The flexible console—FLEXICON

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INTRODUCTION

Mature engineering fields have well-developed tools and standards which aid in development and guarantee product quality. Ironically, after over thirty years, programming remains basically an undisciplined process with most software engineers still using techniques and tools which have changed little over the last ten years. There is as yet no common standard for programming tools and common experience in the use of those tools and techniques which currently do exist. The mounting cost of software dictates that the time has come to offer the software engineer tools which can increase his productivity, via saving time and making man-machine interaction more efficient.

A set of programming tools, brought together in a software development facility such as a dedicated programmer’s console, could provide the framework for a software engineering discipline, and add stability to the computer programming environment. Because of the continuing reduction in the cost of hardware it is now economically plausible to consider the design of a single user terminal with capabilities and features which could not have been justified in the recent past.

The project undertaken by CRD has examined the “wish list” indicated above with the aim of designing a workstation which allows the programmer to work efficiently with an integrated set of electronic tools in place of traditional tools such as pencil and paper, line editors, keypunches, documentation typists, draftspeople and printed reference manuals.

The traditional stages of software engineering or programming (planning, implementation, and testing) were considered to be the activities performed by programmer in which electronic assistance is needed. The primary questions that arose were:

- What tools does a programmer need?
- Can these be satisfied by a programmer’s console?

Several criteria were used to select those features to be included in the Programmer’s Workstation. These included: (1) the applicability of the features to the software effort; (2) the degree of usefulness of the feature to the software effort; (3) the potential power of the feature within the system environment; (4) the ease of implementation of the feature into the prototype.

As work proceeded on the project, it became apparent that many features being designed into FLEXICON could be effectively utilized in applications other than programming. Therefore, FLEXICON was designed as a basic system which could easily be adapted to tasks other than that of a Programmer’s Workstation.

SYSTEM CONFIGURATION OF THE FLEXIBLE CONSOLE

The hardware configuration of FLEXICON makes use of independent MPU subsystems sharing a common bus. Although up to three subsystems can be interconnected via a data link controller, only two were used in the engineering model: a dialog subsystem and a function subsystem. The dialog subsystem manages the man-machine interaction.

The function subsystem performs tasks initiated by the dialog subsystem such as file management, spooling, etc. It is implemented by an INTEL Microcomputer Development System (MDS) with 64 kBytes of memory, double density dual floppy disks, an In-Circuit Emulator (ICE-80), a resident relocater and linker, a text editor, an operating system, and assorted utility routines.

An additional subsystem can be added to accommodate special requirements, for example archival storage or parallel high level language compilation.

Since the tasks a programmer performs require significant amounts of data, a high-speed data link between the dialog subsystem and the function subsystem was needed. Data exchange on the prototype was provided by Direct Memory Access (DMA) in each of the subsystems via a parallel data bus.

The various user I/O peripherals, which have been connected to the dialog subsystem, represent a collection of state-of-art devices intended to provide the user with an optimized man-machine interface. These include: (1) up to four color CRT’s, each with limited graphics; (2) transparent Touch Sensitive Devices (TSD) on each CRT; (3) conventional keyboard.

The CRT’s are Intercolor 8051 intelligent terminals, which can display 48 lines consisting of up to 80 characters per line.
FLEXICON’s use of CRT displays is intended to minimize the need for paper. In this respect, most tasks require a worker to have access to several kinds of information at the same time in order to make decisions and/or to create new documents. The number of sources of information a worker needs at any one time and the amount of information a worker needs to see from each particular source is totally task dependent. However, there is a practical limit to the amount of information that a person can physically perceive. The selection of four CRTs was done arbitrarily for the engineering model as an upper limit, with further study to determine an optimum configuration, taking into account ergonomics, applications, etc.

FLEXICON utilizes modes, control areas, as well as function “buttons” on each screen to organize the system with the objective of maximizing displayed information. CRD found that the basic capabilities required to organize the needs and tasks of a programmer appear to be similar to those required in many other application areas which involve the creation and modification of data or information. CRD believes many of the concepts behind the use of FLEXICON as a programmer’s workstation are appropriate in configuring FLEXICON as a station for users performing similar tasks.

