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A User Requirement Study on the Needs of Visual Artists with Upper Limb Disabilities

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ABSTRACT

This paper discusses the findings of a user requirement study conducted as a part of a larger research project that intends to develop a system enabling artists with upper limb disabilities to create visual art within a digital medium.

INTRODUCTION

In the recent years, increasing growth in the development of technology has been focused on enhancing the ability of disabled people to function at optimum levels. Such technology is known as "assistive technology". For a disabled person, technology has the potential to play a vital role in ensuring, and assisting with, independence, security and productivity. The impact of assistive technology is evident in the growth of both the number of devices and number of users accessing such devices (Scherer 1996; Cook & Hussey 2000).

Many assistive technologies are focused on assisting disabled people in employment and independent living and whilst the authors would not dispute the value of such technologies, there is a dire need to look beyond the pragmatism of economic productivity to a broader notion of enhancing "quality of life" (Daye 1998). Scherer (1996) suggests that assistive technology should not only foster the basic functionality of a disabled person, but should also contribute to positive identity and self esteem.

In most cultures art is considered to be an activity that carries many benefits; contributing to the community, providing economical benefits and perhaps more specifically for the purposes of this study, art provides a vehicle for the expression of individuality and interests (Cocks 1996; Daye 1998). Art may thus function as a socially valued activity through which people with disabilities can enhance positive identity, self esteem and independence. Visual art in particular has become an alternate means of communication for disabled people that has been experienced as both stimulating and aesthetically rewarding (Daye 1998).

Despite the obvious advantages that interaction witth assistive technologies may potentially provide to disabled people, there remains a high rate of abandonment of assistive technologies. Scherer (1996) suggests that, on average, one third of all assistive technologies are abandoned after initial use by its users. Scherer (1996) and Cooks & Hussey (2000) reveal that the single most important factor determining abandonment of assistive technology is failure to meet the users' needs and expectations.

USER-CENTERED DESIGN

User-centered deign is a multi disciplinary design approach premised on active involvement of users to improve the understanding of user requirements and design and evaluation of the system. Using such an approach is intended to overcome the limitations imposed by traditional system- centered design that often results in systems that fall short of users' expectations (Holtzblatt & Beyer 1993; Mao *et al.* 2005; Nielsen 1992).

Nielsen (1992); Norman & Draper (1986) and Vredenburg *et al.* (2002) suggest that understanding the user is a key principal in user-centered design. Such an approach includes; understanding the user's current and future tasks, the tools and methods they employ to carry out the task, what problems they experience with current tools and methods, and key characteristics of the environment they carry out the task (Vredenburg *et al.* 2002).

USER-CENTERED DESIGN AND DISABILITY

When designing assistive technologies for people with disabilities, an understanding of their specific needs, expectations, abilities, preferences and experience are necessary to ensure a successful outcome. The goal of assistive technology should be the enhancement of a persons' capabilities and quality of life (Scherer 1996; Galvin & Scherer 1996; Cook & Hussey 2000; Reilly 1998). Scherer (1996) and Galvin & Scherer (1996) further emphasise that assistive technology designers should take a user -centred approach. Cook and Hussey (2002) state that in order to design effective assistive technology devices, one must study the user of the technology, the activity or the task it will be used for and the context within which the technology will be used.

METHOD

Relying on ethnographic techniques the researchers were able to capture the practice, requirements, problems and expectations of artists with upper limb disabilities. In addition two data collection methods were employed; semi-structured interviews and observations (Gubrium & Holstein 2001; Wood 1997). Using these data collection methods allowed the researcher to obtain both depth and breadth of insight into the user requirements, problems and expectations of artists with disabilities. Neilson (1992) and Wilkinson & Birmingham (2003) suggest that observing the users within their own work environment and talking to the users of the intended system often provides a wealth of usability insights that might otherwise go undetected.

The research studied two groups of users; visual artists with upper limb disabilities who use non-digital tools and visual artists with upper limb disabilities who use digital tools. This approach was taken in order to get a wider understanding of assistive devices used by the disabled artists and also to perform a comparative assessment of non-digital tools and digital tools.

