Distributed Assistive Communication Devices For Non-Speaking Users

Dr. William Beattie, Mr. Nicolas Hine & Dr. John Arnott,
MicroCentre, Applied Computer Studies Division, University of Dundee, Scotland.
Phone. +44 1382 344711, E–mail: wbeattie@mic.dundee.ac.uk

Abstract

Handheld PDA's or wheelchair mounted communication devices offer a disabled user the ability to communicated anywhere and at any time. However, due to the processing power of such devices, they may not be able to perform some of the processor intensive tasks required by some assistive techniques. By using a handheld device connected to a server, the large processing required for some assistive techniques could be provided by the server and the results transferred to the user's handheld device. If effect this would be similar to the user having the processing power of the server in a small portable device.

As an initial experiment a word prediction application was used over a simulated mobile link to see if the information from a remote process could be exchanged at a rate that is sufficient to be useful. This paper will describe the results of this experiment.

Key words: Disabled non-speaking users, Communication devices, Distributed services

1. Introduction

A non-speaking user of a telecommunications service has to overcome a number of barriers before they are able to participate in a conversation. Previous work has demonstrated that it is technically feasible for a telecommunication terminal to be adapted so that non-speaking people can participate in conferencing/ conversation services [IPSNI ii 1995]. In addition, initial results suggest that the use of additional media, such as pictures or video, may enhance the functionality and usability of an assistive communication system [Hine et al (1995a & 1995b)].

The use of client/server systems can provide the user with more information and more powerful assistive processes than can be installed in a local system. In practice, it is proposed that a user has a computer system through which they can communicate with a remote user. In addition, they can use the computer as a platform for assistive techniques that help them in face to face conversations. In both cases, the assistive technique can help the user to produce text (which might subsequently be spoken by the system), to find, display and annotate pictures or to find and play video or sound clips

Although this is achievable within the fixed environment, the reduced processing power, storage capacity and physical size of a mobile terminal (compared to fixed terminals) provide additional problems which need to be overcome. One method of providing such a service for non-speaking users would be the use of client server software. This type of scenario would allow a user to have a cheap, small handheld device linked to a remote server via a mobile data link. The large processing required for some assistive techniques could be provided by the server and the results transferred to the users handheld device. If effect this would be similar to the user having the processing power of the server in a small portable device.

As an initial experiment, a word prediction application was used over a simulated mobile link to see if the information from a remote process could be exchanged at a rate that is sufficient to be useful. This paper will describe the results of this experiment.

2. Hypothesis & Goal

Information required by the disabled user from an assistive process running on a computer at the end of a telecommunication link can be exchanged at a rate that is sufficient to be useful.

3. Subjects

The experiment is designed to provide information on the delay encountered when a predictive text retrieval services was being used. As a result only 1 subject was used who presented with Muscular Dystrophy which affects his speech and motor control. No adaptations were used for this subject and all text was created using the keyboard.

4. Method

Text productions rates were measured with a subject using an assistive process (word prediction) on the local machine.

The assistive process was then be moved to a remote machine and the interface displayed on the local machine. Using a range of network transfer speeds ranging from 1200 baud upwards, quantitative measurements were taken of the rate of text exchanged by the experimental subject. The subject attempted at all times to use the assistive process to help them to produce text.

Following the experiment qualitative information was gathered to see if the subject had any comments about the response times of the system as they used the assistive technique in the production of text.

4.1 **Training**:

2 text typing exercises involving typing a dictated passage of 30 words from a

national newspaper.

4.2 Experiments:

8 text typing exercises involving typing a different dictated passage of 30 words for each exercise from a national newspaper. This test were run locally, and then at the following modem settings: 9600 bps, 2400 bps, 1200 bps. Both experimental conditions for each subject can be directly compared for each word typed or selected from the word predictor.

