"User Sensitive Inclusive Design" - in search of a new paradigm

Alan F Newell
Department of Applied Computing
University of Dundee, Dundee DD1 4HN
Scotland
+44 1382 344152
afn@computing.dundee.ac.uk

Peter Gregor
Department of Applied Computing
University of Dundee, Dundee DD1 4HN
Scotland
+44 1382 344152
pgregor@computing.dundee.ac.uk

ABSTRACT

This paper considers appropriate research methodologies for the development of Universal Usability. It is written from the viewpoint of research which has the long term objective of developing technological systems for everyone, including people with disabilities. It considers whether new research paradigms are appropriate and how they are different from those used within traditional technological research. It suggests the development of a new paradigm of "User Sensitive Inclusive Design" which includes people with disabilities within a User Centred Design methodology, and recommends a collaborative approach to the development of such a methodology.

KEYWORDS

User Centred Design, Usability, Universal Design

UNIVERSAL USABILITY.

A number of initiatives have been launched to promote a consideration of people with disabilities within the user group in product development teams. These initiatives have had a number of titles including: "Universal Design", "Design for All", "Accessible Design", and "Inclusive Design". Examples of such initiatives are the INCLUDE project within the European Union (http://www.stakes.fi/include), and, in the USA, the Centre for Universal Design at North Carolina State University (http://www.design.ncsu.edu/cud/ud/ud.html), and work at the Trace Centre in Wisconsin-Madison (http://www.trace.wisc.edu).

The INCLUDE project produced a methodology for "Inclusive Design" for telecommunication terminals [9], which was based on standard textbooks for user centred design and usability engineering (such as Nielsen [26]), Ulrich & Eppinger's methodology [30], and on an extension of the International Standard for human centred design [10].

They suggested that one approach was "to compromise slightly on the product design so that, while the design retains the functionality required by people with disabilities, it still appeals to a wider audience."

They also commented that "there were many different methods of choosing how to collect user needs and integrate them into product development, and that the suitability of this approach to accommodating a range of disabilities into the design process (in an effective and efficient manner) is unclear". They recommend "guidelines as a good cheap basis for integrating needs of people with varying abilities into design at an early phase". Examples of such guidelines can be found at their web site and within [9], together with other literature on "Design for all".

The Centre for Universal Design at North Carolina State University has also produced guidelines for Universal design which can be found at http://www.design.ncsu.edu/cud/ud/ud.html. Like the Hypponen guidelines [9], these are very similar to general user centred design principles, including: Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Tolerance for Error, Low Physical Effort, and Size and Space be Provided. They also remind the reader to be aware of the needs of people with disabilities when following these guidelines. Their philosophy, is based on the underlying premise of "Equitable Use", that is: " the design should be useful and marketable to *any* group of users" (our emphasis). If taken literally, however, this imposes very substantial requirements on the designer, which may not always be appropriate. The World Wide Web Consortium (W3C) has also produced guidelines for making web pages accessible to people with disabilities http://www.w3.org/WAI.

Newell [19] also proposed the concept of "Ordinary and Extra-ordinary human-machine interaction". This drew the parallel between "ordinary" people operating in an "extraordinary" environment (e.g. high work load, adverse noise or lighting conditions), and an "extra-ordinary" (disabled) person operating in a ordinary environment. He suggested that researchers should focus on the relationship between the functionality of users and the environment in

which they may operate. He introduced the concept of considering a "user" as being defined by a point in the multi-dimensional space which specified their functionality, and the relationship of that functionality to the environment in which the user operated. He underlined the fact that both the position in the functionality space, and the characteristics of the environment, change substantially throughout a user's life from minute to minute as well as from day to day, together with very long term changes due to ageing and physical changes in the physical environment and social situation [22].

An extreme example of the effect of environment on able-bodied uses is engineers in space who, although being apparently healthy individuals at the peak of their physical and mental fitness, are effectively extremely disabled. At a more mundane level, situations where people are using standard equipment, but not in standard locations, effectively disable the user. If a lap or palm top computer has to be operated by a free-standing person, then effectively the user is one handed, and the debilitating effects of having to wear gloves in cold weather are shown when trying to use a small keyboard.

