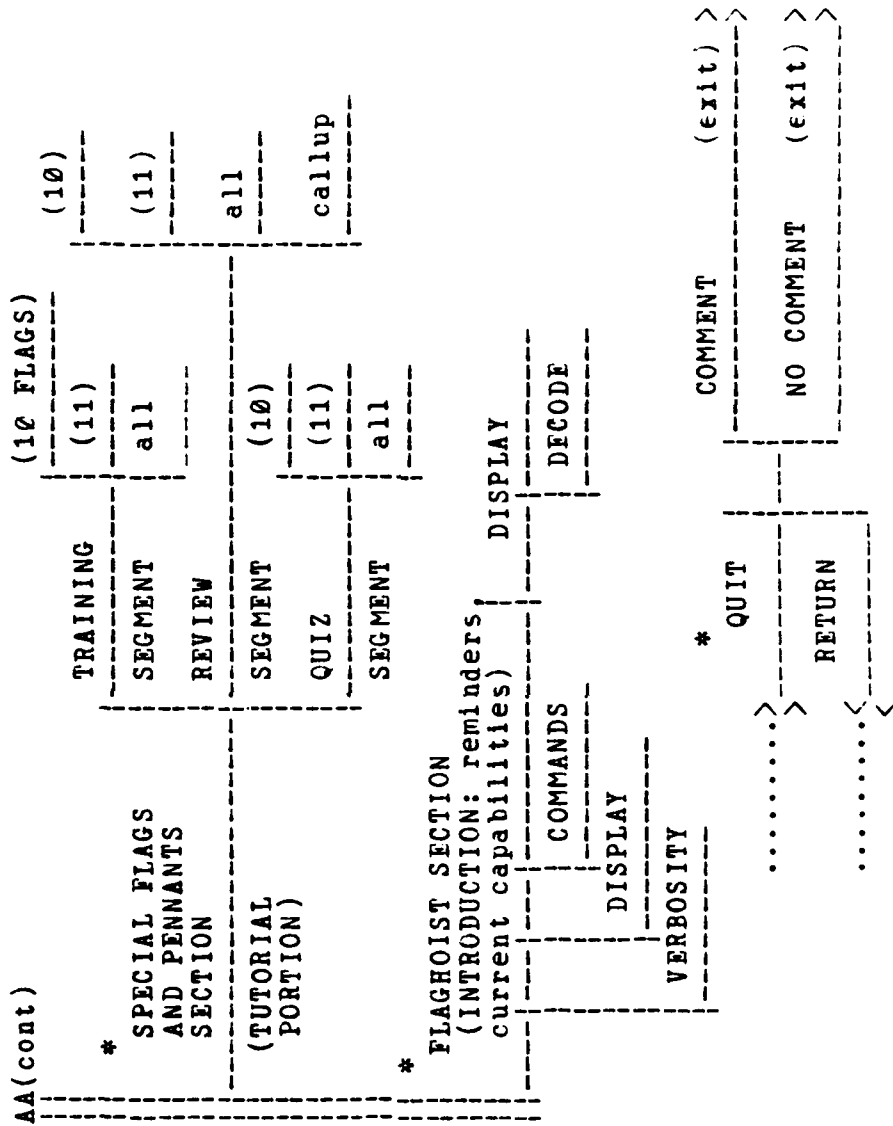


Fig 1 (cont). Diagram Depicting Program Sequence (Flow) and User Options Available (Continued from previous page)

The "Main Selection Level Menu" is the center branching point within the program. It presents the user with six choices to choose from. These are:

INTERNATIONAL ALPHABET FLAGS (TUTORIAL)
NUMERAL FLAGS AND PENNANTS (TUTORIAL)
SPECIAL FLAGS AND PENNANTS (TUTORIAL)
FLAGHOIST DISPLAY/DECODE
DETAILED PROGRAM DESCRIPTION/DIAGRAM
QUIT

A brief description of each selection follows.

- (1) International Alphabet Flags (Tutorial) -- This SECTION contains a complete self-contained tutorial, which will provide the user a framework to become more proficient in the ability to recognize the 26 International Alphabet flags.
- (2) Numeral Flags and Pennants (Tutorial) -- This SECTION contains a complete self-contained tutorial, which will provide the user a framework to become more proficient in the ability to recognize the 10 International Numeral pennants and the 10 Navy Numeral flags.
- (3) Special Flags and Pennants (Tutorial) -- This SECTION contains a complete self-contained tutorial, which will provide the user a framework to become more pro-

ficient in the ability to recognize 21 special pennants or flags. The flags and pennants contained are: preparative, interrogative and negative (governing pennants); emergency, formation, station, turn, corpen, speed and screen (maneuvering pennants); first, second, third and fourth substitutes (repeater pennants); starboard (direction pennant); port (direction flag); division and squadron (unit indicator flags); and designation pennant and code/answer pennant.

