M.I.T. LABORATORY FOR COMPUTER SCIENCE

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PORTABLE PERSONAL TERMINAL

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The attached is a description of a possible new research project. It represents a substantial change of pace from some of the current work of the group.

1. Portable Personal Terminal

1.1 Introduction

It is now commonplace to see a computer terminal on the desk of many executives, researchers, and office workers. The deployment of the dedicated terminal, as opposed to a poolroom where one goes to access a computer, has made certain highly interactive applications practical. In our environment, two obvious examples are the sending and receiving of mail, and the management of an online appointment book. In the commercial world, there are many examples of interactive data management systems, such as airline reservation systems. In order for these applications to function smoothly, it is critical that the user have essentially continuous access to his online system. It would be very nice if access to these systems could be obtained at any time, and not just when one is seated at one's desk. In order to do this, one approach is to provide a portable terminal, small enough that it can be carried in the pocket, and used whenever necessary. The purpose of this project is to perform a number of preliminary studies for the production of such a terminal, exploring ideas which now seem feasible given developments in several relevant areas. The goal of this project is to produce one or more prototype terminals, which can be used in connection with various applications to determine their overall effectiveness. The terminal will be small enough to fit in a large pocket; it will connect the computer via a telephone line but will use internal buffering to provide the illusion of a high speed data link; and it will use speech to augment the limited output delay.

1.2 Background

The user interface to an application is often the greatest hindrance to its use. While one might think that the function provided by the application would turn out to be the critical issue, it is often apparent that superficial details of the manner of access determine a system's acceptability. For example, a major source of complaint about existing timesharing systems is the very simple defect that it takes too long to dial up and make a connection so that one can get to the application in the first place. This project will attempt to provide a new sort of user interface, which we feel will markedly enhance certain specific applications. The applications we have in mind are those which have a strong requirement for accessibility at any time. Examples which already exist within the Laboratory include the sending and receiving of mail, the management of an appointment book, and the management of reminders and other memos, including such things as online address and telephone lists.

Let us consider the example of the online appointment book. Clearly, there are advantages to the online management of calendars. In the online system there will be one copy of the database. In the paper version,

there are often several copies, perhaps one on a secretary's desk and another in one's pocket. If there are two copies, it is possible for two people to make conflicting appointments. The computer system eliminates this possibility. However, there are several drawbacks to the online calendar system. One is that it is necessary to login to look at the calendar, which is much more cumbersome than pulling a book out of one's pocket. More importantly, one can take the book home at night, while one does not normally take one's terminal home at night. Even if one does have a terminal at home, one is not likely to take it with him on business trips or at dinner parties. However, it is often necessary to schedule appointments under these circumstances. This accessibility argument suggests that the terminal should be of the same approximate shape as a portable calculator or small dictating machine, which could be carried in the pocket or at least in the briefcase.

There are many applications for which this tool will not be relevant. For example, it will not be appropriate if a large amount of information must be displayed to the user, or complex manipulations of that information must be displayed. It will not be appropriate if large quantities of information must be input via the keyboard since a small terminal will not have a keyboard as pleasant to use as a full sized machine. However, many applications do not have these requirements. And it is expected that a new terminal of this sort will make possible new sorts of applications which have previously been impractical, because they depended on a mode of access which was incompatible with extensive, bulky, stationary terminals. New technology and new applications tend to drive each other in a circular manner. This is an experiment to determine whether new technological approaches can suggest new applications.

1.3 Proposed Effort

This study will proceed in five phases, which run more or less sequentially with some overlap. We have a number of ideas concerning interesting and novel ways in which of a portable personal terminal might be implemented. The first phase is to explore these ideas individually. The second phase involves combining various of these ideas to come up with one or more total designs for a terminal and its associated application. The third, fourth and fifth phases, which can proceed in parallel, consist of implementing a prototype terminal, a Terminal Interface Computer, and one or more applications which use that terminal. Depending on the outcome of phase 1, it is possible that more than one prototype terminal will be produced, so that we can experiment with alternative proposals. It is difficult at this point to say much about the latter phases of the project, except that the sorts of applications we have in mind include mail, appointment books, personal memoranda systems, and access to certain sorts of limited database systems, such as airline flight information or telephone books. Our estimated schedule for this project is that the individual studies of phase one should be completed in six to nine months, and that a prototype terminal might be available in early 1982. The second year of this study will presumably be occupied with various improvements to the prototype and

experiments involving different applications using the prototype. In this proposal we will discuss those aspects of the project which we currently understand, our initial ideas for the portable terminal, and the initial experiments which we intend to do to evaluate its feasibility.

The Terminal Interface Computer (TIC), requires some description. As we will discuss below, the communication link to this terminal will be rather special. Thus, we do not expect that an interface controller for this terminal would be connected to every computer. Rather, we expect a small specialized machine would provide access to the terminal, and applications would access this machine using existing network technology.

