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Long paper

A multimedia social interaction service for inclusive community living: Initial user trials

N. Hine, J.L. Arnott

Department of Applied Computing, University of Dundee, Dundee, DD1 4HN, Scotland UK
E-mail: {nhine,jarnott}@computing.dundee.ac.uk

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Abstract. The move from institution to community care has resulted in many people receiving care at home. For some, disability or frailty restricts their involvement in social activities outside the home, resulting in unacceptable social isolation. This problem is compounded if the person has a speech or language impairment. In this paper, we will describe a communication service designed to provide nonspeaking people with a means to interact socially when living independently, based on the sharing of stories using pictures and other media. Initial exploration on the usability of the system by a pair of representative users will be described.

Keywords: Assistive communication – Social isolation – Videoconferencing – Internet

1 Introduction

Care in the community has become the dominant means of delivering care in many countries over the last decade. In the United Kingdom, for example, the 1990 National Health Service and Community Care Act defined the move from institutional care to community care for a number of people requiring, or likely to require, long term care. Whilst community care means many things, political rhetoric is being replaced by concrete measures to ensure that different agencies can work together to provide comprehensive care programmes for people living in their homes or in small community homes. The recently published "*Response To The Royal Commission On Long Term Care*" [1] details specific measures that will be put in place to improve the quality of long term care, including the role of technology in the provision of care. This was reiterated in a government Statement on Older People [2]. In 1997, the Scottish Executive [3] planned to spend £1.8M on community care in the fiscal year 2001–02. In spending plans for the year 2000 [4], this had risen to a planned spending of £8.1M for the same year, rising to £10.8M for the year 2002–03.

Community care is promoted because it implies that people are actively involved in their local communities, provided there is a strong social infrastructure and a wide variety of services in place to enable social and economic integration. There is a real danger, however, that individuals with health or care needs living at home or in isolated communities could find that the level of both care and social interaction fall when compared with their experiences of living in good long-term care facilities. Recognising this, the Scottish Executive have considered a number of these vital services, including transport, building regulations, and services in rural areas [5–7].

The political statements are also, to some degree, a response to growing public awareness of rights to, and availability of, high-quality care. When considered alongside various pieces of legislation governing rights and services for people with disabilities, demand for functioning services will continue to grow [8].

Considering the large numbers of statements, bulletins, and research findings published by government agencies, it would be tempting to believe that the concept of community care is well accepted, and that any recognised deficiencies are being addressed. Recent press and television reports have, however, been highlighting the growing incidence of isolation of people living in private homes and receiving care or living in small group homes in the community. For example, MacDonald [9] states:

> "Almost one third of the people surveyed felt they needed help with some aspect of daily living. Social isolation, type of housing, and other environmen-

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> tal factors affected how much support people felt they needed. Many of those most in need did not use social services."
>
> "People who had said they had little social contact were found to include a number who were suffering from loneliness or some form of mental distress. Bereavement was the most evident cause of isolation and loneliness. However, isolation was not necessarily associated with living alone. Some people living with a partner where one or both needed a lot of support were particularly isolated and lonely."

This sense of isolation within communities is also reported by Taylor [10], who states that 35% of people with disabilities do not feel at all involved in their local community, compared with 21% of people without a disability.

2 Social interaction in the community

Social interaction is central to community living. Emler [11] showed that human beings spend more than 80% of waking time in the company of other people. Even when engaged in vocational tasks, people interact socially. Read and Miller [12] make the point strongly that humans are social creatures.CE[a] We interact with others in various ways that influence our status and roles in social communities. Dunbar [13] states that about 66% of conversation is concerned with the exchange of information of social relevance. A key element of this "socialising" is the recounting of stories. Even in environments where the focus is on another activity, once conversation starts, it rapidly moves away from the technical, practical, or even functional, to the social, to "gossiping," and to storytelling. This aspect of communication is fundamental in allowing a person to enhance their reputation and bond with their peers.