- (4) Flaghoist Display/Decode -- This SECTION, which is the display/decode PORTION of the program, is for the most part "transparent" to the user. It is, however, a significant part of the program. It allows the user to display the flags and pennants that compose a signal which is to be sent or received. It also has the capability to decode the signal if the display conforms to proper flaghoist signaling procedures as delineated in the ALLIED MARITIME TACTICAL SIGNAL BOOK. The user is advised if, for any reason, the present flag/pennant arrangement cannot be decoded.
- (5) Detailed Program Description/Diagram -- this selection provides the user with a detailed program description which appears on the terminal, while simultaneously presenting a graphic structure diagram on the color screen. This description/diagram is the same option

the user is given when first entering the program. It is intended to give the user a perspective on the program, what options are available, and the user's current location within the program. This selection automatically returns the user to the Main Selection Level Menu at the completion of the presentation.

- (6) Quit -- this selection allows the user to quit (exit) the program. In fact this is an option that the user may opt for at any time when an input is required to "advance" the program. However, before being permitted to actually leave the program, the user is requested to type in any pertinent comments about any aspect of the program. The quit process is reversible; the user will be returned to the same place in the program if he decides not to terminate.

Within each of the above first three selections - the tutorial PORTION of the program - the user is given the choice of selecting one of three SEGMENTS, besides three other options.

TRAINING SEGMENT

REVIEW SEGMENT

QUIZ SEGMENT

BRIEF DESCRIPTION OF SEGMENTS

RETURN TO MAIN SELECTION LEVEL MENU

QUIT

A brief description of each SEGMENT follows. Where the word "flag" appears it is to mean to be either a flag or a pennant.

- (1) Training Segment -- will provide the user with the opportunity to learn and study one single flag at a time from the flags in the SECTION selected. By presenting the user one randomly selected flag at a time along with its proper WRITTEN name (except in the case of the International Alphabet Flags where the SPOKEN name is given), the user can go through the mental process of associating a flag with a name. The size or the group of flags from which a particular flag is selected is an option chosen by the user. A flag will remain on the color screen as long as the user desires to have it displayed. The same flag will not appear until six other flags have been presented. Another flag automatically appears each time the carriage return key is depressed.
- (2) Review Segment -- will allow the user to choose from two options. The first option presents one randomly selected flag at a time from the SECTION in a similar manner as in the Training Segment. However, unlike in the Training Segment, the name of the flag does not appear simultaneously thereby giving the user the opportunity to identify the flag "on

his own". The correct name of the flag is delayed for four seconds. When it appears it essentially provides instant feedback to the user either in the form of reinforcement if properly identified or of correction if wrongly identified. The second option requires the user to type (enter) the name of the flag that is desired to be presented on the screen. Each time a name is typed the specific flag is shown. By entering "all", the user is shown all the flags in the SECTION on the screen simultaneously. This "call up" option allows for the flag of the user's own choosing to be shown, thereby providing the structure for the user to go through the mental process of associating a name with a flag.

- (3) Quiz Segment -- will present the user with one randomly selected flag at a time from the SECTION. The flag will remain on the screen for five seconds and then disappear. The user is then required to identify the flag by typing in its name on the keyboard. The user is informed by an advisory if what is entered is correct or not. If correct, a new quiz flag is presented. If incorrect, the flag will reappear and the user is given another chance to identify it. The flag will not disappear after five seconds as before; it will remain on the screen until another input by

the user is made. If the user correctly identifies it, an advisory informs the user and a new quiz flag is offered. If incorrectly identified, the flag's name is given and the program then presents the user a new flag to identify. The quiz can be terminated at any time. When the user ends the quiz, a score is given based on the number of correctly identified flags made on the initial viewing of the flag. The names of those flags that were incorrectly identified after being given two opportunities are listed.

C. INDIVIDUAL SUBPROGRAM DESCRIPTIONS

By referring to Appendix B a complete description of each of the subprograms can be obtained. The "Program Summary Statement" located at the beginning of each subprogram has been extracted directly from each of the source subprograms and contains a "description" and a "content" section. The description contains a detailed sequential run-through of what each subprogram outwardly presents to the user. The content contains a brief outline of the structure which is, for the most part, transparent to the user. The content section also delineates the subprogram's relationship(s) with other subprograms.

The complete source code for each of the subprograms was originally to be included as part of the thesis. However, because of the length of some of the subprograms, this in-

clusion was considered as impractical. Access to the code is a relatively easy evolution to perform for anyone who wishes to obtain a copy of any (or all) of the source subprograms. Appendix A outlines the necessary procedure to acquire access.

Figure 2, located on the next page, depicts the relationships the various subprograms have among one another. The titles on the diagram are the compiled programs' names as they are actually called.