With the display of more information on multiple CRTs than previously available, CRD believes that effective, “more natural” methods of interacting with this information must be devised to replace traditional cursor control on the keyboard, light pens, joy sticks, etc. Studies by N. Negroponte have shown that traditional cursor control methods significantly detract from an efficient interaction. For example, a light pen requires a worker to be continually handling it as he shifts back and forth between entering information on the keyboard and using the light pen to manipulate information on CRT screens.

Two approaches have been used in FLEXICON to provide a more natural method of interacting with the large amount of displayed information. First, screen oriented techniques are used in place of the traditional line editor. In other words, the user “sees” everything as it actually is, without the need to imagine as in the line editor approach of the past. Each screen is considered to be a small window into a larger workspace belonging to the file. At all times, a FLEXICON user sees on a screen as much of the file’s workspace as the CRT field allows (42 lines). What the user sees in the CRT window is an exact image of the information in the file workspace. A FLEXICON user can concentrate on the job he has to do instead of being distracted by traditional line editing tools which intercede between him and the information with which he is working. No clutter of commands ever appears in the window area of a FLEXICON CRT screen; only the user’s information appears.

A second technique to provide a “comfortable” interaction with information displayed on the CRTs involves the utilization of transparent Touch Sensitive Devices (TSD) which cover the face of each CRT. The TSDs enable the FLEXICON user to manipulate information appearing in a CRT window simply by touching the information on the CRT.
with his fingertip, thus liberating the user from the inconvenience of handling multiple light pens and/or keyboards. The Touch Sensitive Devices (TSD), together with the visible workspace concepts just described, greatly simplify user interaction with FLEXICON and provide a comfortable and friendly user environment for man-machine interaction.

The use of high resolution graphics is considered not essential to document software. The capability to easily draw lines and boxes and color modification is thought to be adequate for program documentation. However, CRD feels that the graphics provided to the programmer must blend well with individual character manipulation capabilities since programmers create and edit diagrams made up of lines and boxes and alpha-numeric characters and since such diagrams are often intermixed with text.

FLEXICON provides a user with simple, yet adequate, graphics which enable him to create and edit diagrams made up of lines and boxes. An easy to comprehend and easy to use set of editing functions are built into FLEXICON which enables a user to modify, move and edit graphic lines and boxes, including any associated text. These editing functions are all natural language controls. A FLEXICON user can manipulate a portion of the CRT window either as a strip of characters or as a geometric area. The result of combining simple line graphics with both graphic and character oriented editing techniques is a system as easy to use as a ruler and a pair of scissors, but with the power and the convenience of electronic manipulation. All of the controls are able to be activated by touch, rather than by command entry via the keyboard.

Color is available as an added dimension to document clarity. Its use is being studied as a way to enhance various presentations, such as structured program code constructs.

USING THE FLEXIBLE CONSOLE

Traditionally, clerical staff members have used terminals with limited capabilities to do repetitive, rigidly defined tasks. Special knowledge is required to properly use such terminals and to properly perform such tasks. Usually the clerical staff requires extensive training in the usage of a particular terminal and how to perform a particular task.

With the growth of timesharing computer systems, programmers are beginning to use terminals to create and revise programs. Most of these terminals are teletypes or dumb CRTs equivalent to teletypes. To use such terminals to create and edit programs, programmers must learn a command language for a line editor as well as separate command languages to perform such tasks as compilation, linking, program execution and file management. Usually these various command languages are designed for the convenience of computers and terminal equipment rather than humans.

A major design goal of the FLEXICON project has been to produce a unit which can be used after only a short introduction. FLEXICON does not require special knowledge or training to use and does not require the user to know any special command language. FLEXICON is controlled and used by touching items on menus, by answering questions posed by the system, and by following directions given through the use of prompts.