Storytelling is considered to be such an important bonding and community-building skill, Dunbar argues, that this may have been the fundamental driver behind the development of language in human beings. Storytelling is still a primary means of introducing children to language and for stimulating language acquisition.

Social interaction is vital therefore, for successful and fulfilling community living. If people are physically isolated within the community because of the nature of their care needs, an alternative method of social interaction must be available to prevent the inevitable social isolation.

The traditional means of providing social interaction for people who are physically separated is the telephone. But care in the community implies that a person is in need of care, because of a medical condition, disability, or frailty associated with aging. Among the European population, 2.8% have a speech or language impairment [14], and speech or language therapists are involved in a care programme for 0.65% of the population [15]. People with such impairments are unable to use a telephone.

Furthermore, 47% of these people have an additional physical or sensory disability that further reduces their opportunities for social interaction outside their home. They therefore require alternative forms of social interaction, including some means to share stories. Whilst the majority of assistive communications systems have concentrated on transactional interactions and on the sharing of emotions, a few systems have addressed social interaction by providing the means to share stories. Systems such as Talk:AboutCE[b] collect text objects from which stories can be constructed and spoken out using synthetic speech. This commercial system builds on research involving prototype conversation and social interaction support systems, such as PROSE and CHAT, and recognises the point made by Beukelman and Mirenda [16], who report:

> "Most of the research and technical developments in the field of AAC (augmentative and alternative communication) have focussed on strategies for enhancing communication of needs and wants and, to a lesser extent, information transfer. The lack of attention to social closeness reflects both a narrow clinical perspective and the very real difficulties inherent in achieving the goals of social closeness interactions. Nevertheless, from the perspectives of many AAC users and their significant communication partners, this type of interaction may be more important than any other."

3 Alternative communication

Two candidate technologies for providing an infrastructure for remote social interaction that have emerged strongly over the last few years are videoconferencing and the Internet.

3.1 Videoconferencing

The history of videoconferencing goes back to the 1920's, but deployment has been slow because of technical limitations of the systems and the telecommunications infrastructure, and incompatibility between systems. Over the years, therefore, the International Telecommunications Union has defined a set of standards to describe the technical characteristics of videoconferencing on a variety of different network infrastructures. The definition of the H.323 standard provides a unifying videoconferencing service standard that eliminates various incompatibilities [17, 18]. This standard also defines videoconferencing service for the Internet, placing the Internet at the centre of videoconferencing services of the future.

Finn et al. [19]CE[c] discuss various studies that have compared videoconferencing to other methods of engaging in social interaction. They conclude that:

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> "users' desire for video results from the impact on the process of their interpersonal interactions, rather than from its perceived effect on any product of their interaction."

They also make the point that:

> audio is critical, and high quality audio is more important than high-quality video.

This fact emphasises the difficulties faced by nonspeaking and deaf people who are unable to interact using this critical communications channel.

3.2 Use of the Internet

Statistics for the use of the Internet are invariably presented as gross estimates. Hijazi [20] states, for example, that by the end of 1999, there were estimated to be 176.8 million users of the Internet worldwide, an increase of 46% over the 120.5 million in 1998. The increase in Europe was 117%, from 23 million in 1998 to 50 million in 1999.

Lieb [21] reported an increase in people who used the Internet at home but not at work. It had risen from 36% of those using the Internet in 1997 to 41% in 1999. At the same time, the proportion of people who used the Internet at work, but not at home fell from 19% to 13%. The figures indicate a trend towards greater use of the Internet at home, particularly amongst those who are not at work. CE[d] This has been encouraged by trends towards higher bandwidth technologies for connecting homes to the Internet and falling costs for these technologies [22, 23].

