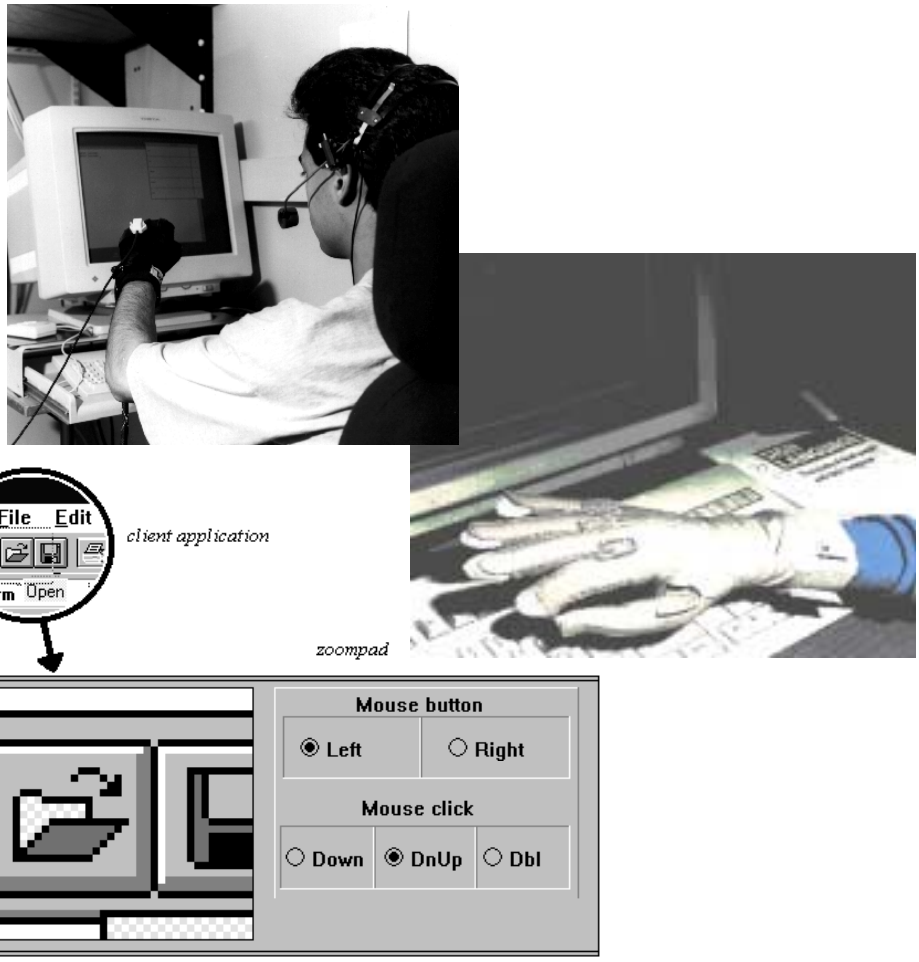
Interfaces

No. 35 Summer 1997

Extra-ordinary Interaction



human computer interaction 1997

Plus:

Leon Watts
recollects the future

Catriona Macaulay
talks to her washing machine

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Pre*face*

The past year or so has seen some changes in the Interfaces team, firstly a change in editor, then new commissioning editors, and now we are saying goodbye to our longstanding production editor, Charles Brennan, who is taking a well-earned rest from Interfaces to concentrate on other things. Ably assisted by Deborah McNish, Charles has managed the production of Interfaces for more than 4 years, seeing it through a lot of changes and developments, and has helped me tremendously in settling in as editor. Many thanks to him, and Deborah, for all their work. Our new production editor is Fiona Dix, of Hiraeth Mixed Media. She is happy to receive feedback and suggestions for how you would like Interfaces to develop in the future (email: fiona@hiraeth.com).

This is the second of our series of themed issues, covering the important subject of HCI and disability. We have had a huge response to this issue, suggesting that there is a lot of interest and work going on in this area. Professor Alan Newell of Dundee introduces the subject by arguing that considering extra-ordinary needs in interface design improves design for everyone. We have reports from two conferences held on the subject and the Window Outside feature looks at the BCS Disability Group. In Focus highlights work in this area at the University of Dundee and articles cover topics as diverse as memory paging, representing music for blind users, and the use of eyegaze software. We hope that you will find the issue stimulating and informative.

The deadline for our next issue is September 30th. It will be a general issue with no particular theme, so why not send us an article, review or conference report on whatever interests you?

Janet Finlay
Editor
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Errata: The gremlins seem to have got into the last issue of Interfaces. An article was inadvertently given the wrong credits. 'Review of Header #1 CD-ROM' was actually written by David Jennings and not as stated. Apologies to David for this error. Also a conference report submitted for the Education issue was omitted. It is included in this issue with apologies to author David Squires for the delay in publication.

With thanks to:
Commissioning editors for this issue: Dave Clarke, Andrew Monk, Sandra Foubister.

To receive your own copy of Interfaces join the British HCI Group by filling in the form on page 26 and sending it to the address given.

A hard day at the office

a light-hearted look at some day to day HCI problems…

Lon Barfield

A while back I needed a darkish yellow background for a web document. If I was choosing paint, a Pantone colour or even a new duvet cover it would be a simple matter of picking and choosing. But as it was something to do with a web page it quickly became a weird and wonderful quest full of exciting twists and turns.

To begin with one needs to be a master of four important areas of knowledge.

Firstly you need to know about the physics of additive colour mixing, how to get a darkish yellow by mixing the three additive primaries: red, green and blue.

Then you need to know about the binary representations of these colour triplets and the fact that 255 is the maximum intensity you can set the three channels at.

Thirdly you need to know how to convert these intensity values to hexadecimal.

And finally you need to know what colour you want in the first place.

I was a master of only three, my weakness was hexadecimal conversion. From my dim and distant past I remembered a colour editor where you could mix a colour and then get a hexadecimal readout of its value. A useful tool and like useful tools in the real world you never know where to find them. I last used it at the lab where I previously worked. I still had a login there, but I needed to find a machine to log into remotely. They were named after birds so I tried a few remote logins: 'magpie', no luck, 'ostritch' (how do you spell that?), 'chicken', 'toucan'. Typical computers, I wanted to specify a colour and there I was racking my brains for the names of birds… Eventually I struck lucky with 'hawk'.

Once logged in I checked my HOW-TO file (an ancient file of computer stuff that I always used to forget), there at the end was a reference to '/usr/local/viewcolour'. I typed the command in and hit enter… 'file not found'. A quick visit to the directory yielded the application 'viewcolor' (American spelling). I ran it; nothing. I reset the display variable so it appeared on my screen instead of on the screen of whoever was sitting at 'hawk' and ran it again. It was not that which I was seeking, it just showed a table of colours and the X windows textual names, no hex specifications.

I started trawling through untouched system directories, murky local contributions, little-used image libraries and found various bizarre tools. Most of them were pretty, but useless; the best were a colour cube and a colour editor called 'cedit' with three sliders (RGB) and a patch of colour but no hexcodes!

I called up the manual pages for the editor 'cedit'. There were none. I tried the man pages for the colour cube and found reference in them to 'showrgb', it sounded useful. I ran it and again got the X windows textual names with their RGB channel numbers, but still no hexadecimals.

Frustrated I logged out of the remote machine and started trawling on my local machine and found a program 'showmap' that showed the colour map, this was not what I wanted but there were a few interesting clues under one of the menus. The options 'cedit' and 'interp'.

Cedit I had seen before; that was the three sliders and the patch. I tried the mysterious sounding 'interp' and got three rectangles with nothing in them. I clicked for a while with no results and then tried the man pages:

"Interp makes smooth color ranges. Two color chips and a Gouraud-shaded polygon showing the shade range between them are displayed. To make a color range, start windows for showmap, cedit, and interp. Select the color at the lower (usually darker) end of the shade range…"

Hmmmm, confusing, and it didn't sound like what I was looking for.

There was still 'cedit'. I tried the manual pages again and now on the local machine they were there:

"The frame buffer of the IRIS contains values which are translated into RGB values by a color map for applications in color map mode. Cedit changes the mapping of any color index…"

Phew, it was heavy going but I had a feeling that there were hidden clues waiting for me. Sure enough:

"The user can toggle between decimal and hexadecimal representations of the current RGB values being displayed via the menu item 'toggle numbers'."

Yes, at last, hexadecimals! But where were they? Where were these numbers that could be toggled. I sat there toggling away trying to discern any changes in the window; none! My version only showed the three sliders and the patch. Maybe the man pages were referring to a more advanced version. The numbers should have been below the sliders. I couldn't see them. Were they being displayed in the same colour as the background, was that possible? What a diabolical trick. Could I force a refresh of the display of that window? Maybe by resizing it? I dragged one of the corners out, the window refreshed and there, wonder of wonders, were the hexcodes. What a cunning twist, the application initially started up in a window that was just big enough to show the sliders and the patch but not big enough to show the hex codes.

I was almost there. Carefully now… Wait a minute, there were 3 hex numbers for the separate channels; 0x60 then 0x8b and 0x53. This wasn't right, what did it mean? How could I crack this fiendish code?

I played around and discovered that the 0x always stay the same and the last two digits were the ones that changed. So by combining the three groups of the last two digits I could crack it and get a six digit figure that was the hex code for that colour.

At last, I mixed a darkish yellow and extracted the hexcodes. It had been a long and difficult journey, but now finally I had the colour definition that I had wanted two and a half hours ago!

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Lon Barfield is a usability expert with a background in IT and design. He was one of the founders of General Design and he lectures at the Utrecht School of the Arts and the University of Delft.

CHI for Everyone

CHI researchers have described an amazingly wide variety of computer hardware and software, but few have ever drawn any conclusions concerning the 'average' or 'typical' computer system! This is in contrast to the conclusions about users, who are often spoken of as a completely homogeneous set; the typical user being sexless, ageless, and perfect in every respect. Even the simple demography of computer games users shows us that males and females have different priorities and likes and dislikes in terms of CHI, but very little research has investigated what these differences might be. Designers thus often ignore some 50% of the potential user base. In addition, interface designs tend to be based on a very stereotypical western culture, and, although the practitioners grow older, CHI research seems to assume that its users will always remain young.

Researchers and developers often seem to forget that people actually have a wide range of individual characteristics, and this can include disabilities, such as impaired dexterity, mobility, vision and hearing. Some users may be unable to speak, or have other communication or language dysfunction, or simply be functionally illiterate. Although users with these characteristics present particularly interesting problems for CHI designers, traditionally they have been the remit of rehabilitation engineers, mainstream CHI practitioners often seeing an interest in disabled users as a fringe activity of a charitable rather than professional nature.

At the 1986 CHI conference, Ben Schneiderman commented that '… we should be aware of subtle design decisions that make usage more difficult for people with physical and mental difficulties and for individuals from different cultures … and not create a situation where the disadvantaged become more disadvantaged'. Many human interface designers have ignored this comment. For example, blind users were just reaping the benefits of having Braille and synthetic speech output when WIMP interfaces substantially impeded their access to new developments in computing.

Despite Schneiderman's plea, design for the needs of the disabled user has stayed at a very low level, possibly because they are often thought of as a minor niche market. It is estimated, however, that between ten and twenty per cent of the population have significant disabilities, and, by the year 2000, ten per cent of the population of the developed world will be over eighty years old. Medical science is enabling those with more and more severe dysfunctions to survive, and to survive for longer periods. Medicine is also expected to do more than just keep people alive, and current trends for 'care in the community' mean that such people will need more support than would be the case if they were confined to institutions. The recent *Americans with Disabilities Act* (July 1992) has also demanded that employers must reasonably accommodate the disabilities of employees and that all public facilities should be accessible to individuals with disabilities.

A hard distinction between able-bodied and disabled users, however, is a mistake similar to the false dichotomy between 'naïve' and 'expert' users. If we represent human beings as points in a multi-dimensional space, whose axes represent physical and mental characteristics, those who are categorised as 'disabled' simply have functionalities on certain dimensions of this space which differ from the average by an (often fairly arbitrary) amount. Every human being has a set of abilities and characteristics, some that can be described as 'ordinary' and some that are very obviously extra-ordinary. People move about this space whilst growing up and eventually growing old. Sickness, accident, lack of sleep or even plain drunkenness can substantially change one's position in this space, and people also move about this space from hour to hour if not minute to minute. In addition, high work load, stress and panic can produce profound changes in the physical and cognitive abilities, particularly if users are not trained to cope with such environments.

A further parameter which affects this multi-dimensional space is the environment. The majority of the lives of most potential users are not spent sitting at an office desk. A typical day may include: being in bed, eating, walking, relaxing, playing sport, being on the beach or in a swimming pool. A simple example of the value of 'design for disability' was a Norwegian telephone, with a large keypad specifically designed to assist people with physical disabilities; this was found to be invaluable in outdoor kiosks where climatic conditions meant that able-bodied users wore very thick gloves.

Even the best of environments are not always stable, and accident or emergency can make a substantial difference to the interface between the human operator and the computer. An extreme example of a user being affected by the environment is the soldier on the battlefield who is deafened by gunfire, blinded by smoke, up to his waist in water (therefore mobility impaired), in a flak jacket (therefore dextrously impaired) and scared stiff (therefore cognitively impaired). Were he to be trying to use standard office equipment, such a person would be considered to have severe disabilities – and he hasn't been wounded yet! On the other hand, if, for example, an interface designed to be operated by visually impaired people was used, it would enable a tank commander more easily to monitor his command and control computer in the thick of battle, and an efficient text communication system based on systems developed for non-speaking people could improve 'spoken' communication between commanders and troops.

The computer, in fact, is often one of the most disabling parts of the environment. Interfaces to equipment usually provide a very restrictive bandwidth between the human being and the computer. A human factors researcher once redesigned the human operator to suit the interface for a lathe: if the user was to be completely matched to a standard computer interface, such a person would be paralysed from the neck downwards, have tunnel and probably monochrome vision, have no vertical movement and only ±3 inches horizontal movement in his lower arms. This user would have no gender, nor sexual capabilities, no speech, and be profoundly deaf except for a sensitivity to clicks. The

Alan F Newell

low data rate offered by the keyboard also applies to many other human interface situations. For example, the very fit and able-bodied pilot who cannot fly his aircraft optimally because he cannot transmit enough information over an interface is in exactly the same position as a physically disabled person who cannot hit the keyboard fast enough to cope with an ordinary task.

Intelligent predictive systems similar to those designed for physically disabled people have a place here; also reduced keyboards designed for those with insufficient manual dexterity to operate a full QWERTY keyboard could be valuable in situations where there is insufficient space for an alphanumeric keyboard. More exotic interfaces often do little to improve situations such as these. For example, even within quiet environments, speech interfaces are less precise than keyboards, and the errors made are equivalent to physical disability causing users to strike the wrong keys on a normal keyboard. In this context it is fascinating to note that some of the more successful speech recognition systems have included predictive interfaces which bear a striking resemblance to word processors which were designed in the early 1980s for people with physical dysfunction.

A consideration of the specialised needs of potential users is important from a market share perspective, but it can also provide an important stimulus to CHI research and development for ordinary users, in terms of encouraging both novel designs and better design procedures. Most ordinary people are very forgiving and adapt reasonably well to many very sub-optimum interfaces (even video tape recorders!). The effects of poor design only become obvious in situations of fatigue or other extreme conditions. Thus, well-motivated able-bodied users seldom provide great challenges to the interface designer. In contrast, a disabled user can present with very difficult problems which demand very detailed consideration of the real needs and wants of the user, how they differ from the expectations of the designer, and whether and how these vary between the potential users of the proposed equipment. These requirements can stimulate the designer to develop new and more effective interfaces. It is interesting to note, for example, that the cassette tape recorder was originally designed because blind people found reel-to-reel recorders difficult to use. At the time, many people rejected suggestions that able-bodied users would be prepared to accept a loss of sound quality in exchange for a more user-friendly interface!

A common fault with designers is to see themselves, or their immediate colleagues, as archetypes of the system user. Some software seems to assume that all users are twenty-five-year-old Anglo-Saxon males, who are besotted with technology and more interested in playing with computers than completing a useful piece of work (a group which is not only a small, but also a very unrepresentative subset of the user population). Demanding that the designer/researchers consider disabled as well as able-bodied users ensures that they give serious consideration to determining the actual characteristics of their user base. Personalizable and adaptable interfaces have only recently become popular with CHI research and development, but computer access for the disabled contains many early and successful examples of interfaces that automatically adapt to the particular characteristics of the user. Since the early 1970s methods for keystroke reduction have been of substantial interest to rehabilitation engineers.

One of the methods used by medical science to increase our understanding of the human being is the examination of extreme cases, and those cases where there is significant dysfunction. Learning from extreme cases has a place in CHI research. An examination of those situations where the human side of the interface is not functioning correctly can be very beneficial in understanding the complex processes involved in many computer–human interaction situations. Disabled users can also provide groups of experimental subjects with a wider range of characteristics than are usually found within normal subject populations. A blind person, for example, would be a more amenable subject for long-term trials of the effectiveness of a speech output interface and may well provide insights which would not come from a sighted user.

Computer Human Interface engineers need to be as interested in the human side of the interface as they are in the computer side. This involves being fully aware that the human side contains much greater variety than the computer side. We should be designing CHI for everyone, not just a subset of the population. We should remember that

- Extra-ordinary needs are only exaggerated ordinary needs,
- Most people have a mix of ordinary and extra-ordinary abilities,
- An increasing portion of the population are likely to have extra-ordinary needs,
- Ordinary people can be handicapped by their environments in the same way as disabled people, and
- Taking into account extra-ordinary needs produces better and more widely useful design solutions for everyone.

Clearly there is a need for designers of systems for the disabled to become more aware of mainstream CHI research, but there is also a need for a move in the reverse direction, where CHI designers also consider the problems presented by disability. Interface research focused on the needs of extra-ordinary people is both exciting and scientifically and technically challenging. As well as being worthwhile and socially valuable, it is central to good human–computer interface engineering. A consideration of users with special needs as part of mainstream CHI research and development will generate a symbiosis of ideas which will lead to:

- Better interfaces for everyone,
- Better design practice, and
- Expanded markets for CHI developments.

Usability and Educational Software Design

A one day meeting held at the School of Education, King's College London on 5th December 1996

The usability of educational software is often conceived in terms of simply operating the software, without a consideration of the implications of usability features for achieving educational goals. In this sense the integration of usability and educational issues is not considered. This can lead to a consideration of arbitrary usability features which may or may not be important to achieving educational goals. As multimedia educational software, with attractive and easier to use interfaces, becomes available, attention to usability may become even more limited. A feeling that interface problems have been solved may prevail. This would be unfortunate, as it would encourage the continued neglect of the relationship between usability and educational issues.

A one-day meeting was held at the School of Education, King's College London, to explore usability issues in an education context. The meeting was well attended with a total of 54 participants (47 delegates and seven speakers). The level of interest in usability in an education context is illustrated by the delegates' backgrounds: education, computer science, cognitive science, psychology, publishing and industry. The participants included one Australian and two German delegates.

The first presentation emphasised the dual perspective of the meeting, with David Squires from the School of Education, King's College, and Jenny Preece from the Centre for People and Systems Interaction, South Bank University, outlining the possibility of developing usability heuristics for educational software design. Richard Millwood (ULTRALAB, Anglia Polytechnic University) challenged the audience to comment on some of the rhetoric of multimedia educational software design; e.g., 'literacy' may be redefined if multimedia software becomes participative rather than simply interactive. Margaret Cox (School of Education, King's College) has recently completed a study commissioned by the National Council for Educational Technology on motivation in educational computing. She discussed the significance of the results of this study for educational software design. Ann Jones (Institute of Educational Technology, Open University) discussed the role of CAL evaluation from the perspective of distance education. Terry Mayes (Centre for Learning and Teaching Innovation, Glasgow Caledonian University) highlighted the paradoxical nature of usability design in an educational context; while it is clearly necessary to make software easy to use, it is also necessary to present learners with environments which require deep intellectual effort if they are to engage in conceptual development. Wendy Hall (Department of Computer Science, University of Southampton) emphasised the inherent danger of passive button clicking as a design paradigm.