In FLEXICON, standard menu buttons on the Touch Sensitive Devices (TSDs) surround each screen. These standard menu buttons are fixed onto the TSDs and do not change. These standard menu buttons organize the major tasks of the user and provide most of the tools he needs to do his job. The present FLEXICON system has been oriented toward a "Programmer's Workstation." Therefore, the standard menu buttons provide the tools to create and edit code, diagrams and documentation. These tools are similar to, and in some ways identical to, the tools needed by other professionals and by secretarial staff to create and edit information. Nevertheless, these menu buttons are really controlled and therefore may easily be changed to suit other applications.

In FLEXICON, "soft" menu buttons are presented to the user in the control area of the screen to provide appropriate functions for specific applications needs. These menu buttons are changed as necessary as part of the prompting scenario. They provide a simple and powerful technique to provide the user of FLEXICON with very specific capabilities tailored precisely to a particular application task. They activate frequently used preprocessed operations.

The Touch Sensitive Devices and the combination of standard, fixed menu buttons and "soft," changeable menu buttons make the FLEXICON unit a natural and simple tool. A FLEXICON user touches the information he wants to manipulate, thereby positioning the cursor, and then touches a menu button to perform certain action with the information.

In addition to the standard and soft menu buttons, FLEXICON uses informational prompts to guide and assist the user in performing tasks. The lower six lines of each CRT screen constitute a control area and are used by FLEXICON to constantly inform the user of the status of the screen including any errors he may have made and the action required to correct the error and properly proceed with his task. FLEXICON also asks questions of the user when it needs specific information to perform a task.

The result of using standard menu buttons, "soft" menu buttons, TSDs and extensive prompting on FLEXICON, is a terminal system concept which can be used productively by a new user in a very short period of time. A user need remember very little about the system to use FLEXICON. He only need look at the physical face of the screens with their associated fixed and soft menu buttons and the prompts to start to work.

APPLICATION AREAS FOR FLEXIBLE CONSOLE

The specific application area of a "Programmer's Workstation" was selected for the initial FLEXICON system. However, the basic tools and capabilities a programmer needs to electronically create, modify, and use software and documentation, and to interchange information with other computer systems, are also the basic tools and capabilities needed by other professionals and staff who create, modify
and use information. FLEXICON is a basic core system to which additional capabilities and functions can be added to tailor the system to other application areas. It is appropriate to consider the use of FLEXICON in any application area in which professionals need user oriented facilities and the capabilities of a highly intelligent terminal to increase their productivity and job satisfaction.

Some of the specific areas in which FLEXICON seems to lend itself include:

- Management Information Systems
- Computer Aided Design
- Automated Architecture
- Database Management
- Database Inquiry
- Secretarial Workareas
- Automated Office
- Order Entry with Inventory Management
- Process Control

Generally, any tasks which can be structured and performed with decision trees, that require the integration of information from several sources or that require the accessing and/or combining of information from several sources are likely candidates for a system such as FLEXICON.

CONCLUSIONS

An all purpose workstation which enables a programmer to increase his productivity, reduce the time required to develop a system and increase the quality of his work, offers advantages: to the programmer, the system designer, the analyst and, indeed, the manager. It must be noted that FLEXICON is not the solution to all a programmer's problems; there are several areas which need more development, specifically the application package itself. The FLEXICON concept is that of a high level tool which can have many applications. There are many additions which can be made to this system to make it a more powerful tool. Much of these are software expansions. CRD is currently looking into various areas in which the computer may ease the load of the programmer to an even greater extent. Some of these areas include such dynamic possibilities as automatic programming, automatic testing, electronic manuals, automatic program analysis, and non-procedural languages.

The future for a system such as FLEXICON is open-ended, constrained only by the needs of the user and technology. The power of the system is defined by the memory size and the usage, be it as an intelligent terminal, a stand-alone system, or part of a network. FLEXICON could be tied to a micro, a mini, or mainframe computer. Computer based systems are being used more and more in all facets of life. Their successful use requires good man-machine interfaces. FLEXICON provides convenient, easy-to-use, man-machine interface, which speeds and simplifies the creation and manipulation of the information needed by these computer based systems.

REFERENCES