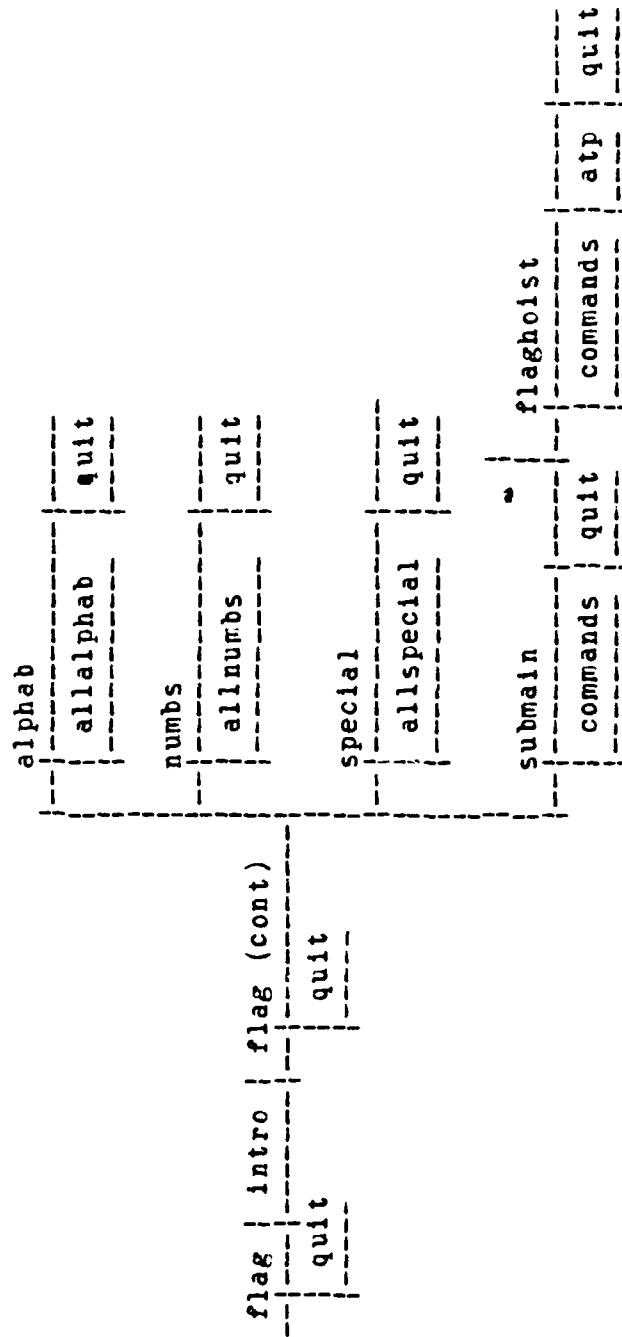


Fig 2. Diagram Depicting Relationship of Compiled Subprograms

IV. RECOMMENDATIONS FOR FUTURE DEVELOPMENT

First, although the current program has met the stated objective and it has incorporated within it all the design features that are considered as necessary to have a successful user-oriented interactive program, there are several "additions" which could be included at some later date to make it even more appealing. Second, the current decoding portion of the program shows only a "capability"; it contains the code necessary to decode only a few of the chapters in ATP 1(B), Vol II. The present capability is listed in Appendix C. Last, the entire objective must be examined in the context of "cost versus value", and a determination must be made whether the pursuit of a fully operational product is a worthy endeavor.

The envisioned long range application for the program is to install such a program onboard a naval vessel for at-sea use. Hardware necessary to support the program would, by necessity, most likely have to be reduced to a "desk top" configuration with the possibility of running several remote graphic CRT's, if graphics were desired; and a "hand calculator" configuration if graphics were not particularly necessary. The program would be used when a vessel was receiving a flaghoist (or flashing light or semaphore) message. The duty signalman would enter the flags on a keyboard

as they are visually read. After entering the flags which make up the signal, the user merely has to type "decode", verify or confirm that the flags are the ones sent, before reading the meaning of the signal on a screen (CRT) or in a window. The Commanding Officer and/or Officer of the Deck could also be provided with a remote CRT so that the message could be instantaneously delivered to the ultimate intended receiver. The tutorial portion of the program would be utilized onboard ship to keep proficiency high in recognition of the flags, and on shore at those installations where signal flag training is a requirement (for example, Signalmen "A" School, Officer Candidate School and Surface Warfare Officer School).

One of the "additions" that would make the program more appealing would be to reduce and/or convert the present program, which is dependent on the PDP 11/70 and Genisco, to one which fits into a microcomputer with a graphics capability or into (smaller still) a pocket translator/calculator size device without a graphics capability. Putting the program (excluding the graphics capability for the present time) on a "chip" so that it could be then easily updated and even encrypted when necessary in order that it then could be put into some small hand held device is the ultimate goal. To speed the process between reading the flags and being presented the meaning, voice input of the flags possibly could be added. In any case, memory space and size

studies would have to be conducted on the feasibility of any of the above configurations before the present program could be made more readily available to its potential users in the Fleet.

Before the program can be considered completely ready for evaluation and use, the decoding portion of the program must be finished. Presently, the program can only claim to demonstrate the capability. The author, however, has carefully selected those chapters thus far incorporated in the program as representative of the remaining material in ATP 1(B), Vol II. For this reason there does not appear to be anything more intricate to program than what has already been done. Memory space may become a limitation, but this should not be difficult to overcome on the PDP 11/70. Research into possibly a better method and/or language to code this portion of the program could lead to a program more efficient overall.

A premise of this thesis was that the stated objective was worthy enough to develop an alternate approach in order to satisfy it. Now that an alternative has been developed, the user community should be approached to see if such a product has real "user appeal". If it is well received, still another major hurdle must be overcome. That hurdle is cost. The present system for learning the flags and pennants used in flaghoist, and decoding (and encoding) flaghoist displayed signals consists of a pack of 68 flash

cards and one formidable publication. What is proposed to replace these items would require a rather sophisticated, though easy to operate, piece of computer equipment. Although the cost of such equipment is decreasing continuously, it may still be too high to make it practical. A cost versus value study would have to be conducted before further substantial time investments are devoted to actually writing the decoding code. It is the opinion of the author after studying the matter, that the tutorial and decoding product is beneficial from the user's standpoint, but that its monetary cost may be prohibitive at this time.