Abstracts of the talks are given here. These can also be found on the BCS HCI SIG Web site: (http://www.icbl.hw.ac.uk/~sandra/uesd/). A special issue of *Interacting with Computers* with full versions of the papers is currently being prepared.

Towards a Set of Usability Heuristics in Educational Software Design (David Squires & Jenny Preece)

Molich and Nielsen (1990) and Nielsen (1990) have introduced the notion of a set of heuristics that can be used by expert evaluators to identify usability problems in the design of a software package. Typical heuristics include 'Visibility of system status: The system should always keep users informed about what is going on, through appropriate feedback within reasonable time', and 'Consistency and standards: Users should not have to wonder whether different words, situations or actions mean the same thing. Follow platform conventions.' (Nielsen, 1994). Research has shown that the use of these heuristics by five expert evaluators will typically lead to the identification of about 75% of the design problems associated with a package (Nielsen, 1992). Although not formally articulated as such, the heuristic approach is becoming evident in the educational hyper- and multimedia evaluation literature. For example, Thornton and Phillips (1996) give eight evaluation questions 'to which answers need to be found if multimedia is to improve and become an effective and efficient mainstream learning tool'. Their questions are simply expressed enquiries, such as 'Do students find it stimulating?' and 'How can the interactivity be improved?' It is likely that this approach will develop in a more formal sense as an educational software evaluation methodology.

An heuristic framework was suggested to indicate the form an heuristic approach could take. It was not claimed to be a comprehensive set of heuristics; rather it was proposed as a basis for discussion:

- Is the complexity of the multimedia environment appropriate?
- Is the learner active?
- Is fantasy used in an appropriate way?
- How appropriate is the content to the curriculum?
- How navigable is the software?
- What form of learner feedback is provided?
- What is the level of learner control?
- Are learners motivated when they use the software?

Issues in multimedia educational software design (Richard Millwood)

This presentation was based on the following definitions and assumptions: Multimedia is the integration by computer of a range of media types which match human modalities. Learning is a social, constructivist activity. Education takes place in society where milestones, outcomes and accreditation are anticipated. Computers know nothing.

Delegates were invited to choose from the statements

David Squires

below. A 'multimedia response' was given to each statement as it was chosen.

- Multimedia educational software will become pervasive as it becomes difficult to buy other than multimedia technology and tools.
- Multimedia is natural to learners, not a superficial gloss to be sprinkled on.
- 'Literacy' may be redefined if multimedia software becomes participative rather than simply interactive.
- Multimedia provides a richer communication from program to learner, with redundancy supporting cognition.
- Multimedia can provide communication alternatives for learners, empowering the disabled, dyslexic and 'normal' alike.
- The time dimension is an issue – text can be read 'out of order' and skimmed, but speech and video are normally experienced sequentially.
- Knowledge structures in textual form are well articulated and common in learning, other media fare less well, but structures exist.
- Multimedia interface elements are not well represented compared to those concerned with text and graphics.

In conclusion it was asserted that new tools, new representations and emerging capabilities challenge usability and HCI orthodoxies, as well as offering new opportunities to software designers to support learners.

Motivation and Educational Software Design (Margaret Cox)

There are many claims made in the literature of the positive effects of using computers on students' motivation. Much of the UK research evidence about IT and motivation has been reported in the mainstream publications on computers and education. Although this provides substantial evidence of the motivational aspects of computers for teaching and learning, relatively little has been reported of the relationships between the types of human–computer interactions and responses promoted by software interfaces, and the motivation of the student engaging in a computer based learning activity. There is, however, much research reported by educational psychologists and social psychologists about the psychology of motivation which provides supporting evidence for the motivational aspects of computers, as well as other teaching and resourcing methods used in education.

This presentation described the results of a study of the research literature on IT and motivation (Cox 1997), including studies about the effects of learning experiences on motivation, and implications for educational software design:

- Positive experiences when interacting with software can provide ego-enhancing achievements leading to greater self esteem, and intrinsic motivation based on achieving specific tasks. Research has shown that there is the need to recognise the distinction between positive motivation, encouraged by success in achieving specific tasks, and negative motivation caused by a fear of, and consequent, failure.
- Studies of motivation and attitudes of learners have shown that learners already have specific personality traits as well as particular attitudes towards using educational software. What may be a good design in terms of providing an easy to use interface may not necessarily be the most motivating design in terms of maintaining the confident user's interest and at the same time supporting those with an entrenched fear of failing.

The design of educational software therefore needs to take account of different users' actions, which might lead to receiving positive feedback and therefore promoting a sense of achievement, as well as less able users being put off because of the interaction reinforcing their sense of failure.

Implications from a Distance Education Perspective for Evaluation (Ann Jones)

The Open University has a long tradition of using CAL as part of its courses and also a long history of CAL evaluation. In 1979 the then recently established CAL Research Group embarked on a series of evaluations of the use of CAL in the Science Faculty at a time when access to courses was a major issue. Examples of subsequent evaluations in the 1980s include formative evaluations of materials aimed at teachers starting to use microcomputers and an evaluation of the impact of a new university 'home computing' policy on students' access and use of computers. Apart from the policy evaluation, the smaller evaluations during this period were independent and not part of any larger project. More recently (1994) a project was started to conduct a wide-ranging evaluation of CAL developments at the university, mainly but not exclusively in science and technology. Such developments include the use of CAL tutorials, simulations, commercial packages and multimedia (including videodiscs), both in students' homes and at residential schools and day schools.

During the period between the previous intensive evaluation studies and this recent project, there have, of course, been significant changes in technological developments and their use in higher education. There is now a deep/particular interest in evaluation of new technologies, reflecting the hope that new technologies can address some of the current problems in higher education. The project drew on the evaluation literature and our own experience to create a framework within which particular evaluations were conducted.

In the presentation the framework was used as a starting point for discussing some of the evaluation issues which are pertinent to the evaluation of CAL and other computer based systems in the current context. Some of the methods used to evaluate students' use of computers were described

Continued overleaf…

Usability and Educational Software Design

David Squires

and discussed. Case study examples were used to illustrate the use of such methods.

Why learning is not just another kind of work (Terry Mayes)

Usability, in the straightforward sense, is a self-evident requirement for all software. Yet there is an interesting paradox in the case of some educational applications, where a seamless fluency of use is not conducive to deep learning. The learner needs to move effortlessly to the conceptual level, but then must engage with the underlying meaning. To put it simply, the software must make the learner think. Learning cannot be approached as a conventional task, with a number of problems to be solved, and an output to be produced. This is because learning is a by-product of doing something else. It is the 'something else' that needs support. This can be achieved in many ways, but none of them have much to do with the conventional multimedia properties of the content.

An attempt to justify this argument was made by:

- briefly characterising conceptual learning as an iterative conceptualisation–construction–dialogue cycle, where the construction of meaning, and the testing of this against other judgements, are the crucial stages for educational software to support
- giving some examples of software which supports learning at each stage of the conceptualisation cycle
- explaining why having to teach leads to the deepest kind of learning

The presentation concluded with an examination of the relationship between usability and educational effectiveness. Usable systems involve capitalising on the user's pre-existing knowledge. Similarly, easily learned material involves information for which a framework for extracting meaning is already in place. Attempting to learn material for which no such framework exists is, literally, a meaningless task. The main challenge in the design of educational software is to support the user in the creation of the framework for extracting meaning: this requires the design of effective tasks, rather than interfaces.

Ending the Tyranny of the Button (Wendy Hall)

In current usage, hypermedia interfaces to information tend to support a passive activity, with the user clicking on buttons to move between pieces of information essentially as directed by the author of the hypermedia application. For some time now, the Multimedia Research Group at Southampton University has been developing hypermedia systems that can optionally present a much more query-based interface, where the onus is on the user to ask 'what information is available about XYZ?' rather than relying on the system telling the user 'click here for information on XYZ'. Such interfaces can lead to much more powerful learning environments but buck the common trend, driven by the phenomenal growth of the World Wide Web, which insists that hypermedia interfaces are 'button driven'. These issues were addressed in the talk using illustrations of work that has been undertaken at Southampton to design educational applications using various hypermedia systems.

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Diary Extra

2nd Euromicro Working Conference on Software Maintenance and Reengineering

9–11 March, 1998, Florence, Italy

Submissions by **15 September, 1997**.
Further Info: Email: csmr98@ozon180.ing.unifi.it;
URL: http://www.isst.fhg.de/csmr; http://www.dsi.unifi.it/~nesi/csmr98.html
Summary: The purpose of the working conference is to promote discussion and interaction about a series of topics which are yet underrepresented. We are particularly interested in exchanging concepts, prototypes, research ideas, and other results which could contribute to the academic arena and also benefit business and industrial community. Researchers, practitioners, technology transition experts, project managers, developers and users of tools are all welcome.

ED-MEDIA/ED-TELECOM 98 – World Conference on Educational Multimedia and Hypermedia and World Conference on Educational Telecommunications

20–25 June, 1998, Freiburg, Germany

Submissions due **October 23rd**
Further Info: ED-MEDIA 98/AACE, P.O. Box 2966, Charlottesville, VA 22902 USA; Email: AACE@virginia.edu; Tel: 804-973-3987; Fax: 804-978-7449; URL: http://www.aace.org/conf/edmedia
Summary: Jointly held international conferences, organized by the Association for the Advancement of Computing in Education (AACE). For the discussion and dissemination of information on the research, development and applications on all topics related to multimedia/hypermedia and distance education. We invite you to attend ED-MEDIA/ED-TELECOM 98 and submit proposals for papers, panels, roundtables, tutorials, workshops, demonstrations/posters, and SIG discussions. All proposals will be reviewed for inclusion in the conference program, proceedings books, and CD-ROM proceedings.

Eye-based Interaction for Users with Special Needs

Howell Istance

Welcome to the third article of our series on 'Software Support for HCI', which is designed to give leading practitioners and researchers the opportunity to discuss how software tools and environments, along with supporting methods and techniques, can aid in the development of effective human–computer interfaces.

There are many ways in which users with differing types of motor impairment can communicate with computers in order to control their environment, to communicate with others, to study or to work. Different input devices can be built to enable a user to take advantage of the control they have over different muscle groups. Using the eyes to drive an input device is attractive in this respect, as users with severe motor impairments often retain good control over ocular mobility when the ability to control other muscle groups is reduced. Eye movement can be used in conjunction with other modalities so, for example, the eyes may be used to position a pointer, and some other modality, such as speech or pressing an external switch, may be used to make a selection action. Alternatively the eyes may be used for both pointing and selection actions.

An important component in rehabilitating motor-impaired users to the workplace is the provision of the means by which they can use the same tools as their able-bodied colleagues. This group of users needs to be able to use the vast amount of software produced for the able-bodied market instead of relying on bespoke software customised for use for a particular type of input device. Additionally, it is important to facilitate the use of several applications simultaneously and to allow the user to switch rapidly between these without the need to reconfigure the input device. The use of many applications does not require extensive text entry, and building an input device primarily round the need to enter text may severely compromise the design. In the use of a web browser, such as Netscape, it is important to navigate around documents by scrolling, clicking on links or selecting sites from a menu, whilst text entry is used infrequently, to name saved documents for example.

The use of eyetracking as a means of enabling users with special needs to interact with computers is well established and previous work in this area falls generally into two categories. First, there are systems which provide access to bespoke software. Notable examples include Erica, an eye-based communication and wordprocessing system (Hutchinson et al, 1989), and the EyeGaze system produced by LC technologies. Both use remote, desk-mounted eyetracking devices and users can achieve high rates of text input with them. Of these, the author only has personal experience of using the EyeGaze system and found the procedures for calibration to be both extremely fast (about 15 seconds) and could be carried out largely unaided. As a simple text input system, it enables a high level of performance in terms of text entry rates and exhibits a high level of usability. There are several different functions provided, including control over domestic appliances, selecting and generating phrases in conjunction with a speech synthesiser, a text to speech facility supported by a simple on-screen keyboard and a limited DOS mode keyboard emulator for use with other software.

Second, there are general purpose interaction devices in the form of on-screen keyboards which can be driven by gaze position or by other input devices. These allow the user to interact with standard application software by emulating the keyboard. Examples of this type of system are the WIVIK keyboard (Shein et al, 1991) and the Visual Keyboard produced by Adaptive Computer Systems Inc. of Iowa. These vary, however, in the extent to which they facilitate interaction with all of the control objects found in a modern GUI application. To be able to use a spellchecker, change printers and perform a wide range of tasks in addition to text entry, the user has to be able to interact with icons in a toolbar, menus, dropdown list boxes, scrollbars and other control objects. If this interaction is not possible, then a word processor with the rich functionality of MS-Word, for example, may be reduced to little more than a basic text editor, such as Notepad.

Requirements for eyetracking

For eye-based devices to be successful, it is necessary to provide low-cost usable systems for measuring gaze position. It is important to differentiate between eye position and gaze position. Eye position refers to the position of some reference point in or around the eye (such as the centre of the pupil) with respect to a co-ordinate system defined in relation to the head. Gaze position refers to the intersection of the line of sight with a plane defined in relation to the external world, such as a display screen. It is necessary to calibrate eye positions to give gaze positions by looking and recording eye positions at known reference points in the external world co-ordinate space.

Trade-off between accuracy and usability

A comparison between different means of measuring gaze position presents a trade-off between accuracy and usability. Usability can be characterised in several ways:

- the degree of invasiveness required by the equipment (whether the user is required to wear something or have something attached to them),
- the degree of comfort over extended periods of equipment usage including constraints on head movement,
- the time and ease of procedures necessary to calibrate the equipment,
- the time taken and procedures for any recalibration during initial calibration,
- whether initial calibration and recalibration can be done by the user alone or whether another person is required to help.

Continued overleaf...

Eye-based Interaction for Users with Special Needs

In general, the higher the accuracy of position measurement, the lower the usability of the system.

Measurement techniques

In addition to enabling eye-based interaction with computers, a more usual motive for measuring eye position is clinical research into the physiology of the eye and the visual system, or the study of visual behaviour, whilst reading for example. Each of these purposes have different requirements with respect to the usability–accuracy trade-off.

Measurement techniques fall into several categories. Electro-oculography, for example, measures the changes in the electrical dipole arising from the potential difference between the cornea at the front of the eye and the retina. This requires electrodes to be placed on the skin surface and, although inexpensive, this system is intrusive and gives relatively poor positional accuracy (1.5–2.0 degrees).

The technique which offers the best usability–accuracy trade-off for user interaction uses a combination of video image and corneal reflection. This relies on fast processing of a video image of the eye so that the area corresponding to the pupil is recognised by simple thresholding from which the co-ordinates of the centre, and the size, of the pupil area can be calculated. The pupil image may be either dark, as is normally the case, or bright due to the infra-red illumination being reflected back from the retina. The video camera may be mounted on the head, which allows considerable freedom of head movement but has the usability penalty of needing a head-mounted device. The camera and the light source can also be completely remote from the viewer and, provided the user keeps reasonably still, the gaze point can be tracked without any equipment being worn. The image of the pupil can be kept 'in picture' by the use of servo-controlled mirrors mounted in the remote device. To compute gaze position with a head-mounted camera system, the orientation of the head with respect to the world also needs to be known.

In order to provide some freedom of lateral head movement, a reflection of infra-red light from the front of the cornea can also be tracked so that differential movement of the pupil centre and the corneal reflection indicates an eye movement, whilst conjugate movement of these suggests a head movement. This technique does not compensate though for head movements along the viewing axis. Accuracies of 0.5 to 1.0 degrees are reasonable to expect for this type of system.

It is necessary to differentiate between accuracy and precision. Accuracy is the deviation between the true position and the measured position, whilst precision refers to the spread of successive measurements around a mean position. So an inaccurate, precise measurement implies a constant offset error, possibly due to a poor calibration, while an accurate, imprecise measurement implies noise in the measuring device requiring some form of averaging or filtering to deliver usable data. Accuracy is expressed in terms of degrees of visual angle so an accuracy of 1 degree translates into an error of 0.7cm at a viewing distance of 40cm, and 1.75cm at a viewing distance of 100cm. The classic paper on the subject of eye position recording methods is that by Young and Sheena [1975].

Supporting eye-based interaction with modern GUI software

Most actions carried out with a mouse on a GUI have a keyboard equivalent. Menus may be pulled down by the *Alt* modifier key and a character key, menu items may be selected using the cursor control keys and the *Enter* key. Control objects in dialogue boxes can be manipulated using the *Tab* key to change the input focus, followed by the cursor control keys to change individual object selections. Some actions, such as selecting icons from a toolbar, do not have a keyboard equivalent, however. It is necessary therefore to support mouse emulation to enable the user to interact with these (often small) objects whilst counteracting the limitations of pointing accuracy inherent in gaze measurement systems.

An on-screen keyboard can generate window system events corresponding to the key-based commands and send these to the target application, such as a word processor. The event-driven nature of windows interfaces means that messages containing information about the current state of the target application can be inspected by the on-screen keyboard. These can be used to adapt the state of the keyboard to the current application context. This means, for example, that the text of a currently highlighted menu item in the target application can be extracted from the message and presented as part of the keyboard. It also means that the keyboard can detect when a dialogue box is opened by the target application.

As the on-screen keyboard will occupy the same screen as the target application, there is a need for some automatic window management to resolve conflicting demands for screen space between the two applications. A dialogue box opened from the target application should not obscure the

Figure 1 **Layout of the visual keyboard with the text keypad loaded in the centre section**

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keyboard and should be automatically moved to appear above the keyboard. Where the target application's window is partially overlapped by the keyboard or is sized to full-screen, it should be possible to move the target application window behind the keyboard to view its different parts. Furthermore, if the keyboard's window is resized then the target application window should be automatically resized to prevent overlap.

In summary, there are several principal requirements that the design of an on-screen keyboard should satisfy:

- it should support both mouse and keyboard emulation
- it should support effective interaction with the whole range of GUI objects and not be designed solely around the need to enter text
- it should provide means by which the inherent inaccuracy in eye-based control can be compensated for
- it should provide facilities for automatic window position and size management
- it should allow the individual user to customise the keyboard device to suit individual preferences concerning tasks within specific applications
- it should be possible to switch between using different target applications without reconfiguring the device.

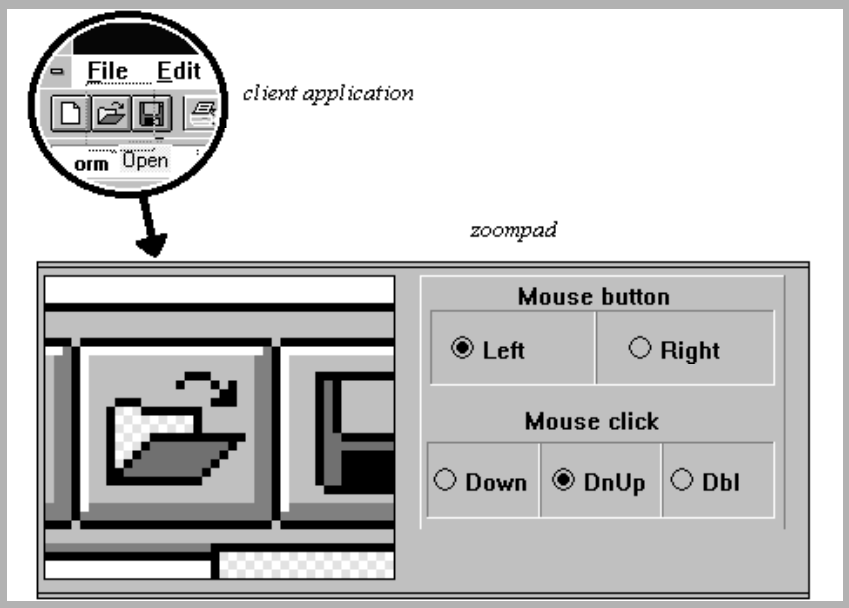

Figure 2 **The 'zoom-pad' which appears in the centre section of the keyboard**

Work at De Montfort and Loughborough

The work on eye-based interaction at De Montfort University has been carried out in collaboration with Peter Howarth of the VisErg Research group at Loughborough University and began some years ago to study the implications of trying to interact directly with standard GUI applications using gaze position. Different ways of emulating mouse actions were studied (Istance and Howarth, 1994) but it was concluded that the inaccuracies inherent in eyetracking meant that an indirect approach via an on-screen device such as a visual keyboard was likely to have a better chance of success than attempts to refine or improve direct interaction techniques. Work carried out recently has concentrated on the design of an on-screen keyboard (Istance, Spinner and Howarth, 1996).