VISUAL ARTISTS WITH UPPER LIMB DISABILITIES WHO USE NON-DIGITAL TOOLS

Three artists groups were interviewed and observed. These artists groups included six to ten adult artists with disabilities who practiced art as a hobby. The artists in the groups had varying and multiple disabilities including upper limb disabilities. Artists in these groups used a variety of non-digital tools such as head sticks, mouth sticks, sticks with grips to hold brushes, and special hand grips in order to create their visual art. The level of disability among the artists varied from individual to individual. Each artists group had an art teacher who functioned as both instructor and mentor and was assisted by a further 2-3 people. The art teacher was also responsible for the coordination of the art classes. The artists met as group in a weekly basis and worked on individual projects, to be exhibited as part of annual exhibitions.

The artists, art teacher and the assistants were interviewed. The interviews were conducted in a group format, usually during the class breaks. The questions in the interview were open- ended, which allowed the participants to express their thoughts and feelings in detail. The interview data was recorded via note taking.

The artists were observed whilst creating art in class. The observations were conducted for four hours in two weekly sessions. The observation data was collected via note taking and where permitted, the artists were also photographed whilst creating art.

VISUAL ARTISTS WITH UPPER LIMB DISABILITIES WHO USE DIGITAL TOOLS

Two artists with upper limb disabilities who use digital tools to create visual art were interviewed in an on-line format. The questions in the interview were open- ended, which allowed the artists to express their thoughts and feelings in detail. Due to the geographical location of the two artists, observation of art practice was not possible.

ERIN BRADY WORSHAM

Erin Brady Worsham is a digital artist from, Nashville, Tennessee. Erin was diagnosed with Amyotorophic Lateral Sclerosis (ALS) in 1994. ALS has left Erin paralysed from the neck down. Erin uses Microsoft Paint program to practice her art using a liberator communication device to interact with the paint program. The liberator has a grid which allows Erin to control the movement of the mouse with her eyebrows. Operating the liberator communication device via eyebrow movements is a long and tedious process. A complex piece of artwork will take many acts of eyebrow wiggling. She operates her liberator communication device via a P-switch (a sensor) taped between her eyebrows. When Erin moves her eyebrow, the switch starts a quadrant-by-quadrant scan of the 128 keys on the face of the liberator device. Another movement of her eyebrow selects the quadrant and the same process is repeated to select a row and column within the quadrant. A complex painting would take more than 400,000 sperate eyebrow movements. For example three blinks would mean to the left, another set of blinks would mean move up, another set of eyebrow wiggling would mean make the line thinner and so on. A painting would usually take more than 300 hours of this process.

PHILIP MARTIN CHAVEZ

Philip Martin Chavez is an artist from California, USA. Philip uses voice recognition software to create his art in digital form. When Philip was first injured with a C4-C5 spinal cord injury, he used wrist splints to draw his art. But after a second accident, he lost most of his functions, which meant drawing art using a wrist splints was not possible. Philip started creating art in a digital format after discovering the voice recognition program Dragon Dictate. The software he uses to create his digital art is Microsoft Paint program and he uses Dragon Dictate to activate functions of the Microsoft Paint program using voice commands. Most of these commands would take the form of “Drag Upper Right”.

Both artists work independently and use their home as their studio.

INTERVIEWS WITH OCCUPATIONAL THERAPISTS

Occupational therapists from two organisations that support artists with disabilities were also interviewed. The questions in the interview were open- ended, which allowed the therapists to express experiences with disabled artists in detail. Occupational therapists from these organisations frequently treat artists with upper limb disabilities. Their therapeutic interaction is designed to gather the requirements of individual disabled artists and find assistive tools that best support the needs of that artist. Interviews with occupational therapists were conducted to gather further insight in to the needs and problems faced by artist with upper limb disabilities.

FINDINGS

The findings from the interviews and observations indicate that visual art is an important activity for people with physical disability. It is an activity that provides a vehicle for creative expression, independence and the generation of a piece of work of which they can be proud. Erin Brady Worsham declared that art became her salvation after the diagnosis of ALS. For many of the artists who attended the group classes it was also an opportunity for socialisation. The exhibitions also served as an avenue for family, friends and the wider community to appreciate the value and abilities of these artists. Such activities serve to enhance the morale and self esteem of these individuals. These findings are consistent with studies by Daye (1998) and Cocks (1996).

