# AN ADAPTABLE USER INTERFACE TO A MULTIMEDIA TELECOMMUNICATIONS CONVERSATION SERVICE FOR PEOPLE WITH DISABILITIES

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**ABSTRACT:** The emergence of multimedia telecommunications services is potentially particularly attractive for people who have reduced mobility and other disabilities. It is often the case, however, that a user will have a complex range of impairments that require specific and often individual attention. By using a computer as the telecommunications terminal additional media can be made available and special intelligent assistive techniques can be added. These changes have implications for the design and customisation of the user interface. Some initial experiences gained in conducting experiments with a group of users with disabilities employing an adaptable emulated multimedia conversation environment are reported.

## BACKGROUND

In recent years, a number of advances have been made in telecommunications and computing technology that have resulted in videotelephone equipment and services becoming available for corporate and domestic customers. It is now possible to choose either dedicated videophone terminals or to add videophone functionality to suitably powerful desktop computer systems. These terminals can operate over local area networks, conventional analogue telephone systems or ISDN digital telecommunications networks. In general, however, all these networks do not have sufficient bandwidth to handle full motion, real time video signals. Recent advances in broadband telecommunications technology, however, promise bandwidth that could readily accommodate full motion, real time, high quality video. In addition, a host of other multimedia services should be available to be added to basic videophone services, allowing flexible and versatile services to be constructed to suit specific applications and user requirements.

The work reported in this paper involved the construction of an emulated videophone service that can be employed in the study of how such a service can be used by people with disabilities. The emulated service was operated through a flexible user interface whose layout could be changed to reflect the information media being exchanged and the specific requirements of the user to compensate for their disability. This interface was designed to follow standard best practice in multimedia interface design. [1,2,3]

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## DESCRIPTION OF THE SERVICE

The emulated service allows the simultaneous exchange of video and audio information between two Apple Macintosh computers with video overlay and audio play-through functionality. The functionality to pass text between the two machines and the functionality to simultanecusly show a picture and to draw or type on it were added. These functions were added to allow the service to be used to study the accessibility issues for people with disabilities. In the case that users are unable to speak, they may be able to communicate their ideas via a text telephone. If they have poor language or literacy skills, they may be able to highlight aspects of a displayed picture.

The emulated service was constructed in the SuperCard rapid prototyping environment. The user interface allows parts of the computer display to be allocated for the display of video or the exchange of text, or the display and annotation of pictures as required. A possible layout where these three functions are available are shown in figure 1 below.

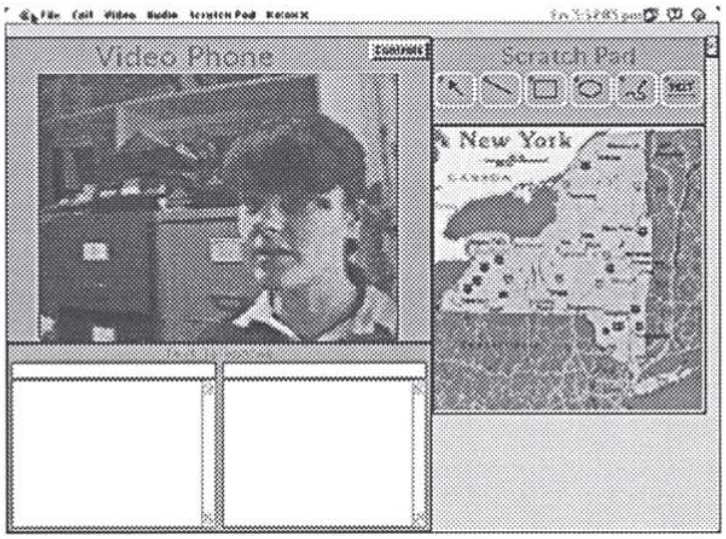


Figure 1 - Emulated Videophone with additional text exchange and picture display/annotation functionality.

In order to study the relative contribution that different media make to the successful exchange of information, and to study the accessibility of different media for people with disabilities, a number of goals were set.