The onscreen keyboard consists of three sections:

- a left hand menu of general system commands
- a right hand menu of selectable keypads
- a central area within which the currently selected keypad is displayed

The keypads themselves are intended for use in different contexts. There is a text keypad for text entry and editing, a menu keypad and a dialogue keypad for interacting with menus and dialogue boxes respectively. A system keypad provides access to task management functions such as switching between tasks. Figure 1 shows the keyboard with the text keypad selected. The keys are dwell sensitive, that is they cause a key event to be generated when the pointer has been within the key for a fixed time period (which is configurable).

Mouse emulation is achieved with what is called a 'zoom' pad (Figure 2). When this pad is selected, the user can look at any part of the screen and, after a time interval, the area being looked at is enlarged and transferred to the keypad. The user can now generate a click event within the enlarged area which is sent to the corresponding part of the screen. This is a very effective way of clicking on arbitrary parts of a document, such as links in a Web page, whilst overcoming problems caused by measurement inaccuracy.

One of the ways in which the design is adapted for the accuracy limitations of eye movement measurement is through the use of 'fish-eye' keys. When the pointer moves into the key, the key area expands, allowing the gaze point to be kept within the key area until the dwell period times out. When the pointer crosses the boundary to the next adjacent key, this expands and the previous key contracts. This can be seen in the right hand panel in Figure 1. This overcomes a design problem with fixed-sized keys. If the keys are too small then there is the risk of the gaze point straying outside the key boundary before the dwell time expires. If all the keys are made big enough to prevent this, then far fewer keys can be accommodated on the keyboard at any one time.

Adaptation to task context

This is achieved in several ways. Dialogue and menu

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Eye-based Interaction for Users with Special Needs

Howell Istance

keypads are automatically loaded when a dialogue box or a menu is displayed by the target application. Other pads can be assigned by the user to be selected automatically in a particular application context. The text from the currently highlighted menu item is displayed as the label string of a key on the menu keypad, removing the need for the user to look repeatedly at the menu in the target application window. Finally the user can design their own keypads using the keypad editor. This allows keys to be defined in terms of appearance and position as well as the events they generate. Macros as well as single key events can be defined and executed. For example, a user could create a Netscape keypad, which is loaded automatically when Netscape is the target application (active window) and which contains a 'My Home Page' key and a 'Load My Bookmarks' key.

Current and future work

At present, work is concentrated in two areas. First, an extensive usability study is being undertaken with motor impaired users into the use of the eyetracking hardware and the visual keyboard software during extended uses of different types of application. Second, work is underway to address the problem of lack of visual feedback. We are used to seeing changes occur immediately in the application window in response to mouse clicks or key presses. These changes are missed by a user who is looking at the keyboard when they occur (try looking at the keyboard or mouse at the moment when the mouse button or a key is pressed and then look for the change in the application window). The visual keyboard described here will be commercially available shortly from SensoMotoric Instruments of Berlin.

References and useful resources

Hutchinson, T.E., White, K.P., Martin, W.N., Reichert, K.C. and Frey, L.A. (1989) Human-Computer Interaction Using Eye-Gaze Input. *IEEE Transactions on Systems, Man, and Cybernetics*, **19 (6)** 1527–1534.

Istance, H.O. and Howarth, P.A. (1994) Keeping an Eye on your Interface: The Potential for Eye-Based Control of Graphical User Interfaces (GUI's). In Cockton, G., Draper, S.W. and Weir, G.R.S. (eds), *Proceedings of HCI'94: People and Computers IX*, 195–209.

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Shein, F., Hamann, G., Brownlow, N., Treviranus, J., Milner, M. and Parnes, P. (1991) WIVIK: A Visual Keyboard for Windows 3.0. *Proceedings of the 14th Annual Conference of the Rehabilitation Engineering Society of North America (RESNA)*, 160–162.

Young L. R. and Sheena D. (1975) Survey of eyemovement recording methods, *Research Methods and Instrumentation*, **7**, 397–429.

(see also) Jacob, R.J.K. (1993) Eye Movement-Based Human-Computer Interaction Techniques Toward Non-Command Interfaces. In Hartson, R. and Hix, D. (eds), *Advances in Human-Computer Interaction*, Ablex, 4. (good review of eyetracking and eye-based interaction although not directed towards special needs users, see also http://www.cs.tuft.edu/~jacob/)

System Suppliers

Adaptive Computer Systems Inc, Iowa (http://www.adaptive-computer.com/) . Producers of Visual Keyboard, Visual Surfboard and Visual HTML editor together with eyetracking hardware.

Applied Science Laboratories. 175 Middlesex Turnpike, Bedford MA 01730, USA (http://world.std.com/~asl/). Largest global manufacturer and supplier of eyetracking systems, good overview of eyetracking system basics in their on-line Eye Tracking Systems Handbook.

LC Technologies, 9455 Silver King Court, Fairfax, VA 22031, USA (http://lctinc.com/). Producers of the Eyegaze system (referred to previously)

SensoMotoric Instruments GmbH, Potsdamerstrasse 18a, 14513 Teltow, Germany (http://www.smi.de). Major European manufacturer and supplier of eyetracking systems.

other web sites

Imaging and Displays Research Group at De Montfort University (http://www.cms.dmu.ac.uk/Research/IDRG/)

VisErg Group at Loughborough University (http://info.lut.ac.uk/departments/hu/groups/viserg/viserg.htm)

Eye movement equipment data base maintained by Dave Wooding at Cardiff (http://www.cf.ac.uk/uwcm/dr/groups/vision/em/equip/)

About the author

Howell Istance is a principal lecturer in the Department of Computer Science at De Montfort University. His research interests lie mainly in human factors issues associated with the use of I/O devices, especially those which are based on gaze measurement. He is also interested in the human factors of navigation in virtual environments in general, and multimodal input for this purpose in particular. He teaches HCI on both undergraduate and postgraduate courses and is course leader for the MSc in Human–Computer Systems which the Department has run for many years.

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Interested in writing an article on Software Support for HCI? Possible topics include:

User interface specification, design and construction tools
Specification and design methods to support their use
Tools which aid in interface evaluation and testing
Case studies on such tools and their success (or not, as the case may be!)
Intelligent and adaptive front-ends
Visual Programming
Programming by example and demonstration systems
Please send your submissions to: Dave Clarke; email: Dave@visualize.demon.co.uk (or on disk c/o *Interfaces*, address on back cover). Articles should be sent in MS Word, RTF or straight ASCII format. Length should not exceed 3000 words. Figures and references may be included where appropriate.

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Alistair Edwards

Working backwards … I am a lecturer at the University of York, and member of the HCI Research Group. I am interested in the use of computers by people with disabilities, particularly visual disabilities. That means there is lots of scope for doing interesting things with novel media, (sounds, gestures, speech etc.)
Before I came here I had a temporary lectureship at the Open University. I did not make any television programmes, so there's no point looking out for me on late night TV. That followed on from doing my PhD at the OU, which I did in the conventional manner at the Milton Keynes campus, and NOT working at home with television programmes and course units or whatever.
I was working at Umist before that. I was a Computer Officer with Jim Welsh working on compilers and related tools.
Before that I had been doing a taught MSc at Penn State University. That followed a year working in a home for children with disabilities and my research essentially grew out of the idea of combining that kind of work with the academic work I had done – which started with a degree in Physics and Computer Science at Warwick.
I've run out of words without mentioning anything about my personal life, so you'll just have to guess from the answers below.

What is your idea of happiness?
A job well done.

What is your greatest fear?
Being asked to be in the Profile column and then coming up with answers which demonstrate that I am shallow and lacking in wit.

With which historical figure do you most identify?
Peter Pan.

Which living person do you most admire?
Nelson Mandela (is that too obvious?)

What is the trait you most deplore in yourself?
A natural tendency to laziness.

What is the trait you most deplore in others?
Lack of consideration.

What vehicles do you own?
A bicycle. A Citroen AX car. A Laser sailing dinghy. A windsurfer. A paraglider.

What is your greatest extravagance?
Gadgets

What makes you feel most depressed?
Northern Ireland

What objects do you always carry with you?
Swiss army knife.

What do you most dislike about your appearance?
My belly.

What is your most unappealing habit?
No one will tell me.

What is your favourite smell?
I've been thinking about this one. Possibly the sea, but since Alan Dix already bagged that I'll say Linseed Oil.

What is your favourite building?
King's Manor, in which I am lucky enough to live.

What or who is the greatest love of your life?
Not sure, yet.

Which living person do you most despise?
I don't like the concept of despising anyone, but my feelings for Michael Howard may come close. (Anyone who agrees with me should visit http://www.demon.co.uk/davidg/basic/howard.htm)

On what occasions do you lie?
When I think I will get away with it, I suppose.

Which words or phrases do you most over-use?
'However' in written text. 'Sort-of' when speaking.

What is your greatest regret?
I could say 'je ne regret rien', but I'd probably just be covering up stuff that is just too personal.

When and where were you happiest?
It hasn't happened yet.

How do you relax?
Sailing. It's about the only thing I can do which will divert my mind from everything else.

What single thing would improve the quality of your life?
I don't think there's much wrong with my current quality of life.

Which talent would you most like to have?
I would like to be Bob Dylan.

What would your motto be?
'No problem is so big or so complicated it cannot be run away from' (Linus Van Pelt).

What keeps you awake at night?
Too much coffee too late in the evening. An inability to 'switch off' (see above on relaxation).

How would you like to die?
Quickly

How would you like to be remembered?
Affectionately

'If you could talk to your washing machine... *what would you say?'*

Catriona Macaulay

British HCI Group Intelligent Interfaces Meeting,
Napier University, Edinburgh
March 25th 1997

The British HCI Group Intelligent Interfaces Workshop at Edinburgh's Napier University may not have been the best attended meeting in history, but it certainly provided a fascinating insight into the diversity of concerns of those working in the field. In one rather incident-prone day we ran the gamut from adaptive systems to washing machines. David Benyon of Napier University had pulled together an impressive range of speakers for the event. As this was my first time at a British HCI Group workshop (and my first experience of student volunteering) I was fascinated to find that the social aspects of such affairs are every bit as important as the presentations.

My first lesson in the lot of the student volunteer was that sod's law applies as much to academe as it does to the rest of life, and SVs often miss the bits they most want to hear. On this occasion my SV duties meant that I missed Michael McTeer's (University of Ulster) opening talk on the relationship between theory and reality in intelligent interface technology. However, I did manage to hear the end of Anthony Lennard's talk on the OASIS system – a project at Lancaster University which allows the user to specify the interface independently of the application. Anthony's central argument was that users ought to be able to develop and carry their own consistent interface between the applications they use.

Next up was Andy Pryke of Birmingham University with a talk on the HAIKU system – a dynamic self-organising interface for data mining. His talk benefited greatly from the screenshots of the system, which proved that intelligent interfaces can also be beautiful interfaces. Unfortunately, we were then interrupted by the first of the day's two false fire alarms. A few minutes of sitting around staring at each other were finally resolved by the decisive move of one of the event co-ordinators, Sandra Foubister, towards the door. Following the example of our very own intelligent agent, we all trooped out into a typically cold and wet Edinburgh morning. Inconvenient as this was, it did provide us with a chance to do a quick spot of 'getting-to-know-you's. When we finally got back in to the hall Andy managed to finish the rest of his presentation uninterrupted.

Lunch provided everyone with another opportunity to engage in some networking, and again I was struck by just how diverse this meeting was – one minute engaged in discussion of the relative merits of JAVA, the next discussing the problems of making interfaces accessible to users with special needs.

Back to business, and John Lee of Edinburgh University's Department of Architecture gave a presentation which once again demonstrated just how diverse the concerns of the intelligent interfaces community are. We were now in the world of CAD and the web, and how best to support/encourage distributed collaborative design. Central to the work being undertaken jointly by Edinburgh's Department of Architecture and the Human Communication Research Centre is a concern with finding ways to map between the different representations of a design object held on different systems. Although this may at first appear to be taking us quite some distance from the traditional concerns of HCI, as John pointed out, there is in fact a similarity here with user modelling – why does the designer choose a particular representation for an object in one system and another representation in another system? Similarly, this work demonstrates the importance of an understanding of the context of practice to systems design.

The last part of the day was opened by Stefania Errore of Italy's CORINTO research consortium. Stefania's detailed introduction to the consortium and the work there on developing adaptive interfaces for the WWW was delivered against a backdrop of uncertainty as to the future of the consortium. The CORINTO project is developing a prototype for a 'Citizen Services' information system which has focused on the issue of incorporating into the system the ability to dynamically derive a user model from the user's interactions with the system, and then adapt the interface as indicated by the model.

John Bonner of Teeside University's Institute of Design then delivered one of the day's most interesting talks – on his work in applying intelligence to washing machine interfaces. Although the project is still in the very early stages, John's presentation generated a great deal of interest from the floor. The complexity of most domestic consumer goods interfaces obviously irritates interface designers every bit as much as it does 'the person in the street'! For John, a key question is how devices 'sense' the user's needs, which re-emphasised for me the centrality of the issues of adaptivity in intelligent interface research.

Sadly, I also managed to miss the final speaker of the day, Christina Hook from the Swedish Institute of Computer Science, whose presentation was on the theme of the steps needed before 'intelligent user interfaces' become a reality. Thanks to Sandra's efforts in co-ordinating the day everything went off smoothly, despite the fire alarms, and it is a testament to the quality of the day's presentations that the formal end of the meeting was followed by some intense informal discussions which only ended with the unanimous 'yes' that greeted David's suggestion of taking matters to the pub. Ever keen to establish the excellent social credentials of his new home town, David took everyone to the remarkable Canny Man's – one of Edinburgh's most interesting watering holes.

From there the hard core engaged in an unfortunately lengthy 'two minute' walk (prompting much debate about my sad lack of real world navigation skills, as well as precipitating a near medical emergency in one unfortunate soul who took me at my word and held his water for quite some time) to an Indian restaurant where the warmth of the food was only matched by the chilliness of the staff! The evening ended in another local pub, where luckily enough some live folk music provided a nice traditional background

for the goodbyes. I, for one, sincerely hope that all British HCI Group workshops are as much fodder for the brain *and* the soul as this one was and can highly recommend student volunteering to anyone who has yet to take the plunge.

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BCS Disability Group

Bob Jamieson

The British Computer Society Disabled Specialist Group was formed over twenty-one years ago by Geoff Busby MBE, who is still our Chairperson at the group. Geoff uses his computer by his nose. Since 1994 we have been trading under our new name: British Computer Society Disability Group.

Quality of life is related to how free people are to make their own choices in what they do. For a large number of disabled people, Information Technology is the key to choice.

Aims

The aims of the BCS Disability group are simple:

- To demonstrate to society that IT is a tool for equality, challenging the preconceptions surrounding disability.
- To work with the computer industry to show that everyone can benefit when access for disabled people is considered in product design. Voice-activated computing is one example.
- To identify, and influence, shortfalls in the general provision of computer equipment and related services for disabled people.
- To encourage the active involvement of disabled people in the work of the group so that they can have a direct input into decisions that affect them. One way is through membership of the group.

Activities

The group is active across a wide spectrum and has attracted interest and support from the IT industry at large. Its example has led to the formation of similar specialist groups in other European countries, notably Germany, Austria, the Netherlands, Greece and Scandinavia. Our group's main activities are:

Ability

This is our name for the group's quarterly journal. 'Ability' is a very important name to have for our magazine, I feel, as IT is a tool for people with disabilities to get their independence and lead full, active lives. *Ability* is our main tool to get information across to people with disabilities; all our members get a free copy of *Ability* four times per year. The journal provides information and ideas on all aspects of IT and its use by people with disabilities.

IT CAN – HELP

This project was piloted three years ago in a big area of south Oxfordshire, Berkshire and North Hants by Ken Stoner. This is a local support network to assist people with disabilities who could benefit from IT. Now IT CAN – HELP is covering ten counties and we hope in the next five years it will be covering all of the UK.

Conferences

The group tries to organise a conference once per year, and our last conference was in Northern Ireland (Belfast) last April; 97 people attended and this conference was jointly run by the Belfast branch of the BCS and our group. Also the Disability Group organises and contributes to national and international conferences and exhibitions, and continually seeks to strengthen links with relevant organisations world-wide.

Group meetings/events

Regular meetings are held for members, and special meetings are arranged to bring together employers, IT suppliers, rehabilitation officers and Government representatives. As I am the group's Meetings Officer, I'm trying to arrange events for members and other people outside London this year, in places like Southampton, Bedford and Cardiff.

Membership

BCS Disability Group membership is open to everyone, especially people with disabilities who've got an interest in IT and computers.

This article is part of a longer talk given by Bob Jamieson at the meeting 'Computers and Disability', held at the University of Dundee on Friday 9th May 1997.

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Non-Visual Musical Representation

A Computer Based Approach

Overview of a proposed system

We are currently working on the design of a computer based system for the non-visual delivery of information that would normally be expressed using graphical music notation. It is our belief that designing an adequate alternative to a medium that is normally highly visual by nature will benefit greatly from a multi-modal approach. This will not only be from the perspective of delivering the musical information to the user but also from that of interaction with, and navigation through, the system itself.

At the heart of the system will be a tactile interface, providing the user with a high-level representation of a piece of music whilst allowing further interaction at lower levels using a variety of output methods. The user will be able to select the most appropriate style of information delivery for their needs. Vacuum formed plastic overlays will be used in conjunction with a touchpad to provide a tactile equivalent to a page of music. Tactile components to be included will mainly consist of symbols that are relevant to the overall structure of a piece of music. A user will be able to explore a page of musical structure in tactile format and request information at lower levels by pressing through the overlay and onto the touchpad. One of our immediate aims is to formalise a set of tactile symbols with which we can realise this interface.

Auditory information will be used to reinforce the tactile interface but also to describe much of the musical information. Different forms of auditory output and the potential problems posed by their combined usage are discussed later in this article.

Although our system will essentially be directed towards facilitating the needs of musicians and music learners who are blind, we believe that a duality of usage should always be maintained. In other words, the system should be meaningful to sighted as well as blind people. This would assist greatly with practical tuition but also assist with integration into music ensembles. If a sighted musician proposes a section for rehearsal by reference to bar, line and page then it would be desirable for a blind musician to be able to follow these same instructions. It is conceivable that this concept of duality of purpose might also provide alternative educational applications, such as aural training, music theory and music analysis, outside of special needs education.

Blindness and music notation

In considering how best to approach the design of a new system for representing complex information to persons who are blind, it would be prudent to fully explore any already existing systems whilst attempting to analyse their respective strengths and weaknesses. The type of information that we are interested in is that which is used to represent a musical composition to a person who needs, for one reason or another, to understand the structure and content of that piece. The reasons for needing to read a section of music can extend beyond simply wishing to realise a performance of the piece; indeed, many music qualifications will require that a student is adept at both reading and writing music to enable them to study harmony, composition and historical analysis. These types of requirements begin to exclude individuals with a severe visual impairment from adequately improving and demonstrating their musical abilities for a number of reasons. These disadvantages will become clearer during the following sections.