If extreme portability as well as high functionality is required, such as in the mobile telephone with an alphanumeric input requirements, then all human beings are effectively handicapped. This is one example of the bandwidth of the information channels between the machine and the user (i.e. the connection between the user and the equipment) being the dominating factor in constraining the performance of the human machine system. It is not without significance that the latest mobile telephones are beginning to use disambiguation techniques (see http://www.tegic.com) which were developed ten years earlier by rehabilitation engineers for people with poor dexterity [4]. The technology which is providing internet access using a mobile phone provides a much narrower human interface bandwidth for the user to access information than is usual, and this will also greatly handicap for the user of such systems. Designers need to be explicitly aware of these concepts and understand how they can be used to the greatest benefit of everyone, including people who are either temporarily or permanently disabled, and that designing with Universal Usability in mind has more advantages than simply increasing market share [20].

The National Science Foundation mounted a workshop with the theme of "Every Citizen Interfaces to the National Information Infrastructure" [6], This laid out a research strategy for the Science and Engineering Community in the USA. The themes included were:

- Understanding and representing user diversity. What really are the functional characteristics of ALL potential users?
- Common dimensions on which users can be classified (e.g. perceptual and motor abilities, educational, cognitive maturation, literacy)
- Dynamic (rather than static) characterisation of users
- Flexible interfaces, and Universal design
- How best to present information most effectively to people with disabilities in the various modalities?
- Universal representations of data to give appropriate "hooks" for those situations were one modality is not appropriate.
- How to design interfaces which do not require good memory and language abilities

There are many exciting challenges, and if we adopt the principle that there are simply some (although sometimes major) differences in the abilities of the user of the final product. It should be possible to include "universal usability" by an extension of the conventional "User Centred Design" methodology which is gradually being seen as crucial to the development good consumer products.

User Centred Design

User Centred Design [27, 28, 25, 7, 8] enables developers to focus on the users as the heart of the design process, and involving disabled people as a normal part of such design gives them the dignity of being treated in the same way as any other users of products. There is the possibility, however, of a tension between issues of "disabled rights" and research goals and methodologies. Within the disability field there is a growing awareness of the rights of disabled people and these have been articulated in the ideas of Participatory Action Research (PAR). Sleeman [29] comments that "in PAR individuals with disabilities are involved in setting the research agenda, developing research questions, participating in the research as researchers, advisors, and consultants, testing research ideas, and most importantly, evaluating the results of the research". This may be appropriate within a sociological research agenda, but in User Centred Design although the needs and wants of users are the focus of the research, the user can not be in control of the research, as is sometimes suggested by the proponents of PAR.

In product research and development, the role of potential users who are disabled should not include setting research agendas, developing research questions, the choice of evaluation methodologies, which need trained researchers. Users should be "involved in" the process, but not have a dominant role in it. The contribution of such users varies with their skills and experience and also is dependent on the particular phase of the research or development. Some parts of the process involve very intensive interaction with users (e.g. in evaluations of prototypes), others almost none (e.g. writing computer code, or designing electronic circuitry). Trained researchers, who happen to be disabled,

of course, can play a very special part in such activities, but they must be careful to separate their roles as researchers and potential users).

Currently there tends to be (possibly artificial) distinctions between:

- Mainstream design (which often seems to be exclusively for able-bodied people),
- The design of systems exclusively for people with disabilities (sometimes called "orphan" products) and
- The so-called design for all/universal design approach.

We need to consider carefully, however, whether the inclusion of users with disabilities should impose significant changes to a User Centred Design philosophy [23, 20]. The users of all but very specialised products have a very wide range of characteristics and functionalities, and many of the guidelines such as those above apply to able-bodied users as well as those with disabilities. There are, however, specific challenges when people with disabilities are part of the formal user group within a product development environment. These include:

- It may be difficult to get informed consent from some users,
- The users may not be able to communicate their thoughts, or even may be "incompetent" in a legal sense,
- The user may not be the purchaser of the final product,
- Payments may conflict with benefit rules,
- Users with disabilities may have very specialised and little known requirements,
- Different user groups may provide very conflicting requirements for a product,

Many of these characteristics do exist in mainstream design, but there can be difficult ethical problems when involving users with disabilities in the design process. In addition, the involvement of clinicians may also be needed when disabled users are involved. Their expertise is invaluable, but it is also vital that the clinicians are fully aware of the motivation and methodologies of the design process, which are very different from a normal clinical situation. In addition communication, between clinicians and engineers can be fraught with difficulties as they come from different backgrounds and have different jargon. A fully co-operative team of clinicians and engineers is a world beating combination, but it needs to be developed and fostered: it does not happen by chance. Also, a reliance on expert opinion rather than observations of users could compromise the very process that user participation is supposed to serve.