People with disabilities tend to adapt to the remaining ability/ies available to create art or perform any other day to day tasks. Artists, who have lost upper limb motor control, may use their head, facial features, voice and feet to create art. Use of these features requires assistance either in the form of human carers and/or tools and technology. Most artists eventually accept their capabilities and adapt to a more suitable style of art creation. For example many artists create abstract or cartoon like images.

The lack of availability of off–the-shelf products for disabled artists to create visual art is a major problem faced by the artists, art program organisers and occupational therapists.

Research indicates that creating art using non-digital and digital tools can be a tedious and time consuming process. For Erin, a painting would usually take more than 300 hours. Artists who use head sticks or their feet to create art take frequent breaks in between brush strokes.

The following problems were also common experience for artists who used non-digital and digital tools to create visual art: use of head sticks, mouth sticks, feet and eye brows to create art require unnatural movement of the neck, leg muscles and eye brows; wiggling of eye brows in 40,000 separate eyebrow movements, requires patience, endurance and training. The ability to move eye brows in such a way is not common among individuals. Unnatural movements of neck and leg muscles often led to fatigue and long term injuries. As the occupational therapists emphasised, long –term use of head sticks and mouth sticks caused chronic neck injuries, teeth dislocation and injuries to the palette.

The differences observed between the artists who use digital tools and artists who use non-digital tools were substantial; artists who used digital tools need no or less assistance from a human assistant when compared to artists who use non-digital tools. The two artists who use digital tools to create their art, work independently with no human assistance. The artist who used non-digital tools such as mouth sticks, head sticks, and adjustable easels needed assistance to change brushes, grip types, or move canvas or paper. However the level of assistance needed varied from individual to individual. In addition, non-digital tools fail to provide the adequate range, control and subtlety required to create visual art. However, this study acknowledges the level of control and subtlety gained by these tools is highly dependent on the abilities, skills and motivation of individual artists.

Nevertheless, when compared with digital tools, the use of non-digital tools to create art is perceived as preserving the intuitive faculties and artistic freedom. Non-digital tools allow artists to play with real paint with real and immediate results while digital tools are perceived as mechanical and monotonous.

Current digital tools require artists to follow a mechanical and monotonous process of art creation. Philip Martin Chavez declared that voice recognition software is not sophisticated enough to create art and that he would like to work with someone to design voice art software with commands like "splash angry red" instead of "drag upper left", which enable a more expressive and intuitive mode of art creation.

Artists who use digital tools are heavily dependent on the technology to create their artefacts. Any defects, faults or failure in the technology or lack of support significantly affects the success of their efforts. Philip Martin Chavez is disappointed that the updates of the Dragon Dictate program no longer support manipulation of art programs. Erin Worsham was unable to work for over a month due to failure in her liberator communicator.

IMPLICATION FOR TECHNOLOGY

The outcomes indicate that lack of intuitive and artistic freedom, lack of availability, support and maintenance and higher costs when compared to non-digital tools all contribute to hindering the uptake of digital tools for wide use among disabled artists. In contrast, digital tools may offer increased independence, range and control during the process of creating digital art.

Interviews with, and observation of, disabled artists and Occupational therapists suggests that multimodal systems are appropriate for disabled people as these systems allow multiple utilisations of their abilities. Utilisation of multiple abilities assists in ensuring the art creation process is less tedious and time consuming. It also could prevent fatigue and injuries caused due to RSI. This is consistent with the studies of Cooks & Hussey (2000) and Reilly (1998).