Common musical notation

Western music is almost exclusively described by a system of graphical notation known as Common Musical Notation (CMN) and it can be virtually guaranteed that if you open a typical music text book then the extracts inside will be described using CMN. There are, without doubt, great strengths in using such a graphical system of representation. In particular, there is the ability to display a considerable quantity of information within a relatively small area, but also of significance is the way in which horizontal and vertical positioning can be used to reinforce durational and harmonic quantities. The power of visual perception is such that the reader can quickly build an impression of a section of music and immediately recognise those features that are

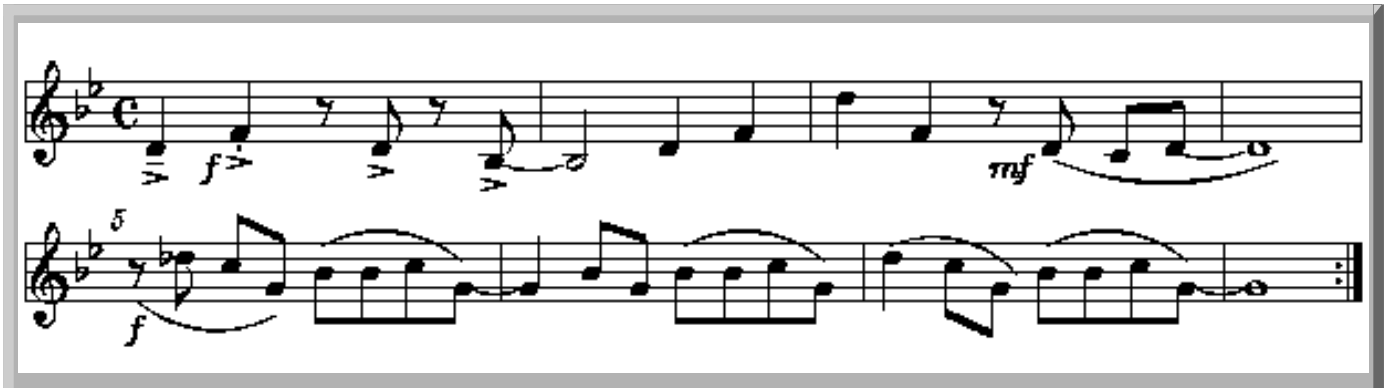

Figure 1 **An example of the fairly typical usage of Common Musical Notation**

Ben P Challis and Alistair D N Edwards

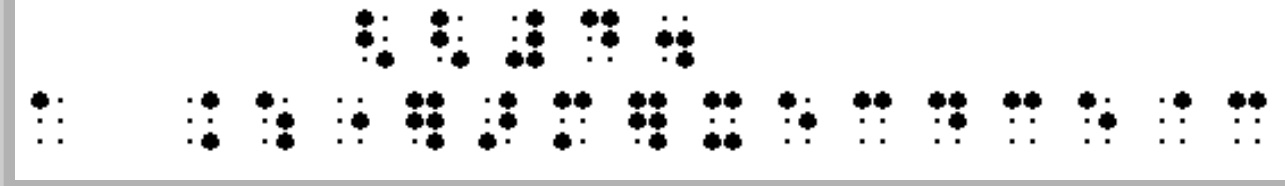

Figure 2 **Braille music version of bar 3 of Fig. 1.** The top five cells signify the key signature and time signature and would normally only appear at the start of a piece. They are included here to show the extract in context.

of absolute importance to a task that they have in mind. The music learner can, in effect, 'browse' through an extract of music. Eaglestone (1992) has suggested that a musical representation can communicate its information at one of three levels of abstraction. At the lowest level this is done on an event by event basis, at a higher level these events are grouped into melodies, harmonies and rhythms, and at the highest level the music is represented as structure and form. The overwhelming strength of CMN is that it is dynamic enough to display all three levels of abstraction simultaneously.

The example extract (Fig. 1) shows individual notes grouped into phrases and also grouped into a section of bars. CMN is certainly a highly efficient method of musical representation for sighted music readers, but what alternative systems of representation are available for music learners who are blind?

Music notation for blind people

There are three practical alternatives to CMN for blind people. The first is Braille music, which is a system of musical representation that employs conventional style Braille cells to interpret a score on an event by event basis.

This short example of Braille music (Fig. 2) is a translation of bar three of the earlier extract of CMN and, excluding the top five cells, which are general to the piece, reads as follows:

> **bar 3, octave 5, crotchet D, octave 4, crotchet F, dynamic symbol, Braille m, Braille f, quaver rest, quaver D, slur, quaver C, slur, quaver D, tied to**

Although Braille music can convey all the same information that CMN can, there are distinct limitations which make it an unsuitable long term solution. Besides the fact that only a relatively small percentage of the blind population can read Braille (Bruce, McKennell and Walker 1991), there is the inherent sequential nature of Braille, which simply cannot accommodate a higher level of abstraction than representing a series of events. There is a typical example of the confusing effect that this can produce in the translation of bar three of the extract. With the CMN extract, the last three notes of the bar are grouped with a slur (the curved line). The slur does not interfere with the appearance of the group; it merely serves as a reminder to the reader to play this phrase smoothly. With Braille music, a slur sign is used to punctuate the three notes. If pitches and durations are the reader's main concern rather than articulation, they must, in effect, ignore the slur sign every time it occurs. From the perspective of the blind music reader, this means that to begin to build a mental image of the structure of a piece of music involves reading, interpreting and organising a great deal of information. The concept of representing durational and harmonic relationships is fundamental to a learner's understanding of a piece of music and yet Braille music cannot adequately express these kinds of spatial relationships.

It is also worth noting that because Braille music is both difficult to learn and time-consuming to prepare, even though there have been attempts to automate the process (Sawada et al. 1990; Graziani and Truquet 1990), there is very little selection available for a music reader to choose from.

The second alternative to CMN is to use a vocally annotated score. These 'Talking Scores' are produced by the RNIB, using volunteer readers, whose spoken description of an extract of notation is stored on audio cassette. In many respects the final translation is similar to the one produced by Braille music. An example of the same bar that is shown as Braille in Figure 2 would be spoken as follows:

> **bar 3, high D crotchet, mid F crotchet, mezzo-forte, quaver rest, slur to bar 3 beat 4 and a half, D quaver, C quaver, D quaver tied to bar 5 D semibreve**

Vocally annotated scores, like Braille music, use a sequential method of translation and as a result suffer from similar limitations. However, they are considerably more accessible as they do not carry the prerequisite of being able to read Braille.

The final alternative to CMN is to learn a new piece by ear. This is not as absurd a notion as it may at first seem. In fact, there seems to be evidence to suggest that blind children are more likely to develop absolute pitch than sighted children (Ockelford 1996; Welch 1988), although it also seems that this is mainly because blind children rely on, and therefore improve, their listening skills in a way that sighted children never need to. Even though playing by ear can be effective, especially with improvisation, there is the

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drawback that a musician can become highly skilled with their instrument whilst essentially remaining musically illiterate. For a further and more detailed discussion on alternative approaches to music tuition for blind people, refer to Ockelford (1996).

Design criteria for an alternative system

After considering the problem, it can be seen that any proposed system of musical representation that is to prove adequate for use by blind people in the long term should meet the following requirements:

1. Provide a method of exploring the music from high as well as low levels of abstraction.
2. Facilitate a reader's desire to discriminate against redundant information.
3. Allow for individual preferences and needs in the recovery of information.
4. Maximise the use of alternative modes of communication.
5. Maintain a strong correlation with the firmly established principles of CMN.

A computer based non-visual musical representation system

The following sections discuss in greater detail some of the possibilities that we will be exploring for the purpose of designing the kind of system that was outlined earlier.

The tactile interface

Most special needs teachers will probably already be familiar with the use of touchpad style interfaces with computers in the classroom. Although there are a variety of such keyboard substitutes available, such as the Concept Keyboard (The Concept Keyboard Company Limited, Hampshire, UK), Informatrix (also by Concept), Nomad (Quantum Technology Pty Ltd, Sydney, Australia) and Intellikeys (IntelliTools, Novato, California, US), the principle remains the same with each. Essentially, a touchpad is a touch-sensitive membrane housed in a slimline A4 or A3 case. The membrane provides an array of switches that can be grouped and defined by a user, using suitable software, to tailor the keyboard to a specific purpose. Once set up, the keyboard requires an overlay that clearly represents the way the switches have been grouped and for what purpose. In schools for children with a visual impairment, this style of interface is often used in conjunction with tactile overlays to display maps and diagrams. A child can trace and explore the raised lines, symbols and areal patterns (covering an area), receiving further information, perhaps speech or digitised sound, by pressing directly onto the overlay and so through to the keyboard. The only area of real difference between the available types of touchpad interface is the quality of resolution. For example, the highest resolution is offered by the Nomad with 9600 switches, the Informatrix II offers 4096, Intellikeys offers 576 and the Concept Keyboard has 256.

With the system that we are proposing, a tactile overlay will be used with a touchpad style keyboard to provide the user with a tactile representation of a section of music. The overlay will contain tactile versions of many of the structural features that would be found in a page of CMN, such as barlines, repeat marks, dynamic changes and time signature. However, for ease of usability it will be necessary to adapt these symbols to allow for known limitations imposed through perception by touch.

The user will be able to follow a guideline across a line of bars of music and retrieve extra information by pressing on the overlay. The overlay itself will be made of thermoformed plastic, which will allow a variety of heights to be employed as a source of redundancy for the user to exploit. The use of three heights has been shown to be an adequate number for this purpose (see Lederman 1979), as it provides a low level for areal symbols, mid level for line symbols and top level for point symbols. With our system, this will allow us to use a mid height line as a guideline for the user to trace their way from left to right with approximately five lines to a page and between four and six bars of music to a line. As they follow the guideline they will cross vertical barlines that are slightly higher in relief and where there are to be double lines the spacing between them will be 5mm to minimise the possibility of perceiving them as a single line.

Any symbol that is of immediate significance will also be of a higher relief whereas information that might only be of significance when, for example, playing through a section for a second time will be at the lowest relief. In practice, the user will be able to interact with and control the playback of any bar or group of bars they wish. How the musical information is delivered will depend very much on the particular task the user has in mind. The output methods available to them will include midi output, speech output and digital audio output and it is likely that auditory cues will be used to reinforce and confirm various interactions.

MIDI output

This will provide the user with an audio playback facility for simply hearing what the piece of music sounds like. The performance they hear will be accurate in that it will include appropriate dynamic changes, tempo changes and uses of articulation. Direct interaction with the tactile interface will allow the user to control where the playback begins and ends and also allow interruption so that bars may be skipped. This way the user will be able to scan through a page in preference to hearing large sections. Using audio playback in this way will also allow the user to learn a piece by ear if they so wish.

Speech output

When it comes to learning the notes, durations and instructions within the piece then speech synthesis will probably be a preferred method of output. An approach similar to a vocally annotated score will be adopted, although the user will be able to decide the depth of level of information they wish to access. For example, they could select to be told only about fingering, only about pitches or perhaps about a

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combination of pitch and duration. This approach would eliminate much of the redundant information that would normally be translated with vocal annotation and would provide the user with greater flexibility in meeting their individual needs.

Digital audio output

A useful method for teaching music in the classroom is to sing the letter names of a melody or to clap the rhythm to help learn a section of music. These are possibilities which we intend to explore within our system. A digitised singing voice could be used to help maximise information bandwidth in that the user will hear the letter names along with their actual pitch whilst also appreciating meter and rhythmical grouping.

Auditory cues

The evolution of the graphical user interface (GUI) has had somewhat disastrous implications for blind computer users who had, until relatively recently, regarded the computer as a powerful ally and now find themselves increasingly excluded from many computer applications because of the rapid trend towards graphical interfaces. There has been much investigation into the use of auditory cues like 'earcons' (Blattner et al. 1989) and 'auditory icons' (Gaver 1989) for reinforcing selections and choices that are made within a human–computer interface. Some positive features like non-visual menu systems and auditory interfaces (Brewster, et al. 1996; Pitt & Edwards 1991; Edwards 1986) have emerged from this research, and the potential for providing better access for blind people to graphical software using sound is quite apparent.

The involvement of auditory cues within our overall system would, on one hand, be of great assistance as a navigational aid, but their use could pose another problem in that a considerable amount of the information being presented will already be using both speech and non-speech sound. Effectively, this could confuse the user. A possible solution to this that we are considering is the use of natural, in particular non-music, sounds as auditory cues to help separate information relevant to the interface from the rest of the musical information.

Additional forms of output

As described earlier, one of the main aims with this project is to provide a flexible system that can accommodate a variety of output methods and therefore allow the user to choose the most appropriate method for their immediate needs. There is no reason why a refreshable Braille display should not be included at some stage to facilitate a Braille music approach, in the same way that using speech synthesis will easily accommodate a vocally annotated approach. For the reasons outlined earlier, however, there are no plans at present to do so.

We will also be considering to what extent 3D sound placement can be used to enhance the delivery of various aspects of musical information. For example, can it be used to suggest the fluctuations in contour that are so apparent with CMN or perhaps display the vertical structure of chord shapes in piano music? There are considerable limitations imposed when using 3D sound (see Begault 1991), one of which is the limited number of elevational positions that are easily perceivable, which, for many people, seems to be three: up, central and down. However, even these three positions could prove useful as most people, blind as well as sighted, perceive pitch as being on a vertical axis (Walker 1978; Walker 1985) so using simple 3D sound placement, coupled with stereo panning, perhaps the same effect that is suggested visually with contour could possibly also be suggested with 3D sound.

Automation

Currently, it is a requirement that the tactile overlays be made by hand but it is conceivable that in the near future such a process may become semi-automated. There are already software packages available that greatly assist in the production of overlays; the real problem lies in easily producing them with differing degrees of relief. As far as preparing the musical data goes it is most likely that much of the information could be taken automatically from standard midi files. There is a wealth in variety of musical arrangements that are already available in this format from many sites on the world wide web. All that would be required would be the minimum of effort in adding some additional information to that which can be extracted automatically.

Current progress

This project is still very much in its infancy and currently our efforts are being directed towards defining a comprehensive set of tactile symbols along with principles for their successful implementation in a tactile interface. A constant drawback in this process is the distinct lack of guaranteed guidelines for the design of tactile overlays. There are many factors to appreciate when considering how best to prepare information so that it can easily be perceived and interpreted through touch. For example, although there are many different tactual patterns that a person can easily distinguish between, only about eight can be in use for any one purpose before ambiguities begin to creep in (see Lederman 1979). This severely limits the amount of areal textures that can successfully be employed within a tactile representation. The same, to a certain extent, is true with many raised symbols; the more that are involved the more ambiguous they are likely to become. A possible solution to this is to use only a relatively simple selection of symbols, textures and line styles but to form further compound symbols from them. This might mean that a raised circle can have different meanings according to the texture that is upon it. This also suggests possibilities for increasing information bandwidth, as symbols that are traced fairly constantly, such as the main guideline and barlines, could have further information superimposed upon them. An example of this that we are planning to exploit is a method for representing gradual changes in parameters, such as dynamics and tempo, by using different textures upon the main guideline itself.

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There will be symbols that occur near the main guideline that indicate either a change in meter, a sudden change in tempo or a sudden dynamic change. These symbols will act as switches that, when pressed, will reveal the specific nature of the change. This will not only cut down on the overall number of symbols that need to be learned but will also help prevent the overlay from becoming cluttered. Whereas with both Braille music and vocally annotated scores a bar number is expressed every time a new bar is encountered, the number of the bar will be accessed by using the first bar line of a pair as a switch. Similarly, repeat marks will have a switch function that explains exactly how many times the section is to be repeated and whether there will be first and second time bars. Other instructional symbols from CMN, such as the 'dal segno' sign, will also function as switches that deliver a more complete set of instructions when selected. Some instructions such as 'da capo' (from the beginning) and `to coda' (go to the ending section) will have a tactual symbol but require no switch function, as their instructions are already quite explicit.

The functions for any tactile symbols that we eventually use will probably already exist either within CMN or as an auditory parameter. Formalising a set of tactile symbols that can be used effectively to convey this information is currently one of our main targets. Our aim is to have a prototype overlay system ready for testing later this year.

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CMC'98: Second Int'l Conference on Cooperative Multimodal Communication, Theory and Applications
28-30 January, 1998, Tilburg, The Netherlands
Submission of extended abstracts by **1st of October**
Further Info: Computational Linguistics and Artificial Intelligence Group, Tilburg University, P.O. Box 90153, 5000 LE Tilburg, The Netherlands; Tel: +31 13 466 30 60; Fax +31 13 466 31 10; Email: denk@kub.nl; URL: http://cwis.kub.nl/~fdl/research/ti/Docs/CMC
Summary: The aim of the conference is to bring together researchers involved in the design, implementation, and application of forms of cooperative human–computer communication where natural language (typed or spoken) is used in combination with other modalities, such as visual feedback and direct manipulation.

Diary Extra

WSCG'98: The Fifth International Conference in Central Europe on Computer Graphics and Visualization 98
9–13 February, 1998, Prague, Czech Republic
Submission deadline: **30th September 1997**
Further Info: Vaclav Skala, Computer Science Dept., Univ.of West Bohemia, Univerzitni 22, Box 314, Plzen, Czech Republic; http://yoyo.zcu.cz/~skala; Email: skala@kiv.zcu.cz Subject: WSCG INFO; Tel.:+420-19-2171-188; Fax:+420-19-2171-188; Fax:+420-19-7822-578; URL: http://wscg.zcu.cz
Summary: IFIP working group 5.10 on Computer Graphics and Virtual Worlds

The 20th International Conference on Software Engineering
19–25 April, 1998, Kyoto, Japan
Further Info: Koji Torii (NAIST); Email: torii@is.aist-nara.ac.jp; URL: http://icse98-info@itc.aist-nara.ac.jp
Summary: ICSE98 will see an unprecedented increase in the level of international participation. In particular, we will give a greater voice to members from the Asian-Pacific region, an area under-represented in the past. Yet our outreach must extend beyond geography. As we continue to build bridges to other software disciplines, researchers and practitioners in allied fields will benefit from an understanding of the contributions that software engineering can make to their work. In turn, we must address their problems in our research. New collaborations between academia and industry will also enrich ICSE98 and our profession as a whole.

New Learning Technologies for People with Physical Disabilities

Stella Mills

This Conference was held on Wednesday 30th April, 1997, at The National Star Centre at Ullenwood, Cheltenham, Gloucestershire, which is a College of Further Education devoted to the rehabilitation of physically disabled people. A variety of students attend the College including respite students and those recovering from accidents. It is situated on the edge of Cheltenham amongst the rolling hills of the Cotswolds and made an excellent venue for the Conference, which was a joint venture with the Cheltenham & Gloucester College of Higher Education (CGCHE). The main organiser was Alan Talbot of CGCHE and he is to be congratulated on a rewarding and smoothly run conference which was enjoyed by all the delegates.

The Conference was chaired jointly by Ian Smith, Head of IT at The Star Centre and Stella Mills, Reader in Computing Ergonomics at CGCHE. After coffee, the opening address was given by Dr Michael Smith, Principal and Chief Executive at The Star Centre, who welcomed all the delegates and asked how far IT could go in bridging the communication difficulties of the disabled, particularly with respect to teleworking at home. He questioned the use of the Internet for learning and saw its potential here as of prime importance. He was followed by Bill Fine from IBM's Computability Centre in Warwick. Those of us who have heard Bill will know there is no chance of sleeping through his talks, which are always lively and provocative. It was refreshing to hear someone from the industry discuss the drawbacks to speech as an input device, and he compared IBM's own work with that of Dragon. Discussion continued over coffee after which Kate Evans of British Telecom gave a demonstration of a learning tool which has been used to good effect for distance learning and assessment and so would help disabled people learning at home. The software allowed a tutor to give feedback on the student's performance and also to keep notes and marks which were not accessible by the student, and seemed to be a useful tool for general computer-aided learning whether or not distance was involved.