The final improvement that is recommended would be to create, design and develop a natural language ENCODE counterpart to the decode portion of the program. This would be a formidable undertaking but great strides have been made recently in natural language query routines and systems. Many of the techniques derived could be applicable in developing an efficient encoding scheme.

APPENDIX A

PROGRAM OPERATING INSTRUCTIONS

An individual desiring either to view the source code or run the "Graphic Tutorial and Decoding Program for Navy Signal Flags and Pennants" must first place the program's source and object files into his/her directory. This is accomplished by making the necessary arrangements to or following the procedures for mounting a magnetic tape labeled "FLAGS", which is stored in the C3 Lab in the custody of the manager of the C3 Lab.

To run (execute) the tutorial and decoding PROGRAM, once all the subprograms are loaded/transferred into the user's directory, the subprogram "flag" should be initially called. "Flag" is the only subprogram which offers the user a choice of Genisco screens which can be activated, and which allows the user to choose another section of the program in which to go. If called first, all other subprograms will automatically default to Genisco screen "0" (left bay screen in the C3 Lab). Moreover, when in certain subprograms the command "main" is entered--which is required prior to being able to select another section--the subprogram will exit automatically and return the user back to the UNIX executive shell level unceremoniously and without any advance warning.

Once "flag" is called, the user should be able to utilize the program as long as desired. The program was intentionally designed and structured to "stand alone" (i.e., to be self explanatory) and does not require any user's manual. If the user does encounter a situation which is seemingly ambiguous or confusing, entering "help" or "?" will provide an advisory which will delineate the options available to rectify the situation. The user must, however, have some knowledge of flaghoist procedures and terminology to derive maximum benefit from the decoding section of the program. No other operator instructions should have to be given to the prospective user before beginning the program.

The program is self-helping and uses simple interface commands. The user has the opportunity to view detailed instructions and a graphic diagram describing the entire program just after entering the program. If the user opts not to see these, he can bypass them and go directly into the Main Selection Level Menu (MSLM); however these instructions are always available to the user as one of the options in the MSLM.

The program employs the techniques of interaction by anticipation since the commands required to progress through the program are the characters corresponding to the correct name of the flag or pennant. The remaining commands are consistent in their meaning throughout the program, and should not be ambiguous to even the novice user.

The program contains defaults in case the user mistypes an input. If the input is not immediately acted upon, the program will echo the user's entry. Within the decoding portion of the program there is a verbosity option which allows the user to tailor the amount of information received after an entry is made. There are three different verbosity levels to choose from.

The program allows the user to quit and exit the program from any point but requires the user to verify his intention to quit before the program halts and returns to the UNIX shell command level. Prior to quitting, the user is requested to enter any comment(s) that may be considered appropriate.

In order to monitor the utility of the program, code has been incorporated within two of the subprograms which will record time of user entry and exit, along with any comments that the user makes when quitting the program. These subprograms will have to be modified if someone (other than the author) would like this information. Subprograms "flag.c" and "quit.c" have been documented sufficiently to permit someone else to do this.

All the subprograms are written in the "c" language. A basic understanding of "c" is necessary if the reader intends to modify the subprograms themselves. A conscientious effort was made to provide detailed documentation along with each subprogram.

All the subprograms were compiled using the compiler command "kcc". For example, to compile the subprogram "flag.c" (all programs must have a filename of the form "(filename).c") the shell command "kcc (filename)" is entered followed by a carriage return. "kcc" is a filename itself containing the following compiler command calls:

```
cc $1.c /usr/graphics/genlib.a  
/usr/graphics/genlib.a /usr/graphics/genlib.a
```

This compiler allows more streamlined graphics commands to be used in the Genisco source code.

APPENDIX B

SUBPROGRAM SUMMARY STATEMENTS

PROGRAM: flag.c

PROGRAM SUMMARY STATEMENT

DESCRIPTION: THE INITIALLY CALLED PROGRAM FOR THE NAVY SIGNAL FLAGS AND PENNANTS PROGRAM.

USER IS GREETED TO PROGRAM ON THE CRT, AND REQUESTED TO AUTOMATICALLY WITH SOME BASIC PROGRAM REMINDERS. FOLLOWING THIS THE USER IS GIVEN A CHOICE OF WHAT GENISCO SCREEN IS TO BE UTILIZED. AFTER THIS HAS BEEN DETERMINED AND THE SELECTION ECHOED, THE PROGRAM THEN PRESENTS TO USER THE FORMAL INTRODUCTION TO THE PROGRAM ON THE GENISCO SCREEN, FOLLOWED BY AN OVERVIEW OF THE OBJECTIVES OF THE PROGRAM ON THE CRT. THE USER IS THEN ASKED IF A MORE DETAILED DESCRIPTION OF THE PROGRAM - WITH A GRAPHIC DIAGRAM - IS DESIRED. IF THE USER SELECTS THIS OPTION A SIX PART SIMULTANEOUS CRT/SCREEN DESCRIPTION/DIAGRAM PRESENTATION IS PROVIDED. THE USER CARRIAGE RETURN KEY. AT THE END OF THIS OPTION THE USER IS AUTOMATICALLY PROVIDED WITH THE MAIN SELECTION LEVEL MENU (MSLM) WHERE HE MAY MAKE ONE OF SIX CHOICES. IF THE USER DID NOT SELECT THE DESCRIPTION/DIAGRAM OPTION, THE MSLM IS PRESENTED IMMEDIATELY AFTER THE POINT WHERE WHEN THE USER INDICATED THAT THE OPTION WAS NOT DESIRED.