1) To be able to construct interfaces where the users, particularly users with disabilities, would see one single "application" on the screen of the computer. Although each function (i.e. video exchange, text exchange and picture display and annotation) was handled through a separate window, this was not supposed to be apparent to the user. This was designed to avoid confusion arising from information being handled by one window being obscured by another window.

2) To develop a system that could be readily altered to move, resize or hide the part of the interface that handled a particular medium.

3) To develop an interface where parts of the display area could be allocated to additional software elements that would provide a user with disabilities with additional assistance, for example an on-screen keyboard.

The flexibility of the resulting system allows the layout of the screen to be altered to reflect the needs of the user and the information to be exchanged. It is possible to restore to each window its conventional boundary features. This allows each window to be resized and repositioned. Once a new layout is approved, it can be frozen and the window boundary features removed. The parameters governing each layout can be stored for later re-use, so task or user specific layouts could be recalled, and the same system tailored to the needs of a variety of different users.

This became particularly important when the needs of users with disabilities were considered. Many people have a complex mix of physical and sensory impairments that not only result in difficult in speaking, but also affect their ability to use a conventional computer keyboard or pointing device. For this reason, a set of devices and software were assembled that could be added to the basic system to adapt the service interface to allow it to be made useable.

Because information could be exchanged in a number of media, and because each mix of impairments and the resulting disabilities are unique to each user, it is impossible to predict in advance exactly how the system should be adapted. For this reason, a structured approach to testing the possibility of providing access to the emulated service was devised. This is described below.

## PILOT STUDY

### Method

Six attenders at a rehabilitation day care facility agreed to take part in the pilot study to test the service and to adapt the interface to make it accessible to them. In each case, the following procedure was followed:

1) A conversation scenario was constructed that involved the user in a discussion about a visit to New York State in the USA. The scenario was

loosely scripted, in that the data to be exchanged and the media to be employed were given, but the users were free to "package" their questions and responses as they wished. A member of the research team took the role of the "travel agent" throughout the study.

2) Each user in the study had previous experience of text processing and drawing and painting applications on the Macintosh (the preferred machine at the rehabilitation centre). A number of the users had taken part in earlier studies involving the use of the text telephone. None had any experience of using a videophone. They were all given hands on training in the use of the various functions of the system, including a practice run through the scenario script. Then an attempt was made to run through the script as a "real" conversation. Where a user encountered a problem, a "helper" (another member of the research team) handled that part of the conversation. The problems were logged.

3) The experience of using the service was analysed. Each problem encountered was considered, and an adaptation to the hardware or an additional software assistive function was proposed. The user interface layout was re-designed to accommodate any changes that were necessary.

4) The system, complete with adaptations was tested with the users. If problems remained, the last step was repeated once more.

## SUBJECTS

The subjects in this study had the following disabilities that affected their ability to use the emulated service.

1) Subject R: Cerebral Palsy, resulting in severe loss of speaking abilities and no useable control of hand movements. R is able to use head movements to press a switch.

2) Subject E: Cerebral Palsy resulting in major loss of speaking ability and little useable control of hands. E uses her chin to control a motorised wheelchair through a set of switches.

3) Subject I: Advanced muscular dystrophy, resulting in major loss of strength and severe loss of speaking abilities. I is able to write, but with difficulty.

4) Subject G: Cerebral Palsy, resulting in major loss of speaking abilities and reduced ability to use hands. G employs an assistive speaking device to generate speech and can slowly use a keyboard and mouse.

5) Subject J: Impairment unknown, but has speech that is difficult to understand and some reduction in the ability to use hands.

6) Subject D: Pre-lingually profoundly deaf with the consequence that speech is very difficult to understand.

## Results

In all cases it was found that the user interface could be adapted so that the users could handle every part of the conversation script. This was achieved after a maximum of two attempts to adapt the interface.

The problems encountered and the adaptations made for each subject are listed below.

1) Subject R: Without adaptation, this user was unable to take part in a conversation using any functional part of the service. Adaptation of the service involved adding a switch interface that triggered an on-screen scanning array. The on-screen scanning array scans through objects in the scan window. The scan can be started by a switch press and stopped when the scan marker is over the object that is desired. In this case, a full set of alphanumeric and punctuation characters were provided in addition to a set of mouse emulation functions. This allowed the user to type and to perform mouse functions on the screen objects, simply by pressing a switch with a movement of the head. This was so slow that text prediction software was also added to the service interface.