After an excellent lunch, eaten by many in the sunshine outside, Martin Cooper, from the University of Reading's Cybernetics Group, gave an interesting talk on the use of robotics in helping the disabled. He brought four of the famous dwarfs, which were so popular he had to stop them working in order for the audience to concentrate on his talk! After a comfort break, Mark Stimson, of Aimtech (Europe) Limited, demonstrated his company's interactive multimedia authoring tool, which allows the development of computer-based learning materials for the Internet or CD-ROM. This was particularly useful for those delegates who wanted to use the Internet for distance learning and complemented well with Dr Smith's opening address. Mark made it look very easy to author a module for the Internet and left many of the delegates wanting to try it.

After tea, there was a Question and Answer Panel, which gave the delegates an opportunity for discussion and most took advantage of this. In particular, it was felt that the Internet was the way forward especially for home-based computer learning as it allowed two-way correspondence between the tutor and the student without the cost of a dedicated network.

The conference was attended by over 70 people from throughout the UK and included a disabled attendee from the Republic of Ireland. All felt that the conference had satisfied its main aims of disseminating information about new learning technologies for the disabled and highlighting how disabled students could benefit from those technologies. Local press coverage was good and there is talk of another conference next year, so please watch for news of this if you want a pleasant and informative day in the Cotswolds next Spring…

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Diary Extra

ESSCS - ECS-MMS 97: 2nd Multidisciplinary Workshop on Cognitive Modeling and UI Development

15-17 Dec 1997, Freiburg, Germany
Submissions by **10 September 1997**
Further Info: ESSCS (Dr. G.J. Dalenoort), Dept. of Psychology, University of Groningen, P.O.Box 41 096, 9701 CB, Groningen, The Netherlands; Tel: +31-50-3636448/3636454; Fax: +31-50-3636304; Email: <G.J.Dalenoort@PPSW.RUG.NL>
Summary: European Society For The Study Of Cognitive Systems (ESSCS) and EACE (European Association for Cognitive Ergonomics). In 1994 a workshop was held on the cognitive aspects of man–machine interaction. In 1997 a follow-up will be held, with emphasis on social cognition. All aspects of man–machine interaction are welcome, as far as they may be considered relevant for cognitive science.

Collaborative Virtual Environments 1998 (CVE'98)

17–19 June, 1998, Manchester, UK
Submissions by **31st of October, 1997**
Further Info: Send electronic submissions (preferred) to: Dr. Dave Snowdon <d.snowdon@cs.nott.ac.uk>. Send hardcopy submissions to: Dr. Dave Snowdon, Dept of Computer Science, The University of Nottingham, University park, Nottingham NG7 2RD, UK; URL: http://www.crg.cs.nott.ac.uk/~dns/conf/vr/cve98/
Summary: A Collaborative Virtual Environment (CVE) is one that actively supports human–human communication in addition to human–machine communication, and uses a Virtual Environment (including textually based environments such as MUDs/MOOs) as the user interface. This is an exciting field with much potential for inter-disciplinary collaboration particularly in the fields of computer science, psychology, sociology, architecture & urban planning, cultural & media studies and Artificial Intelligence.

NeuroPage

A Case Study

Introduction

Head injury, brain infection, stroke, and ruptured blood vessels in the brain can all cause permanent impairment of memory functioning. It is estimated that head injury alone results in 11,000 new cases a year [1]. The majority of people with a moderate or severe memory disability are unable to return to work or enjoy independent leisure activities. They depend on a carer (usually a family member) to prompt them throughout the day, ensuring engagements are kept, medication is taken, and meals are not forgotten. As a consequence, the carer too is incapacitated by the disability.

Conventional memory aids do not offer a satisfactory solution because effective use itself depends on memory. A diary is helpful only if the user remembers to check it, an alarm clock only if the user recollects why it was set, and a 'memo' wristwatch only if the user recalls the significance of the one-word reminder. An electronic personal organiser would overcome these problems, but is too complex in operation for most memory-disabled people to learn. Many memory-disabled people also have impairments to their planning abilities, which further diminishes their capacity to make use of these aids.

Neuropage

NeuroPage is a computer-based reminding system recently developed in the USA specifically for memory-disabled people [2]. The aim of the designers was to keep the complexities of operation 'behind the scenes', presenting end users with a deceptively simple device which avoids the problems of conventional memory aids. It uses a combination of computing and telecommunications to achieve this, and is the first memory aid to capitalise on this technology. The NeuroPage system has three constituents. A centrally located desktop computer stores schedules of reminder messages for different users, for any date and time in the future. At the appropriate moment, a message is automatically dispatched via modem to a commercial paging company and transmitted within seconds to the appropriate pager. The paging device alerts the wearer to the incoming message by bleeping or vibration. The device has just one button to press which simultaneously cancels the alert signal and displays the reminder message on the 80 character screen.

Previous research and methodological issues

Two previous studies of the effectiveness of NeuroPage have been carried out [2 & 3]. Both were group studies of memory-disabled people which demonstrated that reliable improvements in task performance are observed with NeuroPage. While the strength of the group study approach is that it allows generalisation of findings, it has a number of limitations within this context. Ecological validity may be sacrificed for task consistency, with participants required to perform artificial tasks such as telephoning a given number at agreed times. Alternatively, real-life tasks may be investigated by getting participants to record their own performance, but it is difficult to establish comparability of tasks across individuals, the reliability of the data is questionable, and only a small number of tasks can be monitored in this way without overburdening the participant. Finally, where carers are willing to take on the task of data collection, there is a risk that their record-keeping may cue the participant

The current study adopted a complementary approach by using a single-case design. The aim was to carry out an in-depth investigation of one individual's experiences when NeuroPage provided extensive support for a range of routine activities at home. Although case study findings are not generalisable, the limitations of previous studies were avoided, and it was also possible to explore human factors in the usability of the NeuroPage system (an issue previously neglected). There were two options for observing the participant at home. Either the researcher could intrude into the household and risk disrupting the routine, or a member of the participant's family could be recruited to act as co-researcher. This is a role requiring skill, motivation and a considerable commitment, which may explain why there has been no previous in-depth case study of NeuroPage. The current study was fortunate in recruiting the mother of a memory-disabled man as co-researcher, and so gained privileged access to their household routine.

Method

The participant

The participant, JR, is a 28-year-old man with a severe memory impairment resulting from a head injury in a car accident eight years ago. He is unable to recollect any details of a short paragraph read to him half an hour before, or even to recall reliably that anything was read to him. He is also epileptic as a result of the injury, and has to take anti-convulsant medication twice daily within strict time limits. He lives with his parents and when his mother, Mrs R, leaves the house for more than a couple of hours she has to telephone him with reminders or arrange for someone else to visit. JR is uncomfortable with this level of dependence and sometimes resents what he perceives to be 'nagging'.

The co-researcher

Mrs R agreed to take on the role of co-researcher. As an ex-nurse she has experience of recording accurate observations and was aware of the risks of affecting the events she was recording. In addition, the author and Mrs R worked out a detailed procedure to cover contingencies such as JR exceeding safe time-limits for his medication.

Target activities

Discussion with JR and Mrs R identified a number of routine activities for which he needed reminding. Examples included getting up and dressed, eating lunch, watching the news headlines, feeding the cat, and (most importantly) taking his medication. Appropriate reminder messages were composed by JR.

Schedule of study

Pre-trial baseline: JR's performance on the targeted activities

Frances K Aldrich

was recorded for a two week period, with Mrs R giving reminders only when JR was in danger of exceeding safe time-limits for his medication.
Training: JR was familiarised with the pager over a 90 minute period, during which he received six practice messages.
Trial: The pager was loaned to JR for seven weeks, with messages gradually phased in over three weeks. For the last month he received 42 messages a week.
Post-trial baseline: The pager was withdrawn and JR's performance was recorded for another three weeks.

Recording of data

Throughout the study Mrs R made a discreet daily record of whether or not JR had carried out each target activity and, if so, at what time. With the aim of involving JR in the recording process as well, he was provided with tick sheets for two target activities: taking medication and feeding the cat (chosen because they occurred in fixed locations where the tick sheets could be displayed).

Results

Performance measures

JR's own records proved very unreliable but over 1,000 observations were made by Mrs R. Only a brief summary can be presented here but details will be made available elsewhere [4]. Analysis of Mrs R's records show that while using NeuroPage JR:

- got up and dressed nearly half an hour earlier than before;
- carried out household tasks 50% more often;
- watched the news headlines 400% more frequently;
- took his medication more punctually (average time off target decreased from 30 to 6 minutes).

When NeuroPage was withdrawn, some improvement was maintained, although this was task-dependent. For example, punctuality in pill-taking was sustained but frequency of watching news headlines immediately lapsed to previous levels.

Usability of pager by JR

Observation by Mrs R and the author confirmed that the single button operation of the pager made it straightforward to operate, with very little learning involved. However, there were two features which caused JR some difficulty. Firstly, the button must be pressed and released in order to display the message. JR found this counter-intuitive and would hold the button down, causing the message to flash on and off and making it difficult to read. This problem persisted throughout the study. Secondly, the bleeping sound is hard to locate when 'right on top of it'. This is not a problem for people who remember they are wearing a pager, but initially JR ignored the sound, thinking it came from the microwave oven or other source. Switching to the vibrating alarm instead was not an option because of the need for a wake-up call, and ideally the pager should allow sound and vibration simultaneously.

JR's satisfaction with NeuroPage

Throughout the study, JR expressed concern about damaging the pager by knocking it against furniture. He described it as 'clumpy' and would have preferred a thinner, lighter design. For a time he was also anxious that the bleeps might go off at an inopportune moment such as during a church sermon, but this anxiety diminished with reassurance and with his experience using the pager. JR felt the reminders (particularly about his medication) were helpful, and this motivated him to continue wearing the pager. After some weeks with NeuroPage he reported that he was getting on better with his mother who was 'nagging' him less now he was in more of a routine. Although he requested removal of the 'NeuroPage' label early on in the study, he was pleased by the interest the pager provoked from people.

Discussion, conclusion and future research

It is worth reflecting briefly on the kind of information revealed in this study which is unlikely to have emerged from a group study. Usability is the most obvious category, particularly given the difficulty of relying on memory-disabled people to provide accounts of their experiences. For example, it was only through detailed observation that JR's difficulty with reading messages became evident, as JR himself never mentioned it. Similarly, findings concerning JR's satisfaction with NeuroPage had to be gleaned through sustained attention to his comments and actions. Finally, relying on the tick sheets which JR completed himself would have given a very inaccurate picture of his performance. The current study supports the previous group studies in demonstrating that NeuroPage is an effective long-term aid for memory-disabled people. In addition, it indicates that NeuroPage can offer a useful short-term intervention to establish a routine in particular tasks, and that it is an extremely simple aid for a memory-disabled person to learn and to use.

An evaluation of the possible cost savings of NeuroPage to the NHS has just begun at the Oliver Zangwill Centre for Neuropsychological Rehabilitation in Ely, where there are plans to launch a subscriber NeuroPage service shortly. Looking further ahead, while NeuroPage offers reminders triggered by time alone, it will soon be possible to base reminders on location. This interesting new possibility will arise with improvements in the accuracy of commercial global positioning systems, which use satellite technology to specify location. Reminders could then be triggered by: location of the user (e.g. near the post office); presence of other pager wearers who could be friends, relatives and health professionals (e.g. with Person A); and combinations of location, person and time (e.g. near the post office, with Person A, during office hours). Furthermore, the requirement to pre-define all situations in which a reminder is to be sent could be avoided by incorporating artificial intelligence into the software. A rich variety of information would be available as the basis for reasoning and inferencing (e.g. where the user has been during the day, which other pager-wearers the user has seen, and any departures from normal

Continued overleaf...

NeuroPage
A Case Study

routine), and appropriate reminders could then be initiated by the system.

Acknowledgements
This paper appeared in the proceedings of a recent colloquium on 'Computers in the Service of Mankind: Helping the Disabled', published by the Institution of Electrical Engineers in Digest No. 117 (1997). The equipment and technical support for this case study were provided by Barbara Wilson, Jon Evans and Vlastimil Malinek of the Applied Psychology Unit, Cambridge, under the auspices of their grant from the NHS National R&D Programme for People with Physical and Complex Disabilities. I am also grateful to Jon Evans and Lydia Plowman for useful discussions, to Jon Rees for his friendly co-operation throughout, and to Mrs Rees in particular for all the time and effort she invested in this study.

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[3] Wilson, B., Evans, J., Emslie, H. & Malinek, V. (in prep.) 'Evaluation of NeuroPage: A new memory aid.'

[4] Aldrich, F. (in prep.) 'NeuroPage: a case study of a computer-based reminding system'.

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My Thesis

Name and address of researcher:
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Title of thesis:
The development of a methodology for capturing the mental models of intended users of computer systems

Supervisor, department and institution:
Dr Peter Brooks
Applied Psychology Unit
Cranfield University

What my thesis is about:
The development of a questionnaire to measure users' mental models of computers, to be used in software design, implementation and training.

How I got into this:
I began by looking at the role of the Internet in education, but discovered the importance of, and became focused on, the notion that users' mental models of computers vary and users with incomplete mental models will make mistakes.

My contribution to HCI research:
My assumption has been that if more can be understood about users' mental models then better interfaces can be designed and more appropriate training can be provided for users. Having identified that no tools were available to gather information directly from users about their mental models, my aim has been to produce a methodology for measuring users' mental models of computers. Having reviewed the work of many other researchers (e.g. Donald Norman and John Carroll) I arrived at a definition of a user's mental model of a computer which included users' theories and knowledge about computers, as well the contexts in which they use computers and how they explain errors. I developed interview questions around this definition and interviewed users of both sexes, with a range of ages and different levels of computing expertise. Using the words and ideas put forward by the users themselves I produced a questionnaire which summarised all of their responses. After the questionnaire was piloted it was evaluated by software designers, human–computer interaction specialists, IT trainers and change management consultants – all of whom felt that the questionnaire could help them with their work. Thus different forms of the questionnaire, used in different ways (i.e. as a catalyst for discussion in focus groups) could help software designers identify user requirements and IT trainers establish training needs, as well as helping change management consultants to maximise the acceptance of new information systems within organisations.

... continued from page 23

Tania Malkani and Licia Calvi

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Title of thesis

A temporal framework for knowledge representation and information filtering in educational systems

Supervisor, department and institution

Prof. W. Geerts
Department of Romance Languages and Literatures
University of Antwerp (UIA)

Prof. P. De Bra
Department of Computer Science
University of Antwerp (UIA)

What my thesis is about

Navigation and comprehension in educational hypermedia systems that are structured according to a temporal rather than to a spatial narrative.

How I got into this

I have started by analyzing the correlation between comprehension and navigation in educational hypermedia. I have seen that the presently accepted spatial hypertext model does not match the user's requirements/cognitive skills. I have looked for a more suitable model.

My contribution to HCI research

The thesis focuses on hypertext narrative. As such, it is an interdepartmental thesis, i.e. it spans both the literature and the computer science departments. Its literary side deals with hypertext rhetoric, with knowledge as recollection (see, e.g., Plato's Phaedrus), and with modern literary criticism (see, e.g., Eco (1979])). It is also literary since it concentrates on educational systems, by reporting experiences gained while experimenting with a system on language for specific purposes that has been developed for this occasion. But the thesis is more computational despiteits being mainly theoretical, for it discusses a more suitable hypertext model for educational systems, where 'more suitable' refers to its being tailored to users' cognitive skills and requirements. It starts with an analysis of the presently accepted spatial model and it further develops by showing its limitations as long as it turns to comprehension issues. Its core nevertheless lies in the assumption of a better model that is intrinsically temporal. In this context temporal does not entail any real-time considerations. To avoid misunderstandings with strictly temporal systems this term is immediately replaced by 'dynamic' or 'adaptive', because we want to stress that its main feature consists in its unfolding events rather than in juxtaposing them in an information space, in matching onto the users' cognitive abilities by presenting information into subsequent episodes rather than in adjacent clusters and thus by adapting to the users' knowledge level and learning processes, which, supposedly incremental, presuppose navigation more as a progress than as a mere traversal. As such, the study is not at all far from the emerging adaptive hypermedia systems (AHS) research topic, but its main difference is that here adaptation is not pursued in terms of complex user modelling techniques or other cumbersome adaptation mechanisms, rather simply by an adaptive linking presentation, i.e. on the basis of a theoretical knowledge progress, by displaying only the knowledge the user is ready for, while hiding that which the user is not yet ready for by means of the links leading to such information. The temporal claim, i.e. the claim that this unfolding presentation is more in line with the user's cognitive skills, is supported by experiments in the field of cognitive science (see, e.g., Schaeken et al. (1996)). Analogously, the assumption that also in practice this model will work better than the more traditional spatial one is motivated by reporting some preliminary users' evaluations (that will nevertheless be extended and constitute the topic of future research in this area).

Eco, U. Opera Aperta. Forma e indeterminazione nelle poetiche contemporanee. Bompiani Editore.

Schaeken, W., Johnson-Laird, P.N., and d'Ydewalle, G, 1996. Mental Models and Temporal Reasoning, *Cognition* 60, 205–234.

These short articles are now a regular feature in Interfaces. The idea is to offer a platform to Ph.D. students who have just submitted their theses, or who are about to do so. The articles are intended to be short narrative explanations of what the thesis is about, rather than formal summaries. They will allow other research students and researchers working in similar areas to make contact with the author; who knows, they may even lead to offers of employment.

If you would like to contribute to this series, please contact ***Andrew Monk (01904 433148; AM1@york.ac.uk)*** *for instructions.*

British HCI Group Application Form 1997

Please print or type. If renewing your membership, please indicate any changes to your details.

Contact Details (give a personal contact when asking for Corporate Membership)

Title ..... Last Name ..... First Name .....

Work Address .....

.....

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Nature of the work you do: .....

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Please send mailings to: my work address ☐; to my home address ☐.

Membership Status

Current British HCI Group Membership No. (if applicable) .....

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Student status (if applicable) .....

Professional Interests (please indicate up to six areas of professional interest.)

.....

.....

Data Protection Act

The data on this form will be treated as confidential to the BCS. However, the name and address will be used for British HCI Group mailings and statistical information on group membership may be collated from these data, although individuals will not be identified.

Membership Directory

Do you wish your contact details and professional interests to be listed in the Membership Directory sent to all members of the group? (We will NOT use your home address, unless that is all you have given us). ☐ Yes ☐ No

Getting Involved...

We are always looking for people interested in contributing to HCI group activities by, writing for Inter*faces* magazine, helping run the annual conference or joining the executive. If you are able to contribute in this way or if you have ideas for 1-day meetings or new activities please contact the membership secretary, Andrew Monk (AM1@york.ac.uk; Fax. 01904 433181).

Membership form - please photocopy for use

Membership Fee

Membership classes and fees for 1995-96 are:

☐ BCS Member £25 ☐ Non BCS Member £30 ☐ Student £10 £ .....

Corporate £195 ☐ Corporate membership entitles the organisation to 8 copies of Inter*faces* and other mailings; membership for any 4 individuals at British HCI Groups events, as well as, a free one-page entry in the membership handbook.

Journal Subscription to 'Interacting with Computers'

The HCI Group manages a journal, *Interacting with Computers*, published quarterly by Elsevier Science. Members may subscribe to this journal at a reduced rate. Vol. 8-No.1 will appear in March, 1996.