Blue Sky research for people with disabilities

It is particularly important to ascertain the exact influence of users in long term research. Long term / blue sky research has different characteristics to short term product development and this needs to be recognised when considering methodologies and the contribution of the user, be they disabled or not. Particularly when considering disabled users there can be a tendency to pay too much attention to the articulated needs of the user. There are some notable exceptions, but there can be pressures to avoid leading edge issues, because these are thought to be of little practical value, or involve new expensive and/or untried technology. A great disservice is done to disabled citizens of the future by not giving such work a high priority. Users are not very good at explicitly stating what they need of a technology which does not yet exist, and [11] made the point that "need can be unconscious, people may not be able or willing to articulate them, or people may express solutions as needs which can actually be solved in a better way".

Newell deliberately ignored the views of users and clinicians on a number of occasions in both mainstream research [16] and research to develop systems for disabled users [14, 15]. A number of years elapsed between the research at Dundee which showed that predictive word processing systems assisted people with dyslexia and other language dysfunctions, and the point when teachers and clinicians accepted their use for alleviating such problems [22]. A more startling example was the overall concept of CHAT, which was a novel way of using a computer controlled speech synthesis to allow social conversation by non-speaking people [17]. The concept behind CHAT was that it was more important for a user of the equipment to say something than have complete control over what they would say [18]. Initially, this was completely rejected by many therapists on the grounds that the control of what they said was being removed from users. This antagonism lasted a number of years, but many AAC devices now contain features of this nature, and there are thriving and well respected research teams developing new and exciting systems based on these original ideas [20, 31].

It is essential that users are involved in the research, but these users must realise that some research may show that certain techniques are not successful, and be prepared for disappointment. Even more important, however is that, even if the research is successful, the user who was involved in the research may never personally benefit from the outcomes of the research. One of the major measurements of success of a research project, unfortunately, may be the level of disappointment individual users show when the project ends, and the equipment has to be taken away from the users due to financial and/or support considerations. This can pose particularly acute problems when the research has involved significant interaction with users with disabilities.

Involvement Of Disabled Users In Dundee's Research

At Dundee, users with disabilities have a substantial involvement in the research, and they have made a tremendous contribution both to the to our research and to the commercial products that have grown from our research. A significant part of the research has been for people with communication dysfunction and this puts the work in a particular category in terms of relationships with users. Balandin & Rhagavendra [5] point out that "to date, there have been few studies reported in which augmented communicators were included as part of the research team", but quotes work at Dundee as one of the examples [1, 12]. The author and others have also considered the ethics of research with individuals with disabilities, including those with communication impairments [1, 2]. They conclude that it is not as straightforward to work with these users as it would be to work with disabled people who do not have communication dysfunction. Similar problems occur when working with people with cognitive dysfunction.

There are two major ways in which users are involved in research at Dundee:

- As disabled consultants on the research team, where they act essentially as "test pilots" for prototype systems, and
- By the traditional user centred design methodology of having:

  User panels,

  Formal case studies, and

  Many individual users who assess and evaluate the prototypes we produce.

The panels of users are essential, but it was important to make clear to them at the start of the research that the provision of any long term support was not the responsibility of the project. The disabled consultants at Dundee are full members of the research team, and are chosen with great care, and make many very important contributions to the research [32, 3, 12, 13].

It is also important to pay tribute to the contribution made by clinicians. In many types of projects it is vital that clinicians be members of the research team. By employing clinicians on research projects, rather than consulting service orientated clinicians, we have ensured that the ethos of the whole team is a research ethos, which is vital for high quality long term research. Dundee's Applied Computing Department is one of the few Computing Departments which has employed speech therapists, nurses, special education teachers, linguists and psychologists.