The text prediction software presented the user with a list of the most predictable words that matched a character typed by the user. If the required word was in the list, it was selected. If not the next letter was typed. Considerable keystroke savings, and hence time savings can be made using this technique.

The addition of on-screen assistive techniques meant that the layout of the screen had to be altered to accommodate the additional elements. This was accompanied by a reduction in the size of elements such as the video window and the text telephone window. The effect of this on conversation fluency and effectiveness is a matter for further study.

2) Subject E: This user was unable to type or use a mouse, but could use a rollerball mounted so that it could be operated with movements of the chin. The roller ball was equipped with two buttons. The left hand one was configured to act as a conventional button and the right hand one was configured to stay "down" when it was used, allowing screen elements to be dragged. Typing was provided by adding an on-screen keyboard. Items on the keyboard were selected by clicking the pointer on them. In order to improve speed and typing accuracy, text prediction was added. The layout of the interface for this user is shown in figure 2 below.

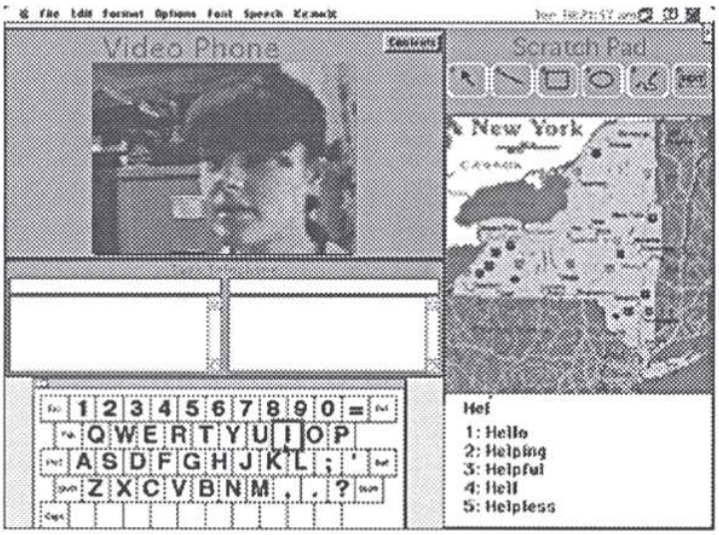


Figure 2 - Emulated Videophone with adaptations for subject E

3) Subject I: The adaptation employed for this user consisted of an on-screen keyboard and text prediction.

4) Subject G: This user did not need any adaptation to the interface. The siting of the keyboard, mouse and the assistive speaking device was critical. Because of reduced hand movement control, a rollerball was tried, but this proved to require too fine motor control for this user.

5) Subject J: The only adaptation made to the system was the addition of the text prediction, added in the space below the picture window.

6) Subject D: Again, the only adaptation made to the system was the addition of the text prediction.

As a result of these adaptations, all the users were able to complete all parts of the conversation without any assistance. It was found that the interface could be configured to suit each user in a matter of minutes by recalling saved layouts.

## CONCLUSIONS

This exercise demonstrated the need for an adaptable interface that could be tailored to the needs of different users, and it showed that it is possible for people with quite severe disabilities to participate independently in a multimedia conversation.

Having verified that the basic emulated service tool operated as required and that the interfaces can be adjusted, stored and retrieved when required, a number of aspects of the interface to multimedia conversation services can now be explored using this tool. These include:

1) The usefulness of different media to a conversation or collaborative task, and how this usefulness can be affected by the absolute and relative positions or sizes of the "media spaces" within the interface.

2) The value of being able to customise the appearance of the interface and its elements according to task or personal preference, and being able to recall task or user dependent layouts.

3) Interaction between people in a conversation or collaborative task, particularly when one or more participants have difficulty handling an information medium. Issues such as those that govern the suitability of another medium to convey the same information, the effect that this difficulty has on the richness of the information being conveyed, and the types of assistance that the remote partner can give the person with a disability can all be explored.

It is the intention of the authors to utilise this tool to explore some of these issues.

## REFERENCES

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