Please send me Vol. 8 (1996) of *Interacting with Computers (£50)* £ .....

Please send me Vols. 7 & 8 of *Interacting with Computers (£98)* £ .....

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HCI Membership, British Computer Society,
1 Sanford Street, Swindon, SN1 1HJ, UK
(Tel. +44(0)1793 417417) Queries about membership can also be e-mailed to: hci@bcs.org.uk

Autumn Diary

To receive more information via email on all these events and others, together with full details of many industrial, academic, and research studentship posts subscribe to our electronic mailing list by sending the following 2-line message, filled in appropriately, to the mailbase server:
mailbase@mailbase.ac.uk

join bcs-hci [optional title] <your first name> <your last name>
stop

EUROGRAPHICS'97: The Annual Conference of the European Association for Computer Graphics

4–8 Sept, 1997, Budapest, Hungary

Further Info: EG97 Secretariat, Viktor Richter, Kende u. 13-17, H-1111 Budapest, Hungary; Email: eg97@sztaki.hu; Fax: +361 186 9378; URL: http://www.sztaki.hu/conferences/eg97
Summary: THE Computer Graphics Conference in Europe!

Competitive Communications'97

18–19 Sept, 1997, Warwick, UK

Further Info: CC97, TEAM office, Engineering Management Building, University of Warwick, Coventry, CV4 7AL; Tel: 01203 524407; Fax: 01203 524343; Phil Foster: Email: foster_p@ema186.warwick.ac.uk; James Pennington: Email: James.Pennington@warwick.ac.uk; URL: http://isolde.warwick.ac.uk/CC97/
Summary: The conference is dedicated to increasing awareness of improved communications in the manufacturing industry, particularly Small and Medium sized Enterprises. Business issues involved in evaluating and deploying communication technologies and restructuring the organisation to take advantage of changes will be catered for. .

CSCW and Organization Development in the Public Sector – Tasks, Work Spaces and Workers' Participation under Change

29 Sept, 1997, Hamburg, Germany

Further Info: Volker Wulf, Institute for Computer Science III, University of Bonn, Rvmerstr. 164, 53117 Bonn, Tel: 0228 - 734 - 276; Fax: 0228 - 734 - 382; Email: volker@informatik.uni-bonn.de; Peter Mambrey, GMD - FIT, Schlo_ Birlinghoven, 53754 St. Augustin; Tel: 02241-142710; Fax: 02241-142084; Email: mambrey@gmd.de
Summary: A workshop focusing on groupware in public administration, which today is under pressure to adapt to new socio-economic conditions. When introducing groupware, work practice, work spaces and workers' participation are changing.

ALLFN'97 Revisiting the Allocation of Functions Issue – New Perspectives

1–3 October, 1997, Galway, Ireland

Further Info: Anne Marie Leonard, COHSS, Dept. Industrial Engineering, University College Galway, Ireland; Tel: +353 91 524411 Ext. 2770; Fax: +353 91 750524; Email: anne-marie.leonard@ucg.ie; URL: http://indeng.ucg.ie/allfn97
Summary: In recent years, the role of humans in complex socio-technical systems has come under increasing scrutiny. The Conference will bring together a variety of perspectives from ergonomics, human factors engineering, CSCW, HCI, industrial engineering and cognitive psychology to investigate the current and future set of activities involved in the area of allocation of functions.

Pacific Graphics '97

October 13–16, 1997, Seoul, Korea

Further Info: Prof. Yeong Gil Shin, Dept. of Computer Science; Seoul National University, Shinrim-dong, Kwanak-ku, Seoul 151-742 Korea; Tel: +82-2-880-6757; Fax: +82-2-871-4912; Email: pg97@cglab.snu.ac.kr; URL: http://cglab.snu.ac.kr/pg97/; Prof. James Kwangjune Hahn, Dept. of Electrical Engineering & Computer Science, The George Washington University, Washington, DC 20052 USA; Tel: +1-202-994-5920; Fax: +1-202-994-0227; Email: hahn@seas.gwu.edu
Summary: organized by: KCGS, CGS, SNU in Cooperation with: KISS, IPSJ, ACM SIGGRAPH (tentative), IEEE Computer Society Technical Committee on Computer Graphics. The conference focuses on computer graphics applications and methods across the areas of information, communication, science, engineering, art, and commerce.

IEEE Visualization '97

October 19–24, 1997, Phoenix, AZ

Further Info: Roni Yagel, Department of Computer and Information Science, The Ohio State University, 2015 Neil Avenue, Columbus, Ohio 43210-1277; Tel: 614-292-0060; Fax: 614-292-2911; Email: vis97@cis.ohio-state.edu; URL: http://www.erc.msstate.edu/vis97; http://www.cis.ohio-state.edu/~vis97/
Summary: The eighth IEEE Visualization conference focuses on interdisciplinary methods and supports collaboration among developers and users of visualization methods across all of science, engineering, medicine, and commerce. The Conference will include tutorials, symposia, and mini-workshops Sunday–Tuesday, and papers, panels, case studies, and late-breaking hot topic presentations Wednesday–Friday.

WebNet97: World Conference of the WWW, Internet and Intranet

31 Oct–5 Nov, 1997, Toronto, Canada

Further Info: WebNet 97/AACE, P.O. Box 2966, Charlottesville, VA 22902 USA; Email: AACE@virginia.edu: Tel: 804-973-3987; Fax: 804-978-7449; URL: http://www.aace.org/conf/webnet
Summary: Organized by theAssociation for the Advancement of Computing in Educationwith WWW/Internet businesses & industry. WebNet 97 is a multi-disciplinary, international forum for the exchange of information on development and research on all topics related to the Web and Internet, encompassing use, applications and societal and legal aspects.

3rd ERCIM Workshop on User Interfaces for All

3–4 Nov, 1997, Alsace, France

Submission Dates: Long papers to be received electronically by **15 September 1997**; Short and position papers to be received electronically by **1 October 1997**
Further Info: Dr Noelle Carbonell, INRIA-Lorraine, 615, rue du Jardin Botanique - BP 101, 54602 Villers-les-Nancy Cedex France; Tel: +33 3 83 59 20 32; Fax: +33 3 83 41 30 79; Email: carbo@loria.fr; Dr Constantine Stephanidis, ICS-FORTH, Science and Technology Park of Crete, Heraklion, Crete, GR-71110 Greece; Tel: +30 81 391741; Fax: +30 81 391740; Email: cs@ics.forth.gr; URL: http://www.ics.forth.gr/events/UI4ALL-97/call.html
Summary: Aims to stimulate further discussion on the state of the art in the field of HCI, and to consolidate recent work in the areas of adaptation (adaptability and adaptivity), platform independence and interoperability, multimodality, interaction metaphors, user empowerment, ergonomic and human factors guidelines, multi-linguality, internationalisation and localisation of interactive applications.

Automated Software Engineering - ASE'97, 12th IEEE International Conference (Formerly the Knowledge-Based Software Engineering Conference [KBSE])

3–5 November, 1997, Nevada, USA

Further Info: Alex Quilici, Department of Electrical Engineering, University of Hawaii at Manoa, 2504 Dole Street, Honolulu, Hawaii 96822; Email: alex@wiliki.eng.hawaii.edu; URL: http://www-lsr.imag.fr/Les.Personnes/Yves.Ledru/ASE97 (European mirror); http://ic-www.arc.nasa.gov/ic/conferences/ASE97
Summary: The IEEE International Conference on Automated Software Engineering, formerly KBSE, has for the past decade provided a forum for researchers and practitioners to discuss the application of automated reasoning and knowledge representation to software engineering problems. ASE-97 will expand this tradition, focusing on computer-based construction, representation, semantic analysis, reasoning, and understanding of software artifacts and processes.

MEDNET 97: The World Congress on the Internet in Medicine

3–6 November, 1997, Brighton, UK

Further Info: The Mednet Secretariat may be contacted at info@mednet.org.uk. For regular updates, subscribe to the Society for the Internet in Medicine list-server. Send a message containing the single line: subscribe sim to majordomo@umds.ac.uk. Postings to the list-server should be sent to: sim@umds.ac.uk; URL: http://www.mednet.org.uk/mednet/mednet.htm
Summary: The rapid spread of internet technology is having a significant impact on healthcare development, management and practice. In order to disseminate ideas on this matter, and to discuss its implications, the Society for the Internet in Medicine is organising Mednet 97, which will bring together hospital doctors, general practitioners, computer and information professionals, academics and hospital IT managers from around the world.

PB'97: Prototyping of User Interfaces – Basics, techniques, experiences

10-11 Nov, 1997, Paderborn, Germany

Further Info: Tel: +49+5251+60-6624; Email: szwillus@uni-paderborn.de; URL: http://www.uni-paderborn.de/fachbereich/AG/szwillus/pb97/pb97_e.html
Summary: Workshop of the SIG 2.1.2 "Interactive Systems" of the German Association for Computer Science (GI) in cooperation with GI-SIG 2.3.2 "Design Tools for User Interfaces" and German Chapter of the ACM.

The Second International Workshop on CSCW in Design

26–28 November, 1997, Bangkok, Thailand

Further Info: URL: http://www.chinavigator.co.cn/edu-sci/cscwd97.htm
Summary: Provides a forum for the latest ideas and results on the theory and application of CSCW, the research of multi-agent systems, CSCW in design, concurrent engineering and other topics. Topics include (but are not limited to): CSCW system architecture; multi-agent systems; Computer supported cooperative design; Concurrent Engineering; Interface for human–human interaction; Detection and resolution of conflicts; Internet, Intranet and CSCW; Applications of CSCW.

CHI 98: ACM SIGCHI 1998 Conference on Human Factors in Computing Systems

18–23 April, 1998. LA, California, USA

Further Info: CHI 98 Conference Office, CHI 98 Conference Administrator, 703 Giddings Avenue, Suite U-3, Annapolis, MD 21401 USA; Tel: +1 410 263 5382; Fax: +1 410 267 0332; Email: chi98-help@acm.org; URL: http://www.acm.org/sigchi/chi98
Summary: Theme "Making the Impossible Possible." It will include Human–Computer Interaction and Society, New Applications and User Populations, Devices and Displays, and Design and Evaluation, and an innovative focus on Education, Entertainment and Health Care application domains. Submission deadlines:
12 September 1997: CHIkids, Demonstrations, Design Briefings, Panels, Papers, Videos, Workshops.
26 September 1997: Development Consortium, Doctoral Consortium.
8 January 1998: Special Interest Groups (SIGs), Student Posters, Late-Breaking Results

For lack of space, summaries are minimal. For full summaries and other conferences, see http://www.hiraeth.com/interfaces/diary.html

Research in HCI for Disabled People

within the Applied Computing Studies Division of Dundee University, Scotland

Historical background

The Applied Computer Studies Division at Dundee University contains one of the two largest academic groups in the world researching into communication systems for disabled people, and was awarded a 5 rating in the recent UK Research Assessment Exercise.

This group grew out of the Microcomputer Centre, established in the Electrical Engineering and Electronics Department at Dundee in 1980. Alan Newell, who was appointed as the Director of the Centre, had been developing computer based systems for disabled people for a number of years at Southampton University. These included: the "Talking Brooch" for speech impaired people, a television subtitling system, used by ITV for their deaf service, and the Palantype Shorthand Transcription System, which was originally designed for use by the deaf M.P. Jack (now Lord) Ashley, and subsequently used in Law Courts in the UK.

John Arnott, who had been working with Alan Newell on the Palantype Transcription system, also came up to Dundee at that time and they were joined by Ian Ricketts from N.C.R., the locally based autoteller machine manufacturer. In 1986, the expanded Microcomputer Research group combined with Mathematics to form the MicroCentre within a Department of Mathematics and Computer Science. In 1995, this became a separate entity, and renamed itself the Applied Computer Studies Division. The mission of the group has remained true to its origins throughout this period, and all three of the founder members of the Microcomputer Centre are now senior members of the Division. The transformation into a Division, however, has meant that the undergraduate and postgraduate taught courses are now firmly aligned with the human–computer interaction and related research strengths of the academic staff. Degree programmes offered by the Division are now entitled 'Applied Computing' to indicate their particular flavour (http://www.computing.dundee.ac.uk).

The Division has an engineering bias and contains a rich blend of disciplines including theoretically and practically based computer scientists and engineers, psychologists, a therapist, a special education teacher and staff who have benefited from an interdisciplinary career structure. In both its teaching and research the Division is committed to the principles of Usability Engineering with a research focus on developing academic and practical insights, and producing software which can be commercialised. In a four year period up to 1997, the fourteen academic staff, and approximately the same number of research staff, have published widely, won a number of prizes and awards, and have licensed software products to the commercial sector.

Major Research Groups

There are six Research Groups within Applied Computing, covering human–computer interaction, computer systems for people with disabilities, medical engineering, digital signal processing and software engineering. The research within these groups, however, is closely linked and all academic staff contribute to more than one group.

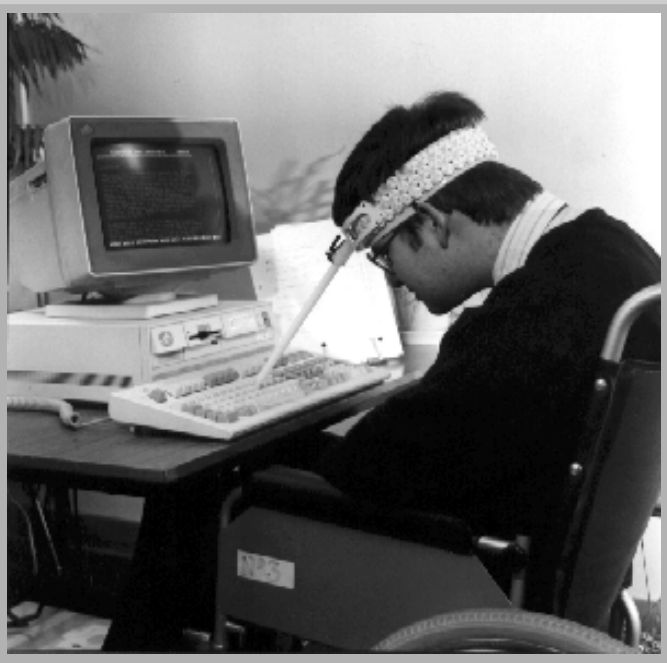
Communication and Learning Systems for Disabled and Elderly People

Norman Alm, John Arnott, Billy Beattie, Lynda Booth, Alistair Cairns, Peter Gregor, Marianne Hickey, Iain Murray, Alan Newell, Ian Ricketts and Annalu Waller

This group led the world in developing computer models of the pragmatics of interpersonal communication. Their research has resulted in a greater understanding of the theories of communication and the needs of users with speech, language and cognitive impairments, and has led to significant improvements in the performance of many commercially available systems.

The problem being tackled is essentially the difference in rate of normal speech (150 to 200 words per minute) and the rate at which someone could produce words if using a typewriter keyboard (which can be as low as 10 words per minute for a physically disabled person). A significant part of this research is based on the idea that it is very important for people to be able to tell stories of their past, because it is through these stories that our personalities are communicated, but it is not easy to do this at 10 words per minute!

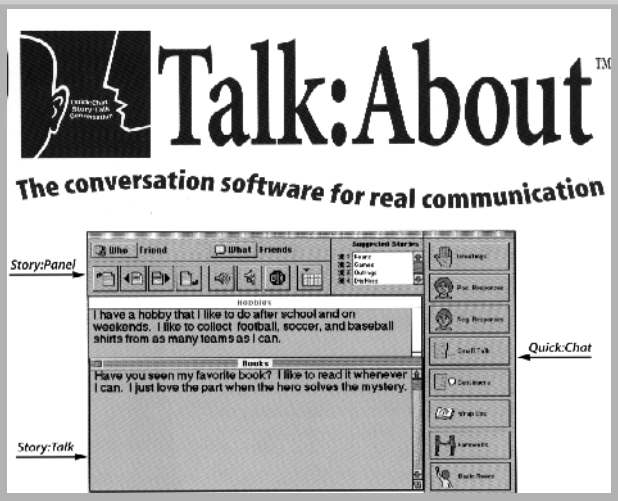
The research is focused on techniques which provide efficient access to pre-stored messages, and facilitate the



Severely physically disabled people often have to use unconventional input devices, which result in extremely slow keyboard entry

Alan F Newell

reuse of conversational material. Techniques which are being investigated include: conversational modelling, fuzzy information retrieval, hypertext structures, narrative based methodology, Schank's ideas of scripts, statistical methods of information retrieval and shallow natural language processing. This research also involves the development of effective engines for content analysis of text, systems for modelling users' behaviour, and hypertext & hypermedia interfaces for conversational systems for language impaired people. Although the focus of the work is on developing communication systems for non-speaking people, the research is relevant to the general fields of information retrieval and computational linguistics (Newell 1992; Newell et al. 1995).



'Stories are particularly important, since past experience and the ability to relate events are an important part of a person's make-up'

The work of this group has been commercialised as Talk:About, a system that enables non-speaking people to retrieve pre-stored text and speak it effectively and efficiently. This is marketed by Don Johnston Inc. (Chicago), and has received very positive reviews from therapists and users, with over 500 copies being sold in the USA alone.

Work in collaboration with Dundee's Psychology Department has led to the development of another such system, marketed as TALK Boards by Mayer-Johnson Co. of California (Todman et al. 1995).

Both of these products benefited greatly from the help of non-speaking people who work with the University on a voluntary basis. Alan McGregor, who is an international disabled swimmer, and Sylvia Grant have provided very important insights into the research, as well as lectured on the work, both in the UK and America, using systems developed at Dundee. Other projects within the Division are assisted by groups of disabled volunteers, who also collaborate in field trials of prototype equipment.

This research includes an investigation of the problems of people with speech and language dysfunction, particularly Aphasia and Dementia. This involves the development of systems for knowledge elicitation, activity monitoring, and automation of training for users, carers and therapists.

Ensuring that the HCI of these systems is appropriate is particularly important for this group of potential users. Work with people who have Aphasia is particularly challenging as this can involve very severe language dysfunction, many of the clients being unable to put their thoughts into words, let alone speak these words. Some are only able to babble. Nevertheless, it appears that very carefully designed software, with extremely simple interfaces, can enable such people to converse with friends and family in a way which would be impossible without computer assistance (Waller et al. 1995).

A problem of current communication systems for non-speaking people is that the speech synthesis on which they rely for output, although intelligible, has few or none of the characteristics which speaking people use to portray their emotional state. Dundee was one of the first research groups to investigate adding emotion in speech synthesis. They have developed a fully working system called HAMLET, which algorithmically can add various emotional qualities to synthesised speech by adjusting pitch contours, speech rate and voice quality. (HAMLET is the "Helpful Automatic Machine for Language and Emotional Talk", but readers will recall that Shakespeare's Hamlet instructed the Players how to speak their lines). Current research is focused on improving the fidelity and extending the range of emotion which can be represented. This has an obvious use in systems for non-speaking people, but there are other mainstream activities in which it would be beneficial for synthetic speech to have an additional emotional content (Murray et al. 1996).

The group began researching into predictive word processors for people with physical disabilities in 1982. This represents some of the earliest work into adaptive interfaces, and it is instructive to note that this occurred within a group investigating systems for disabled people, rather than within more mainstream HCI research. This work was very successful in producing savings in keystrokes for physically disabled people.

Subsequently, however, it was found that such systems were valuable for children and adults with dyslexia and other spelling and language dysfunction. A combination of computer science and clinical and educational research and practice in Dundee and Tayside led to the development of PAL – Predictive Adaptive Lexicon (a predictive text generation system for people with special needs commercially available from Lander Software of Glasgow) (Booth et al.1992).

This software has been expanded to include a syntax driven sentence construction aid and a phonetic/lexical spell checker for those with very severe spelling problems (also commercially available). Recent research is examining language independent predictive systems. Software has also

Continued overleaf...