User Sensitive Inclusive Design

The "Design for All" / "Universal Design" movement has been very valuable in raising the profile of disabled users of products, and has laid down some important principles. In its full sense, however, except for a very limited range of products, "design for all" is a very difficult, if not often impossible task, and the use of term has some inherent dangers. Providing access to people with certain types of disability can make the product significantly more difficult to use by people without disabilities, and often impossible to use by people with a different type of disability. Also the need for accessibility for certain groups of disabled people might not required by the very nature of a product. We need to be careful not to set seemingly impossible goals as this has the danger of inhibiting people from attacking the problem at all. Sir Robert Watson-Watt, the inventor of Radar, once said that the excellent is an enemy of the good. In our context "accessibility by all" may provide a barrier to greatly improved "accessibility by most".

There are some distinctions between traditional User Centred Design with able-bodied users, and UCD when the user group either contains, or is exclusively made up of, people with disabilities. It is thus necessary to determine how best to include a consideration of the particular requirements of working with users with disabilities within this methodology. Such a methodology should cover:

- Much greater variety of user characteristics and functionality,
- The difficulty in finding and recruiting "representative users",
- Possible conflict of interest between accessibility for people with different types of disability,
- Conflicts between accessibility, and ease of use for less disabled people ("temporary able-bodied"), e.g. floor texture can assist blind people but may cause problems for wheel chair users,
- Situations where "design for all" is certainly not appropriate (e.g. blind drivers of motor cars),
- The need to specify exactly the characteristics and functionality of the user group,
- Provision for accessibility via the provision of additional components

Thus some significant differences must be introduced into the User Centred Design Paradigm, if users with disabilities are to be included. In order to ensure that these differences are fully recognised by the field, it would be appropriate if the new methodologies which must be developed were entitled "User Sensitive Inclusive Design". The use of the term "inclusive" rather than "universal" reflects the view that "inclusivity" is a more achievable, and in many situations, appropriate goal than "universal design" or "design for all". "Sensitive" replaces "centred" to underline the extra levels of difficulty involved when the range of functionality and characteristics of the user groups can be so great that it is impossible in any meaningful way to produce a small representative sample of the user group,

nor often to design a product which truly is accessible by all potential users.

In addition, researchers need to consider how best to promulgate the concepts behind universal usability and the results of User Sensitive Inclusive research. Although guidelines can be very useful, it is not obvious that these are the most effect way to transmit the appropriate information to other researchers and designers. User Sensitive Inclusive design needs to be an attitude of mind rather than simply mechanistically applying a set of "design for all" guidelines. This offers a further challenge to the community.

CONCLUSION

Universal usability requires that researchers and designers consider all potential user groups of systems, including minority groups such as people with disabilities. This means, however, that the user groups have too broad a set of functionalities and characteristics to be encompassed within traditional user centre design methodologies, and there are additional ethical and other challenges in dealing with this user group. Rather than produce a whole new paradigm, however, it is suggested that the methodologies of User Centred Design be extended to form a paradigm which could be called User Sensitive Inclusive Design. This should include not only experimental techniques but also methods for communicating the results of the research effectively to mainstream researchers and product developers.

This could be an international endeavour and thus combine the research strengths of European and American research. European research tends to be more holistic, qualitative and socially sensitive, whereas North American research is much stronger in its quantitative techniques and formalism. In addition, there are different legislative frameworks for providing access for people with disabilities, and different timing of legislation, which has affected the situation in the two counties. The different research methodologies and cultures of North America and Europe, can offer a synergy which will provide a design methodology which is better than the sum of the two separate methodologies in this exciting field of User Sensitive Inclusive Design

The development of the concept of, and a methodology for, User Sensitive Inclusive Design will facilitate researchers in the field to develop better specialised equipment, and also provide mainstream engineers with an effective and efficient way of including people with disabilities within the potential user groups for their projects. If we can do both of these, we will have achieved a great deal towards providing appropriate technological support for people with disabilities in the future.

It should be noted that, although this paper exclusively considers people with disabilities within the concept of Universal Usability, many of the ideas contained in it apply *mutatis mutandis* to other minority groups.

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