CONTENTS: TRANSPARENT TO THE USER WHEN SIGNING-IN IS THAT THE NAME BEING ENTERED IS AUTOMATICALLY BEING PLACED IN A FILE CALLED 'INPUT' IN A DIRECTORY PRESENTLY WITHIN 'BIEN'. [NOTE:THE 'PROGRAM MONITOR' WILL HAVE TO INSURE THAT AN 'INPUT' FILE IS MAINTAINED IN HIS/HER DIRECTORY AND THAT flag.c IS PROPERLY MODIFIED TO HANDLE THIS. THIS ALSO MUST BE DONE IN THE quit.c SUBPROGRAM.] WHEN THE CARRIAGE RETURN IS TYPED THE CURRENT TIME IS ALSO PLACED IN THE FILE 'INPUT' UNDER THE HEADING OF 'TIME LOGGED IN:' THIS FILE 'INPUT' HAS BEEN CREATED IN ORDER TO MONITOR USE OF THE PROGRAM, AND ALSO--MORE IMPORTANTLY--AS AN RECEPTACLE FOR USER INPUT COMMENTS WHICH ARE SOLICITED WHEN THE USER INDICATES THAT HE DESIRES TO 'QUIT' (EXIT) THE PROGRAM. (SEE quit.c PROGRAM FOR MORE DESCRIPTION OF THIS OPTION.)

A CONCERTED EFFORT HAS BEEN MADE IN ORDER TO MAKE THE PROGRAM WHERE 'AUTOMATIC ADVANCEMENT' OF THE PROGRAM IS NOT PRESENT. IN OTHER WORDS, EVERYWHERE THAT THE USER MUST TYPE IN SOME ENTRY - BE IT EVEN A CARRIAGE RETURN - AND AN ERRONEOUS ENTRY IS MADE INSTEAD OF THE ONE (OR ONE FROM THE GIVEN SELECTION) PROMPTED FOR, AN ADVISORY WILL BE GIVEN INFORMING THE USER THAT WHAT WAS JUST TYPED/ENTERED WAS NOT ACCEPTED AND THAT ANOTHER INPUT IS NECESSARY TO CONTINUE THE PROGRAM. THERE ARE ALSO ADVISORYS PROVIDED IF THE USER GETS 'CONFUSED' OR 'LOST' AND TYPES '?' OR

THE PROGRAM AUTOMATICALLY FORKS TO (AND RETURNS FROM) intro.c AFTER SCREEN SELECTION HAS BEEN DETERMINED. THE PROGRAM FORKS TO alphab.c IF INTERNATIONAL ALPHABET FLAGS SELECTED; TO numbs.c IF NUMERAL FLAGS AND PENNANTS SELECTED; TO special.c IF SPECIAL FLAGS AND PENNANTS SELECTED; TO submain.c IF FLAGHOIST DISPLAY SELECTED; TO quit.c IF QUIT SELECTED; OR TO THE SUBROUTINE Descr() IF THE USER WANTS TO REVIEW THE DESCRIPTION/DIAGRAM PRESENTATION OPTION AFTER VIEWING THE MAIN SELECTION LEVEL MENU.

PROGRAM: intro.c

PROGRAM SUMMARY STATEMENT

DESCRIPTION: PROVIDES THE OPENING GRAPHICS FOR THE NAVY SIGNAL FLAGS AND PENNANTS PROGRAM. DISPLAYS FLAGS WHICH SPELL OUT IN CLEAR TEXT 'NAVY FLAGS AND PENNANTS' FOLLOWED BY WRITTEN TITLE OF PROGRAM AND AUTHOR'S NAME.

CONTENTS: CALLED AUTOMATICALLY BY flag.c, AND RETURNED AUTOMATICALLY TO flag.c. CONTAINS NO OPTIONS. ENTIRE SUBPROGRAM IS NON-INTERACTIVE. (SUGGEST THIS SUBPROGRAM BE BYPASSED WHEN ACCESSING flag.c A NUMBER OF TIMES WHILE PERFORMING ANY SORT OF MAINTENANCE. SEE flag.c AT FORK TO THIS SUBPROGRAM FOR SUBSTITUTE CODE FOR BYPASSING THIS SUBPROGRAM.)

PROGRAM: alphab.c ***(ALSO [numbs.c] AND {special.c})***

PROGRAM SUMMARY STATEMENT

DESCRIPTION: BY SELECTING THIS OPTION THE USER DESIRES TO LEARN/STUDY THE INTERNATIONAL ALPHABET FLAGS (26) [THE NUMERAL FLAGS (10) AND PENNANTS (10)] [THE SPECIAL FLAGS AND PENNANTS (21)].