The increase in the penetration of the Internet has been accompanied by growth in medical, education, business, and shopping services. For example, Hijazi (1999) reported that 27% of the UK population over the age of 16 were online in late 1999, and 27% of those users were also using the Internet for online shopping. The regular industry observation performed by Neilsen NetRatings [24, 25] revised the estimate for the UK to 19.47 million people, or 32.72% of the UK population by July 2000. Lewis et al. [26] estimated from a MORI poll that by mid-2001 23 million people in the UK would be online. Significantly, 20% of the UK population expected to be dependent on the Internet for shopping within the next few years, and 30% for banking.

3.3 Videoconferencing on the Internet

One outcome of growth in Internet use has been the increasing deployment of videoconferencing. The benefit of videoconferencing in medicine has been recognised for some time. In 1998, Versweyveld [27] summarised some early projects in which videoconferencing was used, including the relaying of live video from ambulances to hospital emergency departments to allow them to more appropriately prepare for the incoming patient. More recently, Versweyveld [28] has described the launch of a telephonic stethoscope to be used in conjunction with a standard H.323 videoconferencing terminal.

The widespread deployment of the Internet, particularly the deployment to domestic dwellings at affordable costs, provides the opportunity to deliver services tailored specifically to the needs of people with disabilities. These include information services that focus on the information needs of these users, social interaction, and practical health and welfare services. To be used by people with disabilities, these types of services should be designed to take the specific needs of these users into account. The European Technical Standards Institute, for example, is actively involved in attempts to ensure that systems and services in Europe meet that goal [29–32].

A number of factors make videoconferencing as 0 a method of distance communication more attractive than conventional telephony. Watson and Sasse [33] summarised a number of studies that showed that the addition of the video channel allowed users to perceive the contents of the audio channel more accurately and to deal with poor audio quality and background noise. Not only could those with poor hearing benefit, because the video might help them interpret the audio channel, but people with good hearing might be able to better interpret speech from a user with impaired speech.

Ramsey et al. [34] highlighted the fact that during informal communication and interaction, users often need to share a piece of information in a more persistent way than the dynamic, transient nature of audio and video channels supports.

Recent trials of services for people with disabilities have generated renewed interest from service providers and manufacturers of rehabilitation technology [35]. These agencies and commercial companies appear to believe that it is becoming realistic to deploy services to the community, as more and more domestic and community dwellings will have the necessary telecommunications or network infrastructure.

For users with poor speech, however, an alternative communication channel must be available for information exchange. McKinlay et al. [36] and McKinlay et al. [37] began to explore issues such as turn-taking and the use of text-prediction techniques to enable text chatting to be used as an alternative communication channel by these users.

A promising recent development is the integration of Internet-based videoconferencing with the World Wide Web (WWW), so that videoconferencing is delivered via a conventional Web browser. This is an immensely flexible method of delivering videoconferencing, because the browser can also be used to deliver other communication services using a variety of media within one integrated Web page.

CE[d] It is rather humorously obvious that people who are at home tend to not be at work, particularly in a context in which these are the two choices. Did the author have some other point?

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4 Multimedia storytelling

Given greater deployment of the Internet and the requirement for social interaction services for disabled people living in the community, various alternative enhancements to a videoconferencing service have been explored. A promising method provides adults who have impaired speech or language with a means of presenting stories in the form of a multimedia narrative. Scott [38], in reviewing the work of Schank and Abelson [39], makes the point that storytelling does not automatically imply the use of words. Other forms of representation are possible, such as using pictures, images, symbols, objects, or even mathematical equations.

Csikszentmihalyi and Rochberg-Halton [40] reported that photographs are the third-most treasured possessions in the home of a modern Western family, after furniture and visual arts. When this is broken down by age, they were ranked sixteenth by children and teenagers, and ranked first by grandparents. An important aspect of this work is the significance of pictures and other objects to the owner. In general, younger people are seeking to establish an identity, to understand their place in the world, and then to assert their individuality and their individual worth. Older people tend to reinforce their comments with evidence of relevant experience. Elderly people tend to share memories and to seek to pass on wisdom based on their experience. This is reflected in the significance that they place on the objects that they gather and, in particular, in the photographs that they hold and display. In all cases, however, photographs are a means of preserving and recalling memories. Csikszentmihalyi [41] does make the distinction between this use of photographs to record history and the use of photographs as an art form and a means of exploring reality. In the case of photography as art, the viewer is challenged to interpret the photograph, to identify with the iconicity or ambiguity in the photograph. It is important, therefore, to realise the potential for ambiguity in all photographs.