5. Apparatus

Figure 1 shows the experimental setup required for all conditions

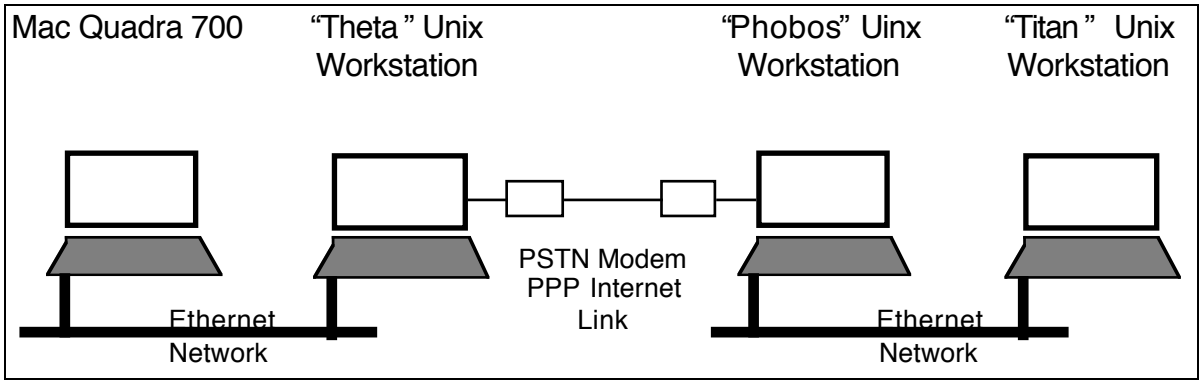

Figure 1 - Experimental Setup

For the experimental conditions (Local and Remote assistive text prediction processes) a number of services were provided which are described in Table 1 showing which piece of equipment provided which service.

Table 1: Processes and the host computer

	Quadra 700	Theta	Phobos	Titan
Local Prediction	Exodus X-Server Displaying Text Telephone and Prediction Interface	Motif X-Windows GUI XTALK Text Telephone process PAL Prediction process	Not Used	Not Used
Remote Prediction	Exodus X-Server Displaying Text Telephone and Prediction Interface	Motif X-Windows GUI XTALK Text Telephone process PPP PSTN/ Internet routing process	PPP PSTN/I nternet routing process	PAL Word Prediction process

Figure 2 shows a screen shot of the word prediction software used in the experiment. With this software users type letters of the words they require and the software predicts, based on frequency and recency of use, a list of possible words. If one of the predicted words is correct it can be selected using a single key (usually the function keys) thus saving effort typing the word in full. For multiply disabled users this saving in effort can be quite significant. If none of the predicted words is correct the user simply types the next letter of the word and is presented

with another list of words based on the typed in prefix. This continues until the required word is selected or the user types the word in full.

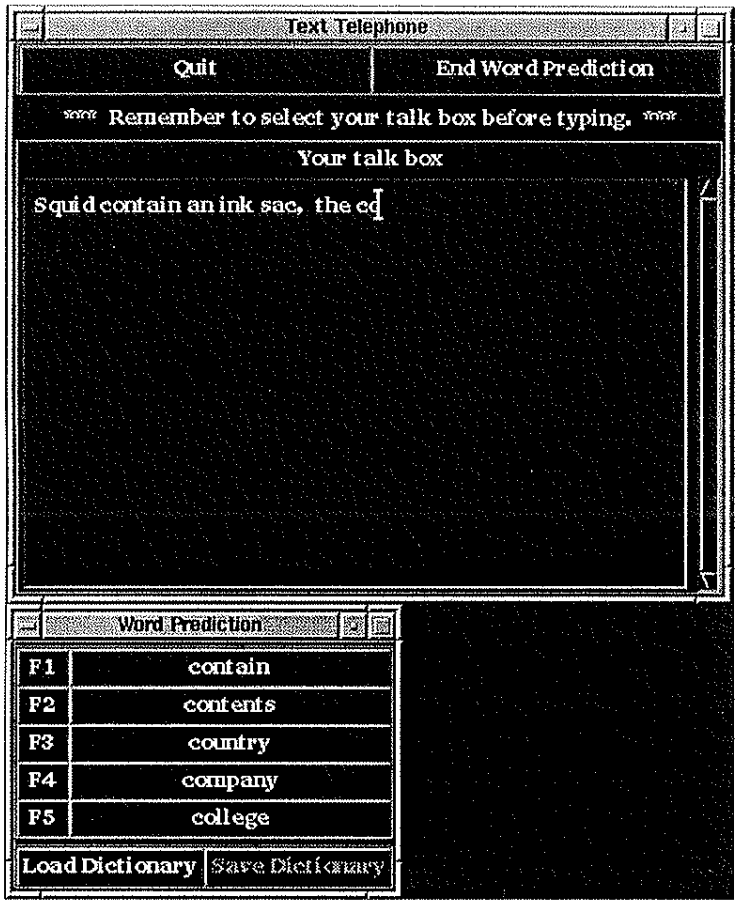

Figure 2: Screen display of the text prediction software.

The following materials were prepared for the experiments:-

8 pieces of text from a national newspaper (each with 30 words)
Timetable of training and experimental sessions

A typical passage is shown below:-

Squids contain an ink sac, the contents of which are released in a cloud to hide their retreat when irritated.

Most squid are small, usually less than a foot in length. Squid are a very popular food on the Orient.

The head of the squid has a funnel. It shoots water through the funnel in order to move itself backwards.

Giant squid is found all over the world. Unlike its smaller cousins, it is not edible. It tastes very bitter.

6. Results

The following records were taken:

Time coded video recordings of the subjects' computer monitor;
Time coded records of all data generated in each terminal, including time coded records of the TCP/IP traffic

From the information gathered during each experiment a measure of the time taken from the user pressing a key to receiving the appropriate set of predictions was calculated. The following graphs show the average time for the predictions to be displayed for all 8 passages for each of the experimental conditions (Local word prediction process and Remote word prediction process using a modem link at 1200 baud, 2400 baud and 9600 baud).