Research in HCI for Disabled People

Applied Computing Studies Division, Dundee University

been developed which automatically identifies literacy difficulties in adults and children by computer assessment of free writing, proof-reading, spelling and dictation.

Telecommunications service provision and remote learning

John Arnott, Billy Beattie and Glen Rowe

This group is researching into how the needs of disabled and elderly people can be satisfied using broadband communication networks. With substantial funding from the EEC they have developed special services for telecommunication use, incorporating speed enhancing techniques, and have demonstrated the advantages of novel graphical forms of communication as an alternative to live video links. Research includes work on mobile communication systems for use by people with disabilities. This activity has been underpinned with research in CSCW, multimedia services and HCI.

It is linked with our more recent research into use of video and other support services for disabled and non-disabled students, and has led to research into networked multimedia services for disabled and elderly people, including tele-medicine, and remote education, work, health care and rehabilitation services (Beattie et al. 1995).

A multi-modal workstation being developed for use by ordinary people in extra-ordinary situations (a pilot, an air traffic controller) and extra-ordinary people in ordinary situations (a severely disabled office worker)

Multi-modal and ordinary and extra-ordinary HCI

Alistair Cairns, Peter Gregor, Alan Newell and Ian Ricketts

The group developed the concept within HCI that extra-ordinary (disabled) people operating in ordinary environments pose similar design challenges to able-bodied (ordinary) people operating in extra-ordinary (high work load, environmentally unfriendly) situations. Research within this group has shown how multiple simultaneous input devices, including gesture analysis, in combination with user monitoring, such as eye gaze, and plan recognition, can enhance the reliability of human–computer interaction for pilots, air traffic controllers, and people with disabilities. Techniques have been developed for recognising gestures by disabled people and for a printing system for European Sign Languages using CyberGlove technology. In collaboration with AT&T/NCR (the world's largest manufacturer of Autoteller Banking Terminals), this group has researched into predictive and other novel techniques within autotellers. (Newell 1993; Newell 1995)

Computer based interviewing and knowledge elicitation

Norman Alm, Peter Gregor, Alan Newell and Ramanee Peiris

Following initial research, which indicated that, in some circumstances, particularly when sensitive information is involved, human beings can be more truthful and forthcoming to computers than to people, this group has been conducting generic research into computer based interviewing techniques. Models of the structures of human interviews have been used to develop general purpose software to conduct computer based and computer facilitated interviews. The techniques developed have been evaluated in clinical use in the State (secure mental) Hospital, and within schools. A commercial product based on this work (ChatterBox) has been marketed by a local company (Intelligent Interaction, Tayside). Further research is focused on more flexible models of computer interviewing for eliciting sensitive information, and the potential of computer based interviewing to improve transferable skills (Gregor & Newell 1994).

Other research groups

Alistair Cairns, Janet Hughes, Steve Parkes and Ian Ricketts

Other research in the Division includes research into novel approaches to automating visual inspection, and other medically related activities, Digital Signal Processing research in remote sensing and space applications, and HCI techniques in software engineering.

External links, and support for students with disabilities in Dundee.

In addition to its international links in America and Europe, and participation in EEC projects, the Division works very closely with therapists, and user groups within Tayside. It also has close links with clinicians in the Medical School and staff in the Psychology and Social Work Departments. A teacher in special educational needs has been seconded to work within the Division for many years. She also works in the BT 'Assist' Centre, whose remit is to provide technological support for school children who have special educational

needs. The group has close links with the Tayside and Fife Higher Education Access Centre, which assesses students with disabilities for technological support, and provides training in the use of this technology. Dundee University has special units for Visually Impaired and Dyslexic Students, and its expertise in working with disabled people has been recognised by the Scottish Higher Education Funding Council locating its National Co-ordinator for Students with Disabilities in the University under Alan Newell's supervision. Collaborative research with these units and the Division has been examining how technology, particularly Inter- and IntraNet, can be used to provide support for students with disabilities by facilitating the provision of accessible versions of course material and examinations.

.Foresight and the future

Two of the major technological areas highlighted in Foresight were 'Communicating with Machines' and 'Telepresence /Multimedia'. In addition, the Health Panel of Foresight highlighted the challenges inherent in the demographic trends of an ageing population. (By the year 2000, 10% of the population will be over 80, and it is forecast that one in four of these will suffer from dementia.) Appropriate computer technology could impact substantially on this elderly and disabled population. Interdisciplinary human–computer interaction research, with theoretical and practical outcomes, including commercially available products, is needed within academic and research institutions to make major advances in wealth creation and quality of life in these fields (Newell 1996).

Further publications and details about the Applied Computing Division are available on the World Wide Web at: http://www.computing.dundee.ac.uk

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'The work is fun, it is very intellectually challenging, and staff and students at the Applied Computer Studies Division can strongly recommend it to others with a general interest in Human–Computer Interaction issues.'

Advert

World Wide Web Usability

Special Issue of the International Journal of Human-Computer Studies (July, 1997)

www.hbuk.co.uk/ap/ijhcs/webusability

This issue brings together seven articles providing detailed treatment of Web-based interaction from the user's perspective, with particular emphasis on learning from over a decade's hypermedia research before the Web took off, and on adapting current user-centred design methods and tools to the Web.

This special issue provides readers with the articles in HTML and Adobe Acrobat form, interactive demonstrations of systems described in the articles, and commentary/discussion facilities tightly integrated with the articles.

We invite the Web community to browse, study, download, interact, comment, debate, and feed back to the journal on this experiment in e-journal publishing.

Simon Buckingham Shum (Open University)
Cliff McKnight (Loughborough University)

International Journal of Human-Computer Studies (1997) 47(1) 1–222
Special Issue on World Wide Web Usability
www.hbuk.co.uk/ap/ijhcs/webusability

Computers and

Ray Jones (University of Glasgow), Sandra Foubister (Heriot-Watt University), Alison Crerar (Napier University) and I helped to organise a joint 1-day meeting on behalf of four BCS Groups (BCS Medical Scotland, BCS HCI Group, BCS Disability Group and the Edinburgh Branch). The meeting took place on 9th May 1997 at the University of Dundee on the banks of the silvery river Tay. Our aim was to bring together UK researchers who are applying computers to help people with disabilities. The meeting attracted wide support and, as I hope you will (re)discover from the edited abstracts, that is because the UK combines a strong research base plus some exciting new developments which together make a portfolio of research which compares favourably with the best in the world.

Overview of research work in the Applied Computing Department (ACD) at Dundee University

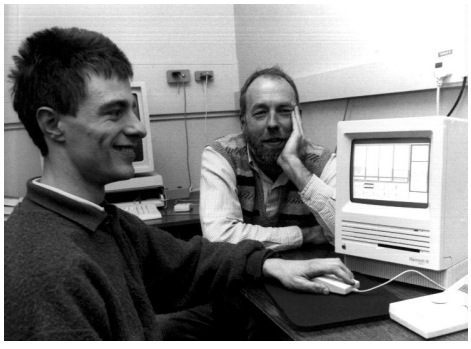
Ian Ricketts, ACD, University of Dundee.
email: ricketts@mic.dundee.ac.uk

See *Research in HCI for disabled people* on p. 28 of this issue of *Interfaces*.

Conversation modelling to improve augmentative and alternative communication

Norman Alm, Alan F. Newell & John L. Arnott, ACD, University of Dundee; email: nalm@mic.dundee.ac.uk

Despite considerable technological advances, severely physically impaired non-speaking people are still waiting for a breakthrough which will allow them to move beyond extremely slow and minimally augmented communication. One research direction which has been taken to increase the speaking rate and communicational impact of augmentative and alternative communication for non-speaking people is to use conversational modelling to direct predictive systems. A series of prototypes have been developed to experiment with such an approach. Commercial products are beginning to include this form of assistance. A number of key findings have emerged from this line of development. Systems which use pre-stored and reusable conversational texts have shown that they can be incorporated naturally into augmented conversations and can increase the user's participation and control of the interaction. Conversational features such as opening/closing sequences, back-channelling, story-telling, and step-wise topic shifts have all been investigated and produced lessons for system designers, not all of which are intuitively obvious. Norman provided an introduction to and summary of the current state of this area of research and identified those features which still need to be explored, so we can incorporate predicted texts gracefully into an easy to use communication system.



Disability 1997

Ian W Ricketts

Predictive retrieval of stories and sentences in an augmentative communication system for aphasic adults.

Annalu Waller, Fiona Dennis* et al., ACD, University of Dundee & *Ninewells Hospital, Dundee
email: awaller@mic.dundee.ac.uk

The University of Dundee, in partnership with the Dundee Speech and Language Therapy department, has developed TalksBac, a predictive augmentative communication system. The system was described, together with the results from the evaluation of its use with non-fluent aphasic adults.

Background: Although there are many augmentative and alternative communication (AAC) devices available, they do not meet the needs of adults with non-fluent aphasia (a language disorder resulting from brain damage). Some non-fluent aphasics are able to recognise familiar words and sentences. The TalksBac system harnesses this ability by predicting conversational items on a computer screen.

The System: The TalksBac system consists of two programs, one for the aphasic user to retrieve and speak items, and another for a carer to manage the conversational data. TalksBac uses a prediction algorithm to keep track of the way in which the user retrieves sentences as this allows the system to anticipate which sentences may be required in future conversations.

Evaluation: Four aphasic adults and their carers were trained to use the TalksBac system. The clients' communication skills were assessed at the beginning and at the end of a nine month intervention period. Annalu and Fiona provided us with a concise summary of the results and their implications.

A tool to aid basic numeracy and problem solving

Tom Claypool, Ian Ricketts & Peter Gregor, ACD, University of Dundee; email: tclaypoo@mcs.dundee.ac.uk

In response to an apparent lack of software support for the basic numeracy needs of physically disabled pupils, and recent reports which suggest that Britain lags behind its international counterparts in ability in this field, researchers at the Department of Applied Computing (ACD) of the University of Dundee have investigated the use of a computer based arithmetic assistant. The program, developed by ACD researchers, provides on-screen alternatives to the traditional workbook and concrete materials approach to teaching arithmetic. The program contains an on-screen jotter which was originally designed to simplify the setting out of basic calculations for motor impaired pupils. Also provided are two tools which take the place of concrete materials and are used as an aid to understanding the abstract mathematics performed on the jotter. The system has found application with a number of user groups who are able to benefit from the dynamic link between abstract and concrete concepts on the screen. Researchers believe that by enabling pupils to explore abstract and concrete forms and the translations between these concepts they are providing a powerful aid to the development of problem solving skills. Tom desribed the maths tool in detail and its application as a learning aid.

ScripTalker: the use of scripts in an augmentative and alternative communication aid

Gillian Harper et al., ACD, University of Dundee
email: gharper@mic.dundee.ac.uk

Gillian reported on the development of a new Augmentative and Alternative Communication (AAC) aid named ScripTalker. Physically disabled non-speaking people often rely on AAC devices to communicate. AAC users tend to have slow rates of communication and find it difficult to participate in conversations, especially with unfamiliar conversation partners. A new AAC device called ScripTalker is being developed to help disabled non-speaking people communicate in everyday situations with a variety of conversation partners. Research has shown that many everyday interactions follow predictable patterns. This knowledge has enabled the development of a conversation model and scripts of common interactions. These have been incorporated into the ScripTalker system which offers relevant predictions and easier retrieval of pre-stored utterances during everyday interactions to help the user communicate more effectively. The ScripTalker system has the following characteristics: a large number of pre-stored utterances; a rapid speech act facility for common conversational routines and feedback remarks; retrieval of pre-stored utterances via a context dependent interface; a pictorial interface in a cartoon style usable by both literate and non-literate users; facilities for literate users to create new utterances and to prepare text for later use, word prediction and an on-screen keyboard.

The development of a language independent word prediction program

Tom Claypool, Ian Ricketts, Peter Gregor & Lynda Booth* ACD, University of Dundee & *City of Dundee Education Department.; email: tclaypoo@mcs.dundee.ac.uk

Word prediction programs are used to assist text entry into computer software. A typical system works in conjunction with a word processor or other software that requires textual input. The prediction system monitors the partial input of a word and produces a list of alternative words which it considers to be possibilities for the one being typed. If the correct word appears in the list the user may take advantage of this and avoid typing the remaining characters of the word by selecting it from the list. In this way the user reduces the amount of key presses needed to produce a piece of text. Such systems have been shown to be extremely useful in assisting multiply handicapped users with their written communication and also learning-disabled pupils through the promotion of correct spelling. The team of researchers in the Applied Computing Department at the University of Dundee have developed a word prediction program which has the capability to handle a number of

Continued overleaf...

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European Languages. Dictionaries have been built using sample text collected from web sites using a feature of the program which allows data to be extracted from text files. The system extracts singular word frequencies and inter-word probabilities which allows words to be predicted in context. The system has application as a foreign language learning aid where the use of correct spelling and syntax are to be encouraged. The program is currently undergoing trials in schools in Tayside. Tom demonstrated the software and outlined the development of this program and its application as a learning aid.

The application of text retrieval techniques to a communication aid

Marianne Hickey, Stefan Langer, ACD, University of Dundee; email: mhickey@mic.dundee.ac.uk

In the WordKeys project Marianne and Stefan are investigating the application of lexicon based text retrieval techniques to a message based communication aid for non-speaking people. The talk focused on the possibilities and problems of using standard text retrieval techniques for AAC and argued that in order for a communication aid to have a satisfying recall rate and to reduce the cognitive load on the user, it needs a query expansion algorithm. For query expansion, information about semantical relations between words are needed. In WordKeys, this requirement is met by using a large semantic lexicon to determine semantic distance. The lexicons used for retrieval are all derived from the large semantic database WordNet. The semantic relations currently used are synonymy and hyponymy. Generalising the results from the use of these relations from WordNet, they suggest that statistical information about word frequency or other usage information is indispensable in semantic lexicons for information retrieval purposes. One step in this direction is the inclusion of word frequency information. Evaluations carried out with WordKeys have shown that the use of this information considerably increases recall rates. Currently Marianne and Stefan are evaluating the device with an AAC user to confirm the suitability of the current retrieval algorithms for a communication aid.

The BCS Disability Group and IT in my life

Bob Jamieson, Hon. Secretary, BCS Disability Group email: egbow@globalnet.co.uk

(See also *BCS Disability Group*, p.15, this issue of *Interfaces.)*

Bob described his personal use of IT. This started at the age of 10 with a second-hand typewriter. Later on he obtained a QWERTY communication board. This he found convenient as it is small (he can put it inside his wheelchair), it never broke down, and is more personal to talk to people with compared to a Lightwriter which he obtained later. His first computer was a portable Epson, which he later changed for a BBC microcomputer and most recently a pentium computer, with track ball, colour printer, CD drive and modem, funded by a trust.

Bob told us of the problems he found with the reliability of equipment and finds that at times he has to go back to using his old computer. He described the Possum environmental control system in his bungalow and some of the problems (and successes) that he has had with it. In summary, Bob's message for all organisations was that we need to consider more carefully the individual needs of disabled people.

User-centred design of technology for people with visual disabilities.

Helen Petrie, Sensory Disabilities Research Unit, Hertfordshire University; email: h.l.petrie@herts.ac.uk

The Sensory Disabilities Research Unit at the University of Hertfordshire is working on the development of a number of computer-based systems which improve the quality of life and independence of individuals with visual disabilities. Their research has been in the areas of elicitation of user requirements, design, rapid prototyping and evaluation of such systems. In the course of that work they have evolved a number of user-centred design methodologies particularly appropriate for the development of technology for disabled users. Helen outlined two of the systems which have been developed and discussed the methodologies which were used. MoBIC is a navigational aid for blind pedestrians which includes both a pre-journey system to allow blind people to study a digital map and prepare travel routes for themselves, and an outdoor system to assist them in orientation and navigation during journeys. DAHNI is an audio-tactile interface to hypermedia systems for blind students which has been incorporated into standalone hypermedia applications and a World Wide Web browser. In summary, Helen emphasised how a user-centred design approach can produce more effective and usable computer systems for visually disabled individuals.

Access to keyboard configuration facilities

Shari Trewin, Department of Artificial Intelligence, Edinburgh University; email: S.Trewin@ed.ac.uk

Many computer users with motor disabilities choose to use keyboards for input, but find the physical movements required are difficult. The resulting input errors can often be minimised or eliminated by employing existing software configuration facilities such as Sticky Keys, which make the keyboard more accessible. Unfortunately, the configuration facilities are underused, due to a lack of awareness of their existence, and the perceived or actual difficulty of employing them, particularly on shared machines, where one person's ideal configuration may conflict with that of another. Automated support for keyboard configuration could help to solve this problem. As an initial step in this direction, Shari explained how researchers in the Department of Artificial Intelligence at Edinburgh have developed a model of keyboard skills, capable of making recommendations of appropriate configurations. The model has been developed and positively evaluated using typing logs from

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Ian W Ricketts

twenty keyboard users with motor disabilities and six with no disability affecting their typing. It is currently undergoing final field testing, early results of which were presented. Shari outlined how the model could be used for dynamic assessment of keyboard configuration requirements, with a view to informing users of potentially relevant facilities, and helping them to alter their configuration as they choose. Alternatively, automatic configuration could he attempted. In due course these approaches may be particularly useful on shared machines, or where users are unable to perform their own configuration.

Automatic production of conversation aids tailored to users with different needs

Portia File et al., University of Abertay, Dundee
email: mctpf@tay.ac.uk

There are people who are capable of thinking of things to say but who are unable to speak. Augmentative and Alternative Communication (AAC) devices are available to help these individuals communicate. However, AAC users have differing sets of capabilities and it is important to select the AAC system from the wide range of available systems that will allow them to make the most effective use of their capabilities. At present, to the extent that variations in systems can be made available, they are produced either by a computer professional who must adapt them at considerable expense or by someone with quite other concerns, for example a busy speech therapist, who must learn enough about the system to tailor it to the needs of particular individuals. Researchers at the University of Abertay, Dundee, are currently developing an alternative solution that combines expert systems with an object approach to developing AAC devices. Portia explained how an expert system can collect information about a particular AAC user's requirements and produce a specification for that user's AAC system. This specification is then used to select system features from a tool kit of such features, each represented as an object. These components are then combined to produce the implementation that is tailored to the user's needs.

Using non-speech sound to improve usability

Stephen Brewster, Dept. Computing Science, University of Glasgow; email: stephen@dcs.gla.ac.uk

Stephen described on-going research projects investigating the use of sound to improve the usability of computers for people with disabilities. Speech already provides informa tion in interfaces for blind and partially sighted users but such interfaces make little use of non-speech sounds. The current research in the Department of Computing Science at Glasgow University addresses this problem. There are three aspects to this work:

I. The integration of non-speech sounds into human–computer interfaces to aid partially sighted users. The present interfaces often use very high-resolution graphics. These can be very difficult to use with reduced visual acuity. The addition of sound can indicate objects that can be pressed or when interaction mistakes have occurred that would otherwise not be seen.
2. The use of sound to provide navigational cues in hierarchies of information. Navigating through structured information (such as electronic books or computer file systems) can be difficult and can result in users becoming lost. Structured sounds can provide navigation information to overcome this.
3. The use of sound to improve scanning input for physically disabled users. Scanning input is slow and sound can speed this up by taking advantage of our natural rhythmic abilities.

Stephen provided an insightful presentation illustrated with demonstrations.

A non-visual approach to musical representation

Ben Challis, Dept of Computer Science, University of York
email: bpc@minster.york.ac.uk

See *Non-visual musical representation*, p.16, this issue of *Interfaces*.