THE USER IS PROVIDED WITH A SECTION MENU WITH CHOICE OF FOUR MAIN OPTIONS (BESIDES CAPABILITY TO QUIT AND TO RETURN TO THE MAIN SELECTION LEVEL MENU (MSLM)), DEPENDING ON WHAT SEGMENT (TYPE OF FLAG PRESENTATION) IS DESIRED. THE TRAINING SEGMENT PROVIDES ONE SINGLE RANDOM FLAG WITH ITS CORRECT NAME SIMULTANEOUSLY; REVIEW SEGMENT PROVIDES TWO MAIN OPTIONS WITHIN ITSELF: (1) A RANDOM FLAG DISPLAYED WITH FOUR SECOND DELAY OF THE FLAG'S NAME, (2) FLAG DISPLAYED WITH NO NAME (FLAG NAME TYPED ON KEY BOARD TO CALL FLAG TO SCREEN.) OR BY ENTERING SCREEN TOGETHER; AND QUIZ SEGMENT WHICH PRESENTS A RANDOM FLAG AND USER MUST PROVIDE NAME. A SCORE IS MAINTAINED IN THIS SEGMENT. THE FOURTH OPTION PROVIDES USER WITH A BRIEF DESCRIPTION OF EACH OF THE SEGMENTS FOR USER'S PERUSAL. WITHIN THE TRAINING AND QUIZ SEGMENTS THERE ARE THREE TUTORIAL SESSIONS; WITHIN THE REVIEW SEGMENT THERE ARE FOUR SESSIONS. THE FIRST SESSION WITHIN ANY OF THE SEGMENTS DISPLAYS A RANDOM FLAG FROM ONE HALF OF ALL THE FLAGS IN THE SECTION (A-M [0-9] {10 SPECIAL PENNANTS}), THE SECOND SESSION WITHIN ANY OF THE SEGMENTS DISPLAYS A RANDOM FLAG FROM THE REMAINING FLAGS IN THE SECTION (N-Z [p0-p9] {11 SPECIAL PENNANTS}) AND THE THIRD SESSION TAKES A RANDOM FLAG FROM THE ENTIRE GROUP OF FLAGS AVAILABLE (A-Z [0-9 & p0-p9] {21 SPECIAL PENNANTS}). THE FOURTH SESSION WITHIN THE REVIEW SEGMENT ALLOWS THE USER TO DISPLAY ANY FLAG OF THE USER'S OWN CHOOSING, OR ALL THE FLAGS TOGETHER.

CONTENTS: THERE ARE NO LIMITATIONS TO A TUTORIAL SESSION; WHEN THE USER DESIRES TO TERMINATE A SESSION ALL THAT IS REQUIRED IS 'end' TO BE ENTERED. THE USER WILL BE RETURNED THE SECTION MENU AT THE END OF EVERY SESSION. THE USER MAY RETURN TO THE MSLM OR QUIT FROM EITHER A SESSION OR AT THE SECTION MENU LEVEL. HOWEVER, ONCE A SEGMENT HAS BEEN SELECTED, THE USER IS NOT PERMITTED TO RETURN TO THE MSLM OR QUIT UNTIL THE USER IS WITHIN A TUTORIAL SESSION.

CALLED FROM flag.c MAIN SELECTION LEVEL MENU WITH INPUT 'a' ['n'] {'s'}. FORKS TO allalphab.c [allnumbs.c] {allspecial.c} IF USER SELECTS COMMAND 'all' IN THE CALL UP OPTION OF REVIEW SEGMENT. FORKS BACK TO flag.c WITH 'rain'; TO quit.c WHEN 'quit' ENTERED.

PROGRAM: allalphab.c
(ALSO [allnumbs.c] AND [allspecial.c])

PROGRAM SUMMARY STATEMENT

DESCRIPTION: DISPLAYS TO THE USER ALL THE 26 [20] {21} FLAGS/PENNANTS IN THE SECTION ON THE SCREEN AT ONE TIME.

CONTENTS: CALLED FROM alphab.c [numbs.c] {special.c} WITH INPUT SUBPROGRAM WHEN ALL FLAGS/PENNANTS ARE DISPLAYED. CONTAINS NO OPTIONS. ENTIRE SUBPROGRAM IS NON-INTERACTIVE.

PROGRAM: submain.c

PROGRAM SUMMARY STATEMENT

DESCRIPTION: GREETES USER TO DISPLAY/DECODING PORTION OF PROGRAM. PROVIDES USER INPUT REMINDERS AND THEN PRESENTS THE CURRENT DECODING CAPABILITIES BUILT INTO THE PROGRAM. THE USER IS THEN GIVEN THE OPTION TO CHOOSE FROM THREE LEVELS OF VERBOSITY. NEXT THE USER IS GIVEN THREE OPTIONS FROM WHICH TO CHOOSE WHAT FLAGHOIST DISPLAY CONFIGURATION IS DESIRED. THE FINAL OPTION PROVIDES THE USER, IF CHOSEN, WITH ALL THE VARIOUS KEYSTROKE COMMANDS (OTHER THAN FLAG/PENNANT NAMES) WHICH WILL BE ACCEPTED.