The social implications of the ability to take pictures and make movies personally and nonprofessionally are explored by Chalfen in his book *Snapshot Versions of Life* [42]. He develops the notions of "Home Mode" photography and explores the culture that they portray, encapsulating it in the term "Kodak Culture". He extends the work of Csikszentmihalyi and Rochberg-Halton [40] by including home movies as a means of recording significant events and objects from the world within which people exist. His work explores the reasons that people have for recording their life, the parts that they record, and the selection of specific parts of that record that are shown to various audiences. He argues that the popularity of "home mode communication" reflects the need of an individual to make significant and personal statements about his or her place in society, and to record the significance of his or her own involvement in that society.

Chalfen [43] went on to study the differences between video and pictures when capturing and reliving memories. The key findings of this work were that video is perceived differently from pictures and that video gives a greater sense of "being there".

The use of images in mobile communication has been studied by Mäkelä et al. [44]. They report that little research has been done on the use of still pictures in communication, but they found that images have an important role in communication at a distance. A conclusion of their field trial studies was that images are not sufficient for functional communication. Text or speech is required as an additional annotation medium to make the picture's meaning or communication intention clear. Neilson and Lee [45] reiterate the need for pictures to be set in a context with an accompanying natural language statement. Without this, the message of the picture or the statement that it is intended to convey can be ambiguous.

The personal value of images was found by Mäkelä et al. [44] to be in socialising and social interactions and in recording memories. In fact, this study qualified the work of Csikszentmihalyi and Rochberg-Halton [41] by showing that younger people tended to use images to capture humorous situations or everyday objects that were important to them. This is contrasted with their use by older people to illustrate memories and to recount them in stories. A fundamental finding here was that the message of an image is likely to change over time. Its meaning for the user changes, and the story that it tells changes. In all cases, the images were used to add detail to a description or to explain when the user is having difficulties describing an object or situation with words.

5 A multimedia storytelling service

Based on these findings, it seems that a system enabling users to share experiences and stories in the form of a multimedia narrative might be attractive for some nonspeaking people. A multimedia storytelling service was designed to explore the feasibility of using pictures and other media objects as a means of telling stories. An architecture was proposed that enabled users to collate pictures, video clips and audio clips and to present them as sequences of narratives. Individual media items were organised using a database and presented through a Web browser as an interface based on Web pages. The architecture of the service is shown in Fig. 1 below.

The stories are organised according to a small number of topics and subtopics. These topics are presented as a set of choices on a user interface. When a topic is selected, the five stories associated with that topic are retrieved from the database, and added as choices to the interface. When a story is selected, the five media items associated with the story are retrieved from the database and added as choices to the interface. When a media item is chosen, it is presented on the interface,

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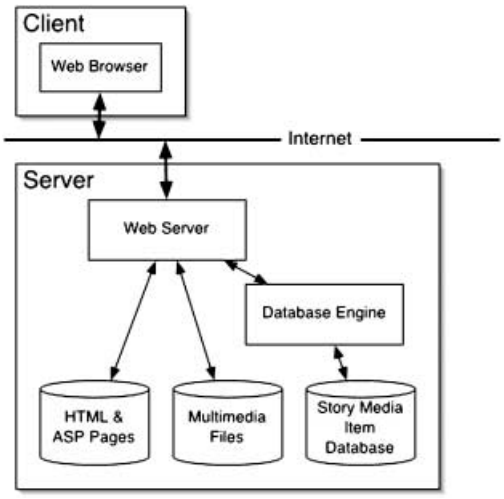

Fig. 1. Architecture of the multimedia communication service

Fig. 2. User interface of the multimedia communication service

together with a single phrase of text stating the message of the media item. The complete interface is shown in Fig. 2.