Computer-aided conversation for non-speaking people

John Todman, Department of Psychology, University of Dundee; email: j.todman@dundee.ac.uk

High tech conversation aids which depend on the user entering text during a conversation produce synthetic speech output at a rate (typically 2-10 words per minute) that is too slow to sustain anything approaching natural conversation. Pre-storage of phrases ready for use in subsequent conversations can, in principle, increase the rate of speech output, but the relatively small number of fixed messages available is generally thought to be too restrictive to support free-ranging conversation. In natural social conversation, however, much content is 'approximate rather than ideal' and much of it is recycled repeatedly. This reflects the reality that much social conversation is motivated more by goals such as 'enjoyment of the interaction' or 'creation of a favourable impression' than by goals concerned with the accurate transmission of information. The pragmatic features of natural conversation that 'make it work' for participants have been modelled in a conversation aid based on phrase-storage. John outlined his research, in the Department of Psychology at the University of Dundee, in the development of TALK, and reported that users of the system have achieved socially effective conversations with greatly increased output rates. The main innovative features of the system were described and an interesting summary of evaluative research given.

Continued overleaf...

Recollecting the

Computers and Disability 1997

The development of a sign language printing system

Ian Ricketts, Alistair Cairns, Peter Gregor, Craig Ramsay & Julian Cracknell*, Applied Computing Department (ACD), University of Dundee & *Logica Ltd., London.
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I reported on the development of a sign language printing system (SignPS). Research has shown that prelingually deaf people have only a limited command of the spoken and written languages of the community in which they live. Communication within the deaf community commonly occurs by means of sign languages which, currently, have no conventional written form. Signed information is usually recorded using video, photographs, or line drawings. None of these methods provide easy or efficient communication platforms. The sign printing system that we are developing allows users to record signs and signed texts efficiently, in a standardised, highly readable format using the computer.

The system consists of a sign font that is used for the two-dimensional representation of signs; a sign and document editor; and special purpose input devices. A prediction system is incorporated to reduce user effort in creating documents, and also to improve the accuracy of the input devices. The system comes supplied with a dictionary of predefined signs and it is possible for the user to edit or create sign representations at will.

Two specialised methods of inputting signed information have been investigated. One method uses a pair of Virtual Technologies CyberGloves where changes in location, orientation, shape, etc. of the hands are calculated and used for recognition by the system (see front cover). Another method uses video cameras to monitor the subject performing signs to extract a frame by frame description of their actions and attempts to recognise them. In addition, a standard method of input has been developed: the Virtual Keyboard, which allows the user to enter sign information manually using mouse and keyboard.

The results of evaluation with a range of sign users suggest that the research project has achieved its aim and will shortly be available as a supported software product.

Acknowledgements: SignPS is funded by the CEC under the TIDE program (Project No. TP1202) and is a collaborative venture between five European partners: IRV, Hoensbroek; LTI, Aachen; ACD, University of Dundee; RNR, Amsterdam; Handicom, Harderwijk.

Conclusion

All the attendees that I spoke to commented that it was a stimulating and informative meeting and the overriding question, apart from 'Can I have your email address so I can get some further details?', was 'when is the next one?' This was another success and another challenge for the BCS.

Dr Ian W Ricketts
ACD, University of Dundee
email: ricketts@mic.dundee.ac.uk

Leon Watts attended the CHI'97 Conference over the third week in March, 1977. He co-organised and ran the two-day Basic Research Symposium (1), participated in a one-day workshop on Awareness in Collaborative Systems (2) and presented a technical note to the main conference (3). His work is supported by the *Economic and Social Research Council* under the *Cognitive Engineering Programme.*

The Setting

On Thursday, March 20th 1997, the City of Atlanta saw the arrival of the Association for Computing Machinery SIGCHI's outriders for the annual Conference on Human Factors in Computing Systems. By the time the Conference officially opened, on Tuesday, March 25th, 2100 people had overrun the Peachtree area of downtown Atlanta. By the time the Conference closed, they would have shared over 30,000 cups of coffee (and an unrecorded number of cups of tea) with one another, vast numbers of sticky buns and gallons of juice.

The pre-conference activities

So what happened between March 20th and March 25th? Did it take the outriders so long to prepare the ground? Well, no. Not exactly. CHI does rely heavily on the services of volunteer effort. Without these people it would founder under its own weight. Of all these, the muscle power comes in the form of that extraordinary individual, the student volunteer. No doubt, Stephen Pemberton and Alan Edwards, the CHI97 Conference co-chairs, were having kittens. I saw Stephen Pemberton on the Saturday morning, wandering about with his camera at the venue for the earliest events, looking dazed, stupefied and really rather proud. And so he should. They needn't have worried. It was these volunteers, together with their co-ordinators, who began to arrive on Thursday 20th. By Friday, these keen and tireless, smiling characters from the four corners of the earth were up to their eyes in briefings, hoardings, infostands and jet lag. Here's a personal thank you, once more, from an ordinary CHI-goer.

At the same time, the organisers of the 32 (that's right, thirty two) tutorials and 15 workshops were quietly having kittens in their own way, each working in a microcosm of their own organisational crises. Additionally, there were three rather more open-ended pre-conference events: the Development Consortium, co-chaired by Gerrit van der Veer (Vrij Universiteit) and Austin Henderson (Apple); the Basic Research Symposium, co-chaired by myself and Susanne Jul (EECS, U. Michigan), and the Doctoral Consortium, chaired by Allan MacLean (Rank Xerox). These events each serve no particular theme but rather exist to promote communication within the constituencies for which they are designed, to foster good practice and thereby to enrich HCI as a whole.

The range of topics covered, intentions motivating and people involved in these 50 events beggars belief, and in itself reflects the health and strength of HCI. I know that

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Future

A personal account of the CHI97 Conference on Human Factors in Computing Systems March 22–27, Atlanta, Georgia. USA

Leon Watts

several of them were hugely oversubscribed. The tutorial 'Designing user interfaces from Analyses of User's Work Tasks' (Johnson, Johnson Wilson, QMW) was anticipated to attract around 30 HCI practitioners. It was delivered to 105 satisfied customers! The two-day workshop on Navigation in Electronic Worlds (Furnas Jul, U. Michigan) had to turn away half of the people who wanted to be a part of it. At the same time, that enormous diversity brings with it a kind of identity crisis. For me, the identity and direction of HCI were the central theme of CHI97. It's not that HCI hasn't suffered from this angst before. Jack Carroll called for it to be 'ontologically minimised' in 1990 (4) – but nobody understood what he meant. It is a given in psychology that perception operates as a function of cognitive readiness or anticipation. In other words, it's a very personal matter and cannot be decoupled from an individual's prior state. Certainly, this was one of the matters that concentrated the minds present at the Basic Research Symposium. I hope therefore for some dispensation in this regard from those others who were at CHI97 and found the event to be defined by some other characteristic.

Reports on each of the workshops should appear in the October 1997 issue of the ACM's SIGCHI Bulletin.

The main event – the future of HCI

The content of the Conference is a matter of record. I shall not reiterate it here. Rather, I shall try to convey parts of the Conference that cannot easily be derived from its official publications.

The theme of this year's Conference was 'Looking to the Future' and so directions for CHI were right at the forefront of the organisers' consciousness. In consequence, CHI97 was bracketed by opening and closing plenary speakers who have a long view on matters CHI related. But what does that mean, 'CHI related'? One of those people entrusted with introducing CHI97 to its 2100 paying guests was an official of CHI's parent body, the Association for Computing Machinery. His enthusiasm bubbling over, matched in equal measure by his inability to get a grip on what SIGCHI is about, he described the CHI community as dealing with 'reality processing'. It didn't mean much to the audience – at least, it didn't bring any reaction, just an awkward silence – but I think I can see what he was getting at. Just where does the 'interaction' between human and computer reach to? There was a time when HCI meant interface design. For some people, interface meant nothing more than 'look and feel'. It wasn't so long ago. But if you were to ask some of the most perceptive computer scientists about the true consequences of dealing with interactions between people and the systems they design, they would say that the separability of the interface from system architecture is a myth. HCI reaches right into the architecture of computer systems (5). Their organisation and their structure delimit their utility such that a 'front end' is a totally misleading epithet for the product of the HCI professional. At the other end of the scale, HCI reaches into the design of work itself and the shape of organisations. It is the business of understanding how people structure their working lives and their relationships with others such that opportunities for technological intervention are exposed and exploited.

Rick Prelinger, an archivist of moving-image media, began the Conference proper. He presented a series of film-clip visions of the future, as foreseen by our predecessors of the twentieth century. His account of the process of envisionment was articulated through these old Utopian ideals. It was fragmented and idiosyncratic and, ironically, seemed to suffer from the same lack of direction that I thought was his message about contemporary future-planning. He indicated that Utopianism died out in the early '80s. Once, people thought big, planned big, and many of the things they strove towards have become unnoticed parts of our everyday lives in the developed world. Whether or not one agrees with the purposes these planners had in mind, or the vehicles they employed to carry their dreams, they had dreams and plans and ideals. Prelinger seemed to me to leave his audience wondering what today's plans were. That could have been his most powerful message. In my estimation, Prelinger was not calling for the imposition of other people's ideals on the world at large. He was at pains to point out that much of the Utopianism embodied in his film archive was driven by commercial opportunism (anyone for a world entirely fashioned out of Plexiglas™ etc.?), premised on a sexual division of labour. It was rather that there seems to be a sense in which the fallibility of future vision has been equated with a feeling that it is just plain wrong to try to do it. It seems almost as if the problems of, for example, tower block (lack of) communities have brought about a small-think culture: 'there's no point in planning because you'll only get it wrong'. However, those tower block planners did put an end to slum dwelling and open sewers, and pollution so dense that in Manchester pedestrians would get lost just trying to cross the road.

Douglas Coupland, who wrote the zeitgeist novel *Generation X*, closed the Conference in a rambling, amiable chat that did a lot to express the gulf that separates him from the CHI community. He told jokes during his address that nobody understood and received jokes afterwards that he did not understand. He did however remind us of something that should persuade us of the value of thinking about the shape of the world we live in. – the 'reality' that CHI defines for technology consumers to 'process'. He observed that there is always some new wonder technology that will change our lives radically and forever and then be superseded and ignored. He told us about some wood and two IBM electric typewriters in a skip near his home. The wood lasted for a couple of days before being 'liberated' by a local entrepreneur. The typewriters are still there. The next big thing, Coupland called it 'Fred', is just around the corner. 'Fred is inevitable'. What does that mean? It means that the excitement with which we each treat Fred, whatever that turns out to be, ought to be set into the context of all Fred's children. Again, to my mind, it requires of every active HCIer to invest some of their energies in conceiving of the likely consequences of their work.

Continued overleaf…

Recollecting the Future

There is a problem in 'looking to the future'. That is, one requires a viewpoint from which to do it. As Yvonne Waern put it rather enigmatically, 'Today is tomorrow's yesterday'. To know how something is going to develop requires a pretty clear understanding of what that thing is now. Everything has a history that is just as important in determining its future as the events that it encounters on the way.

Two particular events, both panels, reflected HCI's search for an identity more than any others. One of these was called 'None of the above: What's really essential in HCI education?', organised by Andrew Sears, Comp. Sci. DePaul University, and Marian Williams, Comp. Sci. Univ. Massachusetts Lowell (CHI97 Extended Abstracts, 109–110). A rough synopsis is that Jean Gasen, Tom Hewett, John Karat and Gail McLaughlin debated the notion that HCI should not be taught as a body of knowledge but as a set of skills. To quote directly from the panel's description

1: HCI is changing too fast to teach specific content. We need to teach people generic skills that will help them adapt to a world where change is the norm.
2: Academia shouldn't be teaching specific workplace skills. Universities provide education, not training.
3: Academia isn't preparing graduates to be useful in the workplace, because it isn't giving them useful skills.
4: HCI is a state of mind, not a body of knowledge or a set of skills.

Understanding root issues grappled with by the 'education' panel requires some understanding of the other panel. This was 'Design v. Computing: Debating the future of human-computer interaction', organised by Tony Salvador, Intel Corp. Dan Boyarski of Carnegie Mellon (6). Paul Dourish and Wendy Kellogg defended the 'computing' camp whilst Jim Faris and Terry Winograd attacked from the 'design' camp in promoting a resolution:

> It is resolved that the CHI community should disassociate from professional computing societies and realign closely with professional design societies.

Pitching design against computing within an HCI conference could not work, even given that the proposal focusing that panel was intentionally confrontational. The reason is that the defenders of computing are not computer scientists. Well, not any more. They have been 'corrupted' such that they would more properly be described as HCI professionals. So the main thrust of Dourish and Kellogg's riposte to the Faris and Winograd argument was that they simply did not recognise the caricature of computing that was their target. They countered with examples of 'computing' that appear to me (admittedly as a human scientist) to be 'HCI'. In other words, HCI already just isn't computer science, any more than it is psychology. To be fair to Winograd and Faris, it is true that SIGCHI (and the British HCI Group) are sections of national computer associations (the ACM and the BCS respectively) and so it was more reasonable that computer science should be set up as a straw man than any of HCI's other contributing disciplines.

I personally think Winograd and Faris are right in their intention. That's not to say that computer science is some kind of evil but that HCI is ready to stand outside of any particular disciplinary umbrella and assert itself independently. There are indications that HCI is responding to this challenge, such as Judy and Gary Olson's description of the 'School of Information' at the University of Michigan (7). Also in the USA, SIGCHI is taking steps in that direction by working towards status as a society in its own right, rather than as a SIG of the ACM. Whether or not the will and the resources are there to back this up in the UK is another matter. I think this is where the first-mentioned panel fits in. HCI education takes place in computer science departments – check the affiliations of the panellists. This association is far more telling than that its professional bodies exist under the aegis of superordinate computer societies. The education debate seems to me to revolve around a mindset of trying to treat the teaching of a discipline as if it were a single skill, something that is inevitable so long as HCI is compartmentalised as a side issue of only one of its contributing forces. Even if it is promoted as a (presumably finite) set of skills, the attempt to dissociate skills from knowledge is either to consign the area to the realm of rules of thumb or to deny that there is a system and history to the methods and techniques within the HCI community. To my mind, it is a deeply significant matter. HCI has run headlong into its own epistemology (including scope and validity of methods for deriving and recognising knowledge) after years of promoting *ad hoc* heuristics and fragmentary 'truths' (e.g. 'seven ±2 chunks on a menu').

You may be wondering what technological trends, if any, were detectable at CHI. In other words, 'is there any word on Fred yet?' Well, more and more computational devices are presented as augmentations of the environment in which we live, whether they be wearable computers, or output devices built into the very fabric of the places we live and work in. This kind of development is variously referred to as augmented reality, ubiquitous computing and seamless technology. The Web is still huge news (last year's Fred) and reared its head this year primarily in terms of navigation issues and information overload, as well as in prospect of mass public involvement with the integration of internet and television media. The latter points were controversial on two levels: whether or not the buying public are really interested in the set-top box route, and if they are, what kind of a society are we going to be living in 20 years from now. In an invited speakers' session, Jeff Johnson (8) and Tim O'Shea (9) worked as a fascinating counterpoint to one another. Jeff Johnson extemporised on the theme of a market-driven commercial model of this technological synthesis, emphasising the logical consequences of current divisions between the haves and the have nots. He reminded his audience of the fallacy of 'global connectivity'. Tim O'Shea described the Open University, a substantially public-funded body dedicated to providing the highest quality of education to a wide range of people who would otherwise be excluded from it. 200,000 students, 80,000 tutors delivering courses all over the world, exploiting the

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full range of available media. It was a counterpoint because it demonstrates that the power of the public purse, at least outside of the USA (astonishingly, the USA is the only country in the world without an OU equivalent), will be just as influential on the development of on-line services as profit-driven market economics.

The spirit of CHI

On the grand scale of things, there are bigger conferences. But within the field of Human–Computer Interaction, CHI rules. There were six parallel tracks for formal events, including panels, long and short papers, the (extremely successful) invited speakers, demonstrations, organisational overviews and design briefings. At the same time, the posters and informal demos were competing for the attention of the attendees. Additionally, 19 Special Interest Group meetings, for people who have particular professional commonalities, were organised to run in 90-minute slots throughout the Conference. The very enormity of CHI makes it a magnet for the international HCI community; one might almost say it has the gravity of a sun in a system of HCI relations. As such, it provides a rare opportunity for these people to gather with their peers. The Special Interest Group meetings are a formalised version of the many thousands of meetings that occur spontaneously throughout CHI. In a more general sense, for the majority of people I spoke to, this is the 'eighth track' and the most beguiling of them all.

Superficially, these interactions may seem to be empty, mechanical politenesses. Many of them are. But why do people take part in them? Look a little deeper and I think you'll find much of the real business of CHI: surprising, encouraging, provoking, evolving professional relationships. There were many friends made at CHI this year, and many old acquaintances renewed. Through those new friendships a deeper understanding of otherwise dry work comes about, or even the true value of the conceptual work articulated through apparently trivial gizmos. People from all corners of the HCI world and beyond come to CHI. I can't help but think that the mêlée of CHI is one of the most creative and inspirational happenings in what I consider to be one of the most creative and inspirational fields of human endeavour. Where else would one find a hamster's wheel driving a ceiling-mounted display in the form of ripples on a pond? (10) Or a demonstration of an internet camera mounted in the wire frame of a pair of sunglasses used to film the filming of supermarket security cameras filming the filmer? (11) Or the spectacle of DOS and people-with-paper competing live against the latest information-browsing mechanisms on a special 'logically loose' test database? (12) DOS lost, by the way, but did not come last! These strangenesses are not the CHI norm, but they are typical of the spirit of CHI. CHI demands energy from its participants. Without that investment, CHI flows over and past one, leaving one bobbling about, bemused in its wake. Once committed to it, in its intense, almost rowdy atmosphere, one experiences a kind of phantasmagoria where the brave mind is thrust out into uncharted territory, forced to do some new mapping and thereby adding to the scenery in a way that will, for some at least, have a lasting and profound significance.

Extra information about the conference publications and links to the CHI Web sites can be found at `http://www.york.ac.uk/~law4/CHI97Trip.html`

References

1 The Basic Research Symposium is an event with an emphasis on highly interactive exchange and in-depth consideration of contemporary issues in HCI research. CHI97 Extended Abstracts p. 220. More information is available at: http://www.york.ac.uk/~law4/brs97/chi97_brs_cfp.html.

2 Organised by Susan McDaniel & Tom Brink, University of Michigan: CHI97 Extended Abstracts p. 237. http://www.crew.umich.edu/~brinck/cscw/awareness.html

3 "Telemedical Consultation: Task Characteristics", Leon Watts & Andrew Monk , CHI97 Proceedings pp. 534–535.

4 "Infinite detail and emulation: an ontologically minimised HCI" John Carroll, CHI90 Proceedings, pp. 321–327.

5 "From single-user architectural design to PAC*: a generic software architecture model for CSCW" Gaëlle Calvary, Joëlle Coutaz & Laurence Nigay. CHI97 Proceedings, pp. 242–249.

6 CHI97 Extended Abstracts, 99–100.

7 CHI97 Extended Abstracts, 75–76.

8 "Invited talk: Universal access to the Net: Requirements and social impact" Jeff Johnson, CHI97 Extended Abstracts, p. 118.

9 "A typology for educational interfaces" Tim O'Shea, Extended Abstracts 119-120.

10 Description of the ambientROOM, as part of the presentation of: "Tangible bits: towards seamless interfaces between people, bits and atoms" Hiroshi Ishii & Brygg Ullmer. CHI97 Proceedings, pp. 234 - 241.

11 " 'Eudeamonic eye': 'Personal Imaging' and wearable computing as result of deconstructing HCI; towards greater creativity and self-determination" Steve Mann, CHI97 Extended Abstract, pp. 28- 29.

12 "On your marks, get set, browse!" Kevin Mullet, Christopher Fry & Diane Schiano, CHI97 Extended Abstracts, pp. 113 - 114.

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