CONTENTS: (THIS SUBPROGRAM PRIMARILY WRITTEN BECAUSE OF MEMORY SPACE LIMITATIONS IN flaghoist.c.) SUBPROGRAM PROVIDES STRUCTURE FOR INTRODUCTION TO DISPLAY/DECODING PORTION. BOTH VERBOSITY AND DISPLAY CHOICES ARE ECHOED. DEPENDING ON WHAT VERBOSITY SETTING CHOSEN, SOME ADVISORY INFORMATION EITHER PROVIDED OR OMITTED.

CALLED FROM flag.c MAIN SELECTION LEVEL MENU WITH INPUT 'fh' (FLAGHOIST). FORKS TO commands.c IF USER SELECTS COMMAND OPTION; FORKS AUTOMATICALLY TO flaghoist.c AT END. FORK OPTION TO quit.c AND flag.c (AT MSLM) AVAILABLE AT CERTAIN POINTS.

PROGRAM: flaghoist.c

PROGRAM SUMMARY STATEMENT

DESCRIPTION: PROVIDES USER WITH CURRENT VERBOSITY AND DISPLAY SETTINGS. INFORMS USER THAT FLAGS MAY BEGUN TO BE DISPLAYED. ALLOWS USER TO TYPE IN ANY FLAG OR PENNANT BY NAME AND DISPLAYS FLAG OR PENNANT ON A SIMULATED HALYARD OF THE USER'S CHOOSING IN FLAGHOIST ORDER. USER MAY CHANGE/MODIFY FLAGS DISPLAYED BY USING APPROPRIATE COMMANDS PROVIDED FROM THE 'COMMANDS' LISTING. WHEN THE USER HAS THE SIGNAL DISPLAYED ON THE SCREEN WHICH HE WANTS TO HAVE DECODED, THE COMMAND 'decode' IS ENTERED. THE PROGRAM RETURNS THE NAME OF THE FLAG(S) AND ITS (THEIR) FLAG POSITION(S) FOR THE USER TO CONFIRM, BEFORE ATTEMPTING TO DECODE THE SIGNAL. MEANING OF SIGNAL IS NATO CONFIDENTIAL WHEN ARRANGEMENT OF FLAGS AND MEANING ARE ASSOCIATED.

CONTENTS: CALLED FROM submain.c AUTOMATICALLY WHEN submain.c ENDS. FORKS TO commands.c WHEN EITHER 'commands' OR 'help' ENTERED; AUTOMATICALLY RETURNED AFTER COMMANDS ARE PRESENTED ON CRT. ACCEPTS ANY CORRECT FLAG NAME OR COMMAND AND EITHER DISPLAYS FLAG OR EXECUTES COMMAND. FORKS TO atp.c SUBPROGRAM IF USER SO INDICATES A DESIRE TO KNOW IF THE DISPLAYED FLAGHOIST SIGNAL IS VALID I.E., HAS A MEANING. ALLOWS USER TO LCOP AS MANY TIMES AS DESIRES; WHEN USER CHANGES DISPLAY OPTION ALL FLAGS ARE REMOVED; DISPLAY OPTION TWO ('disp2') NOT CURRENTLY AVAILABLE DUE TO MEMORY SPACE/COMPILE CONSTRAINTS. FORK OPTION TO quit.c AND flag.c AT THE MSLM AVAILABLE AT ANY TIME.

NOTE TO ADVANCED USERS OF THE PROGRAM: BY TYPING 'flaghoist' FROM THE UNIX SHELL LEVEL, THIS SUBPROGRAM CAN BE ACCESSED DIRECTLY WITHOUT HAVING TO GO THROUGH THE MSLM (flag.c) OR THE DISPLAY/DECODING PORTION INTRODUCTION (submain.c). HOWEVER, IF THE VERBOSITY AND DISPLAY SETTINGS ARE NOT IMMEDIATELY CHANGED TO VALUES THAT ARE RECOGNIZED BY THE PROGRAM, THE SUBPROGRAM WILL NOT FUNCTION IN A STAND ALONE CAPACITY. REMEMBER, THIS SUBPROGRAM WILL ONLY OPERATE IN THIS MODE AT THE LEFT BAY SCREEN IN THE C3 LAB BECAUSE OF THE DEFAULT TO GENISCO -0 WHICH OCCURS WHEN NOT INITIALLY GOING THROUGH flag.c.

PROGRAM: commands.c

PROGRAM SUMMARY STATEMENT

DESCRIPTION: LISTS ALL THE COMMANDS AVAILABLE FOR MODIFYING DISPLAYED FLAGS, CR FOR CHANGING VERBOSITY LEVEL AND DISPLAY CONFIGURATION.

CONTENTS: CALLED BY submain.c OR flaghoist.c. RETURNS TO CALLING SUBPROGRAM WHEN CARRIAGE RETURN (OR ANY OTHER INPUT) ENTERED; NO OTHER OPTIONS ARE AVAILABLE.