5.1 Experimental validation trials

One objective of using thumbnail pictures to label information in the communication service is to help the user to quickly find and identify information they want to use. Because the approach used in this system was different from the more conventional text or icon labelling used in the majority of assistive communication systems, it was necessary to ensure that this approach did assist in navigation to the appropriate information. In order to test the approach in general, an experiment was devised that compared the time taken to retrieve information using a text labels or pictures. Three versions of the user interface were constructed, one in which all media items were identified by their text label alone, one where the interface consisted only of picture thumbnails, and one where the interface consisted of text and thumbnails.

5.1.1 Hypothesis

The hypothesis underlying this trial is that users will be able to find information that they wish to present faster using the picture thumbnail representation of the information than if they were using text representations alone.

5.1.2 Participants

Two participants were chosen for this exploratory study. They were both nonspeaking adults with cerebral palsy. The participants selected a set of ten stories each, based on six media items per story from their personal photograph, video and music collections. The participants worked with the project team and their care assistants to prepare each media item (primarily pictures) with a text label, a picture thumbnail and a short descriptive annotation. Participant A has poor reading skills, but B is able to read well. Both users were intimately acquainted with the communication service.

5.1.3 Procedure

The experiment was designed to measure the difference in retrieval time of media items, depending on wheher the media items were labelled with pictures or with text. The interface was modified so that it had three different versions for each user: a text-only version, a picture-only version, and the conventional version with text and picture labels. Examples of these are shown in Figs. 3, 4, and 5 below.

In order to time the interactions made by the user, an isolated network was set up. The database and the Web server were running on a Windows NT 4.0 server, and the client Web browser was running on an Apple Macintosh G3 PowerBook. Both users use a Macintosh computer on a daily basis. A third computer, a Toshiba Tecra 540

Fig. 3. The multimedia communication service text-and-picture version of the user interface populated with B's media items

Fig. 4. The multimedia communication service picture-only version of the user interface populated with B's media items

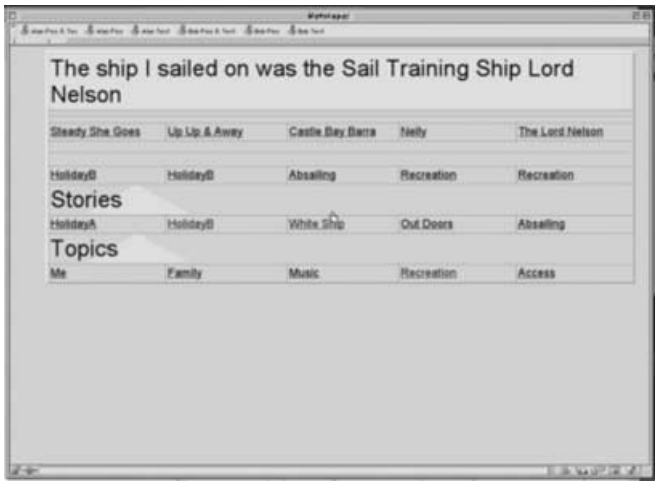

Fig. 5. The multimedia communication service text-only version of the user interface populated with B's media items

CDT running Windows 98, was used to log network traffic. The Toshiba was running EtherPeek 4 network traffic-monitoring software. This software is able to capture all, or a filtered selection of, packets passing on the local area network.

A set of 45 questions was prepared for the participants. Fifteen questions were to be answered by navigating through a text-only interface, fifteen by navigating through a picture-only interface, and fifteen by navigating through an interface of pictures and text. The order of interface to be used was randomised beforehand. An example of a command was

"Find your niece now".

The participant was instructed to find the topic, then the story, then the story media item that answered that command.