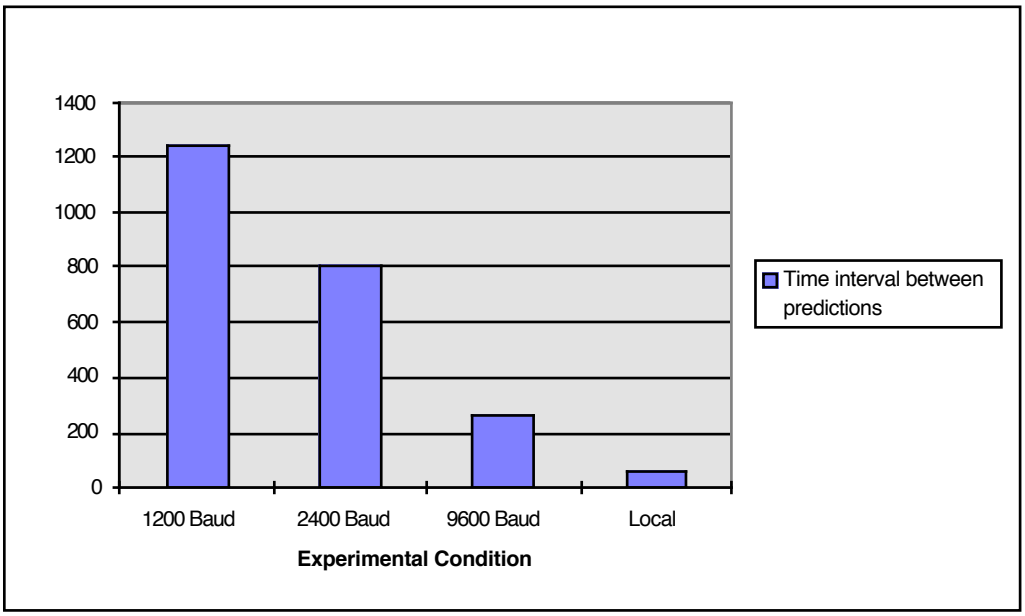

Figure 3 Time interval between predictions

Obviously as the speed of the link between the user and the remote service decreases, the elapsed time for the predictions to appear increases.

7. Discussion

The experiment was designed to test the hypothesis that information from a remote process can be exchanged at a rate that is sufficient to be useful. Comparing the remote process to the Local process shows that there is significant increases in the time taken to present the predictions (from and average of 60 ms in the local process to 1248 ms for a remote process with 1200 baud link).

Qualitative information gathered from the subject on the quality of the assistive process showed that the subject did notice the extra delay as a result of the process being run remotely. However, the delay only affected his typing at rates lower than 2400. This was evident from the number of characters that were type -

using the 2400 baud link the subject typed more characters (average 110) compared to the Local condition (average 89). This was due to the subject missing predictions - when he typed a letter he looked for the prediction list expecting it to appear without much delay however due to the delay caused by the communication link, a previous prediction list was still displayed on the screen. Often this obviously contained the wrong words and so the subject typed in the next letter of the word before the correct prediction list had been displayed. This caused the subject to miss some of the predictions which were in the correct prediction list.

The subject stated that he did not like using the remote process running at 1200 or 2400 baud because the predictions appeared too slowly.

8. Conclusions

The results show that for word prediction to be effective over a remote link, there must be a band width of at least 9600 baud which is dedicated to the text prediction process. Below 9600 baud the user notices the delay and this can lead to frustration and errors. Obviously with other types of process, using perhaps media other than text, the bandwidth requirement will have to be investigated.

The results of this experiment show that remote processes can be used effectively. This type of scenario would allow a user to have a cheap, small handheld device linked to a remote server. The large processing required for some assistive techniques could be provided by the server and the results transferred to the users handheld device. If effect this would be similar to the user having the processing power of the server in a small portable device.

9. Acknowledgements

This work is undertaken within the ACTS UMPTIDUMPTI Project AC027 with financial support of the Commision of the European Communities.

10. References

Hine, N.A., Wilkinson, D, Gordon, I.A.S & Arnott, J.L. (1995a). Picture Annotation As A Communication Method For Non-Speaking People. In Proc. ECART 3, 1995, pp 146-149.

Hine, N.A., Wilkinson, D, Gordon, I.A.S & Arnott, J.L. (1995b). An Adaptable User Interface To A Multimedia Telecommunications Conversation Service For People With Disabilities. In Proc. Interact ’95, 1995,Chapman & Hall, pp394-397.

IPSNI ii (1995). CD-ROM Integrated Telecommunications For People With Special Needs.