PROGRAM: atp.c

PROGRAM SUMMARY STATEMENT

DESCRIPTION: PROVIDES THE USER WITH THE MEANING OF THE DISPLAYED FLAGS/PENNANTS ON CRT.

CONTENTS: ALMOST ENTIRELY TRANSPARENT TO THE USER, THIS SUBPROGRAM CONSISTS OF ONE VERY LARGE 'IF' LOOP WHICH ATTEMPTS TO SEARCH FOR A MATCH BETWEEN WHAT IS IN THE FIRST ONE TO FOUR FLAG POSITIONS WITH A 'DATA BASE' CONSISTING OF BASIC GROUPS EXTRACTED FROM ATP 1(B), VOL II. WHEN A MATCH OCCURS THE MEANING IS PRESENTED AND THE SEARCH CONTINUES USING THE NEXT GROUP. A GROUP IS DEFINED AS AN ARRAY OF THOSE UNIQUE FLAG NUMBERS UP TO BUT NOT INCLUDING A TACK (68) OR A SPACE (0). TACKS AND SPACES ARE DISREGARDED BUT ARE USED AS END OF ARRAY AUTOMATICALLY TO flaghoist.c AFTER ALL FLAG NUMBERS HAVE BEEN SEARCHED FOR AND MEANING HAS/HAS NOT BEEN FOUND AND PRESENTED ON THE SCREEN. IF NO MATCH IS FOUND, AN ADVISORY INFORMING THE USER OF THIS IS PRESENTED.

THIS SUBPROGRAM IS NATO-CONFIDENTIAL AND SHOULD BE ACCORDED THE PROPER SECURITY FOR SUCH A CLASSIFICATION.

PROGRAM: quit.c

PROGRAM SUMMARY STATEMENT

DESCRIPTION: REQUESTS THE USER BEFORE TERMINATING THE PROGRAM TO TYPE IN ANY COMMENTS THAT ARE DEEMED APPROPRIATE. IF THE USER WISHES NOT TO COMMENT, (S)HE THEN MAY EXIT DIRECTLY. IF THE USER DESIRES TO RETURN TO THE PROGRAM, (S)HE ENTERS 'ret' AND IS REINSTATED AT THE SAME LOCATION IN THE PROGRAM AS BEFORE.

CONTENTS: PRESENTS A GRAPHICS 'TO WARN' USER THAT THE END OF THE PROGRAM MAYBE NEAR. IF USER INDICATES THAT (S)HE WISHES (WILLING) TO MAKE SOME COMMENTS, THE 'INPUT' FILE IS OPENED TO RECEIVE ENTRIES UP TO EIGHT LINES IN LENGTH; TIME OF EXIT ALSO ENTERED. IF THE USER INDICATED THAT NO COMMENTS ARE WANTED TO BE MADE 'INPUT' OPENED TO RECORD TIME OF EXIT AND AUTOMATIC ENTRY OF 'NO COMMENT'. (SEE ALSO flag.c.)

CALLED BY flag.c, alphab.c, numbs.c, special.c, subrain.c, OR flaghoist.c. RETURNS TO CALLING SUBPROGRAM WHEN 'ret' ENTERED. ALLOWS USER TO 'EXIT GRACEFULLY' FROM THE PROGRAM. PROCESS IS REVERSIBLE.

SINCE RETURNING TO THE UNIX SHELL COMMAND (THE REAL INTERPRETATION OF QUITTING) CAN ONLY BE ACCOMPLISHED BY EXITING OUT THROUGH THE INITIALLY ENTERED PROGRAM, A PROSESS WAS DEvised TO 'BACKTRACK' THROUGH THE VARIOUS SUBPROGRAMS FORKED INTO. THIS WAS ACCOMPLISHED BY CARRYING A VALUE IN THE 'exit' ARGUMENT. A PRIOR TO ENTERING THE quit.c SUBPROGRAM; A '1' (ONE) VALUE WOULD RETURN ALL THE WAY BACK TO flag.c WHERE IT THEN WOULD RETURN TO THE UNIX SHELL. (SEE ADDITIONAL DOCUMENTATION WITHIN SUBPROGRAM.)

APPENDIX C

CURRENT PROGRAM DECODING CAPABILITY

The following is extracted directly from the "submain.c" subprogram and lists the current decoding capability of the program.

PRESENTLY INCORPORATED IN THE DECODING PORTION OF THE PROGRAM ARE THE FOLLOWING CHAPTERS, ARTICLES, PARAGRAPHS FROM ATP 1(B), VOL II. (AS OF 15 MAR 81)

111	GOVERNING PENNANTS
112	GOVERNING GROUPS
115	PLAIN TEXT (NOTE 1)
122	UNITS OF REFERENCE (partial) (NOTE 1)
123	FRACTIONS (NOTE 1)
124a,c	TIMES
126b,c	BEARING AND DIRECTION/DISTANCE (NOTE 1)
128a,b,c	METHOD OF ORDERING SECTORS (NOTE 1)
301	EMERGENCY EXECUTE SIGNAL
302	EMERGENCY ALARM SIGNALS
303	EMERGENCY ACTION SIGNALS
1001	ANTI-AIR WARFARE SIGNALS

NOTE 1: WHERE APPLICABLE IN SIGNALS EXTRACTED FROM CHAPT 3-32.

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