In order to time the response, as the question was presented and completed with the word "now", the appropriate interface was loaded. This action generated a call to the system server, generating a packet of data passing from the client machine to the server on the network.

As the user answered the question by clicking on the topic, story, and media item links, corresponding packets passed from the client machine to the server. The time taken to answer the question could be measured as the difference between the moment the packet carrying the request to load the user interface was observed on the network to the moment that the request for the correct media item was generated by the participant and observed as the appropriate packet on the network.

Each packet passing over the network was saved by the EtherPeek software. The time that the packet was generated is recorded as a time stamp in the header of the packet. The payload of the packet was used to verify that it was the correct packet. To measure the time taken for A to answer the question, the time stamp for the packet requesting the user interface was subtracted from the time stamp for the packet requesting the correct media item from the database.

Each participant was given six initial questions, two for each user interface, to ensure that they understood the test procedure. They were then given the 45 test questions.

Once the full set of questions were asked, two Etherpeek files were saved. The first file was a comprehensive log of every packet sent, including the Ethernet header and the payload. The second file was a summary of the network traffic, listing the date, time and URL of the transaction.

5.1.4 Results

Two properties of each interaction were calculated:

- The time taken for an answer
- The number of clicks on links that were not part of the three steps necessary to get the correct media item. These have been classified as errors.

From the times and errors for each interaction, the average time taken to answer the question for each interface and the average number of errors per transaction for

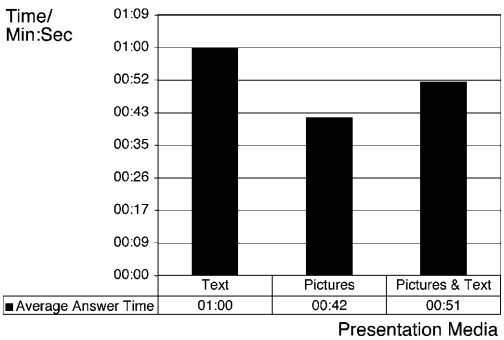

Fig. 6. Average time for participant A to answer questions

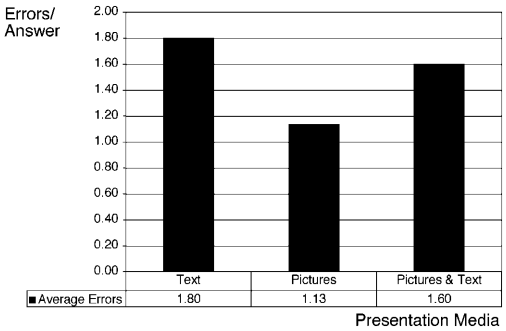

Fig. 7. Average time for participant B to answer questions

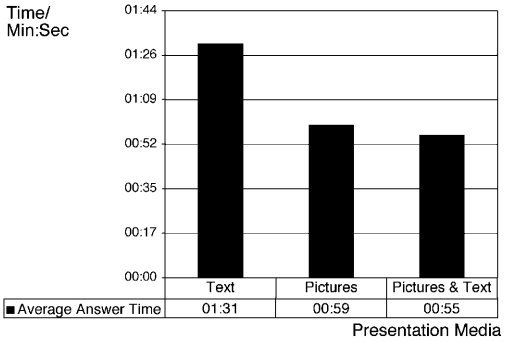

Fig. 8. Average number of errors made by participant A when answering questions

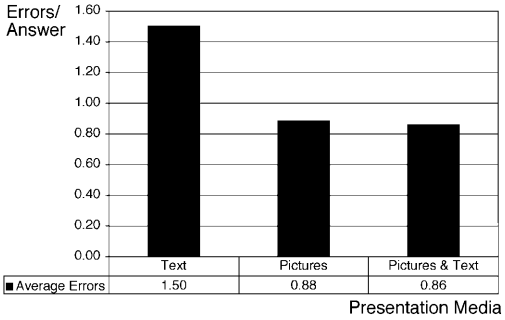

Fig. 9. Average number of errors made by participant B when answering questions

each interface were calculated. The results for A are summarised in the graphs in Figs. 6 and 7 below and results for B are summarised in the graphs in Figs. 8 and 9 below.