There are four important aspects to this terminal: its keyboard, its display, the manner in which it is connected to the computer, and its use of speech for input and output. The most obvious approach for obtaining a keyboard is to use a technology developed by the calculator industry. Some of the large calculators have as many keys as a normal typewriter. We intend to explore alternative keyboards, such as the chord keyboard developed by Nat Rochester at the IBM Cambridge Scientific Center.

While we are interested in exploring novel technologies that might provide new sorts of displays, our initial approach will be to use the available alphanumeric display chips. The size limitations of the terminal suggest that the upper limit is a small number of lines, perhaps two or four, each of which has at most 30 characters. Presumably, an adjunct to this terminal would be a video driver which would enable a television set to be used for a display if it were available.

Since the terminal is to be usable anywhere, we must pick a communication technique with universal availability. The only choice is the telephone. The problem of connecting the terminal to the telephone is not significant, but this constrains the bandwith which we may assume we have, since we cannot package a complicated modem into the terminal. Thus we must assume that we have voice grade audio channels, and digital bandwidth somewhere between 300 and 600 bits per second to and from the computer. This is a rather limited bandwidth, and we must work to avoid its bad impact. In some circumstances, higher speed channels may be available, and we will consider how they might be used as an augment to the basic design.

We imagine speech being used in two ways as part of this terminal. First, if we can obtain speech vocoders (which would obviously not be a part of the terminal itself, but rather a part of the TIC to which the terminal dials), then we can build a variety of applications which involve the management of digitized audio information. For example, we could send and receive audio messages, rather than messages typed into the keyboard. We could have a personal memo system in which the memos are dictated rather than typed. We could in fact use the system for dictation, by providing secretaries with a different form of station in which the

digitized audio can be played back as is done with a traditional transcribing machine. Such a dictation facility will allow one to dictate computer mail, which was subsequently translated by one's secretary into a form suitable for sending in the computer mail systems of today. This use of digitized speech does not involve its real time transmission between stations, but does involve processing and transmission of this information between various computers and the TIC. It would advantageous to use vocoders which consume a small digital bandwidth, since this will markedly reduce the storage space required to hold digital messages.

The other use of speech involves a Votrax or higher quality speech output device, which can be used as an alternative to the limited display into the terminal. One could imagine a mail system in which the ASCII mail was read to the user over the telephone. It is possible that if the speech device were of high enough quality it could completely replace the display, so that no other output device is required. It would be reasonable, in a production system, to spend a substantial amount of money to obtain a high quality output device, such as the one developed at MIT by John Allen, for reading to the blind, since the machine would be located at the TIC and shared among all the users of the system. Presumably, one unit would be able to serve a substantial number of users, since most of the applications we have so far proposed consist of fairly brief interactions with the system.

The above description gives some idea of how the prototype terminal might be configured. The following are a number of preliminary experiments which we will do to determine the feasibility of these ideas.

There are a number of issues surrounding the display. Since the display will be small, perhaps 100 characters, and we have a very low bandwidth link to the computer, considerable human engineering will be required in order to make this display useable. One set of experiments has to do with various ways in which such a display might be managed. We envision that the portable terminal would contain an internal buffer holding the text of relevance, and the user would be provided with a variety of scrolling controls which would stream this text through the display at high speed. We must therefore consider how the text should move through the display -- should the text imitate a signboard smoothly flowing from right to left? Or should it jump from line to line as in a high speed reading machine?

Another set of experiments will explore how the application should manage this internal buffer. Clearly, most applications do not involve the simple streaming of text past the reader. The data has structure, and the reader picks his way through the structure. For example, when reading mail, one may read part of the header and then skip to the body of the text, or may skip the message entirely and proceed directly to the next. We have developed a structuring model for the internal buffer which will make it possible for the user, with the cooperation of the application, to manage the buffer in this structured manner. We wish to explore the

validity of this strategy.

A final set of experiments related to the display have to do with packaging and power requirements. It is possible that certain scrolling modes may move the text so fast that LCD's are not quick enough. This will require us to move to LED's, which have vastly increased power requirements. Some substantial compromises may be required in order to avoid having a battery pack which is larger than the terminal.

Some of these experiments involving the human engineering of the display can be performed by emulating the intended behavior of the display using a bit map raster scan video display, such as the Alto. Once we have created a display on the Alto's screen which is the same shape and size as we expect to have in the terminal, we can then experiment with moving characters through this window in various ways to see which is the most pleasing to the user.

In the area of the keyboard and the telephone interface, the principal studies involve packaging consideration, and the possibility of adopting novel alternatives to the normal keyboard.

There are a number of studies required in the area of speech. One project involves obtaining a Votrax or similar output device and attempting to program an application so that it uses this as its normal means of communication. If we can obtain a speech vocoder, we would presumably build a simple application which involved management of digitized speech. We could build a very simple speech message or memo system or a dictating system without having to build a personal, portable terminal. A project related to the use of speech is the use of a modem for the terminal which can switch back and forth between digital and analog transmission without either end becoming confused. We believe this is a simple task, but it is one that has not been done.