5.1.5 Discussion

The results show that it was faster for participant A to answer questions when the answer was represented with a picture and faster still when the answers were labelled by a picture alone. A t-test was performed on this data, which showed a significant result ($t(1.76) = 2.25$; $p = 0.02$) when comparing the use of text and the use of pictures but not a significant result ($t(1.76) = 0.75$; $p = 0.2$) when comparing text and text plus pictures. This result seems to reflect the difficulty that A has with reading. He has poor literacy skills, but his conventional means of interpersonal communication is to point to words on his own (familiar) paper word chart. When using this chart, he does not, according to his helpers, read the words. Rather he selects the words that have the meaning that he is seeking to convey based on the position that he knows it occupies on the word chart. In this trial the presence of text on a label seemed to distract him, and he would attempt to read the label. His helpers suggested that it was likely that he was trying to do the "right thing" and read the label. When the text label was not present and he could only identify the media item by its picture, he made the selection more quickly than when the text was present.

The results also show that it was faster for participant B to answer questions when the answer was represented with a picture. A t-test was performed on this data, which showed a significant result ($t(1.79) = 2.62$; $p = 0.011$) when comparing the use of text and the use of pictures, and a significant result ($t(1.79) = 2.37$; $p = 0.018$) when comparing text and text plus pictures, showing that there is a consistent phenomenon being observed for user B.

An interesting question was whether the data showed any specific reason for the delay in finding information. Examining the data logs more closely, a prominent feature of the use of the text-based interface was the higher number of errors that took place when using it. The errors were different for the two participants.

For A, the errors occurred for two reasons. In some cases, particularly when text was present in the label, A had difficulty distinguishing between the topic *Family* and the topic *Friends*. As part of his ongoing reading training, he attempts to identify a word based on its first letter. As both these words have the same first letter, he sometimes chose the wrong one. The other difficult that he had was remembering the structure of the topics and stories. For example, when asked to find his parents at Niagara Falls, he looked first under the topic "Family", even though he had placed the media item in a story under the topic of "Travel". This suggests that a more useful interface for A would be to have media items linked to a number of stories, and accessible from a number of topic-to-story paths.

For B, the errors occurred in a small number of specific instances. In these instances, the difficulty arose when the text labels were not sufficiently explanatory for the user to be able to tell what specific part of the story was being referred to. In one case, for example, the user couldn't remember if the answer was in the story HolidayA or HolidayB. The only solution was to keep clicking on labels until the answer was revealed. This problem didn't occur when the picture was present because the picture itself indicated where the story was. In all three presentation style cases, however, some errors occurred when the user selected an adjacent media item due to poor motor control.

5.1.6 Conclusion

This trial showed that the labelling of story media items with pictures reduced the time taken by these participants to retrieve specific media items for presentation. In the case of these participants, it highlighted a potential problem that users may find with text and other symbolic labels, that of running out of suitable unique and self-explanatory labels for information. As an assistive communication service is populated with more and more information, the potential for forgetting exactly what a label describes increases. The use of pictures meant that the user had a very concrete label for that specific media item, conveying a richer set of attributes than a short text label. This reduced the ambiguity in identifying the media item for the user and increased the chance of finding the required information.

This study also highlighted the need to have a more flexible retrieval path than a simple tree based on media items being part of one story only and that story being attributed to one topic only. This would allow a media item to be part of both a "Family" story or a "Travel" story, which would smooth the transition from one media item to another and reduce the need to move up and down the tree to find stories in different topics.

This study however needs to be considered as an exploration. Although the results were strong for these two participants, the study was limited in its duration and in the number of participants that took part. A more comprehensive study is currently under way, with ten users compiling a large bank of stories from their private media collections and from the archives of the occupational and training centres that they have attended.

5.2 Application and future work

In order for the multimedia storytelling service to be effective in promoting social interaction for isolated people living in the community, it needed to be integrated with a videoconferencing system suitable for domestic use. This was achieved by combining the Web-based interface of the multimedia storytelling service with a Web-based videoconferencing system. The Web-based videoconferencing allows users to connect to a videoconferencing server and load a Web page into a Web browser. This page can include plug-ins for controlling and delivering video, audio, and text-based chatting. As this Web page can be constructed as a set of frames, part of the overall page can be used for delivering another Web page, in this case the interface for the multimedia communication service. The Web page being presented within the frame can be synchronised in all the browsers connected to the conference. In this way, users with disabilities can select multimedia story items with their browsers, and this page is presented in the appropriate frame in the page being browsed by all other participants in the conference. A typical Web-based conference page, including the multimedia communication service is shown in Fig. 10. The videoconferencing plug-ins are operating in the right-hand vertical frame, text chatting is operating in the lower right-hand frame, and the large frame on the right is being used to present the multimedia communication service.

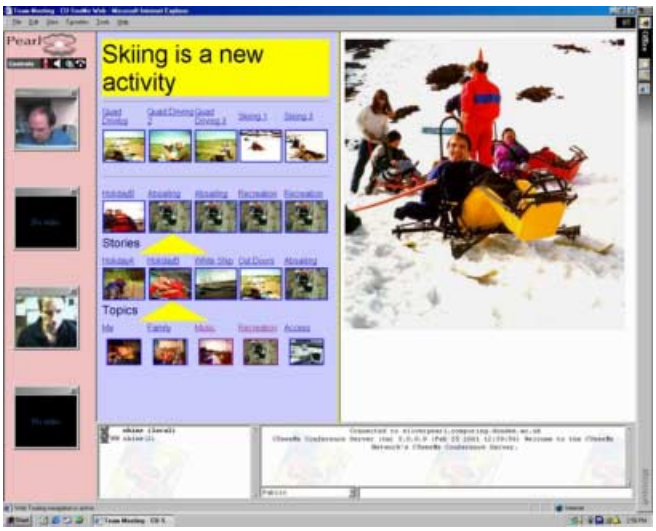

Fig. 10. User interface of the multimedia communication service integrated with the Web-based videoconferencing

This arrangement has been validated as technically feasible in the laboratory and field trials are planned, coupled with an exercise to gather a large corpus of multimedia objects from more users.

The initial system presented in this paper was piloted on laptop computers and tablet computers. In order for the system to be truly portable, work is underway to port the service to a Pocket PC handheld computer in order to explore the user-interface challenges presented by a small display.

6 Conclusions

This paper has presented a case for providing additional means of engaging in social interaction for people receiving care in the community in order to minimise the social isolation of these people. Evidence for the penetration of the Internet into the home, the case for wider deployment of Internet-based videoconferencing, and the interest being shown in the use of these technologies to provide services, including care service, at a distance have been presented. A new service for promoting social interaction has been introduced and an example of how this can be integrated within an Internet-based videoconferencing service has been explained. The trial presented in this paper has demonstrated a significant reduction in the time taken to retrieve and present elements of a narrative when the elements are labelled with pictures compared to the conventional text label. This reduction in time was significant for the two participants who took part in this study, who were chosen as they were considered to be

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representative of their nonspeaking peers likely to be interested in this type of social interaction service. These initial findings are sufficiently encouraging for the authors to have instigated an exercise to collate a bank of stories from a larger group of potential users.

Work is also currently underway to measure the utility and usefulness of this service as a tool for promoting social interaction at a distance. Trials are taking place to measure the effectiveness of multimedia-based stories in reducing the inferred interjection[CE:f] that takes place when users of assistive communication systems present speech at a slow rate. Exploratory investigations are taking place to consider if this type of social interaction support can help nonspeaking people to convey their personalities more strongly than current speech systems allow.

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