Voice recognition research has become increasingly focused on human computer interaction where the voice is an alternative input/output method (Alder & Davis 2004; Walker & Brewster 2000). For disabled people, particularly those who have lost control of upper limb function, voice recognition technology may provide greater freedom, control and independence (Vital 1991; Karimullah & Sears 2002). Facial movements are among the abilities that may be available for people with upper limb disabilities (Reilly 1998; Lyons 2004; Gorodnichy 2002). Darrell et al. (2002); Gorodnichy et al. (2002) and Kjeldsen (2001) have investigated the ways in which the nose might be used as an alternative to the mouse in interacting with interfaces. Nose pointer techniques and algorithms have been tested for selection tasks, pointing tasks, positioning tasks and drawing tasks, with mixed results. However, it is evident in the literature, that with further work noise pointers show promising capabilities as an alternate mouse. Lyons (2004) studied the ways in which different facial features could be used to interact with interfaces. As a part of this study Lyons (2004) experimented with a program that allows creation of paintings via hand and mouth. In this program the drawing was done via a hand controlled stylus. The properties of the brush such as size and hardness, and paint properties such as colour and opacity were controlled by the mouth shape. This allowed the artists easy and continuous control of the brush or paint properties while the stylus is moved. In addition, research has been conducted to investigate ways in which eye gazing might be utilised to interact with interfaces. Literature suggests eye gazing is most suitable for interacting with large screen work places; virtual environments and when the natural movements of the eyes are utilised to interact with the interfaces (Pastoor *et al.* 1999; Sibert & Jacob 2000; Jacob 1999; Kawato and Tetsutani 2004). The authors will investigate ways in which voice and facial features may be used to interact with computers to create visual art in a digital medium. The purpose of such a system would be to develop a multimodal system to assist in the creation of visual art for artists with upper limb disabilities.

Affective Computing is computing that relates to, arises from, or deliberately influences emotions (Picard & Wexelblat 2002). Picard & Wexelblat (2002) suggest that human-computer interaction is both social and emotional even when interfaces are not designed with such goals for interaction. Advances in technology have enabled computers to recognize, express, and respond to emotional and social information. Applications of such technology include the development of intelligent human-computer systems that learn from natural interaction, the development of new computational theories of affect and learning and tools for human expression (Scheirer et al. 1999; Picard & Wexelblat 2002). Interviews and observations with disabled artists reveal that most disabled artists are hobby artists who have little or no education in visual art. For these artists, visual art functions as a vehicle for expression of feelings, emotions, stories and moods (Daye 1998; Cocks 1996). Philip Chavez in his interviews stated that *"I'd like to work with someone to design voice art software with commands like splash angry red instead of drag upper left"*. Human expression through voice depends not only on the words and sounds we utter; but also on the way we speak (Vital 1991). The sounds made by the human voice are unique in its physical characteristics and in the way it is interpreted (Markowitz 2000, Harrington and Cassidy 1999). Certain forms in visual art may describe certain emotions, feelings and moods. For example a bending upright line suggests sadness, broken jagged lines describe anger and blues, and violets describe coldness(Rasmusen 1950; Landa 1983; Arnold 1976). Form in visual art may also have visual properties such as location, position, size, orientation, opacity, closure and depth (de Sausmarez 1983; Rasmusen 1950; Landa 1983). The authors will investigate the ways in which emotions expressed via voice, such as joy, anger, sadness and the physical qualities of voice such as frequency, pitch and amplitude might be mapped into and manipulate form.

The future for environments that support creativity is based on the premise that computer devices will become ubiquitous. Ubiquitous computing has became recognised as "Computers Everywhere" since Mark Weiser presented his ideas in Scientific American in 1991 (Weiser 1991). As computer hardware components become smaller, faster and cheaper, they are increasingly being embedded into everyday appliances. These hardware components are often intelligent and linked via wireless networks (Mitchell *et al.* 2003). Ubiquitous Computing potentially bodes a significant change to the way computing is used today. Millions of devices embedded in the environment would mean intelligent surfaces and appliances that support humans in battlefields, home, office or in studios (Mantoro & Johnson 2003; Mitchell *et al.* 2003). Scherer (1996) states that disabled people often withdraw from technology as wearing devices announce their disability to the public. Scherer (1996) and Galvin & Scherer (1996) further suggests that as with any other person disabled people prefer assistive technology to be attractive, slick and sexy. At this stage the authors will not consider a ubiquitous device, as such a development lies beyond the scope of the project. However, research into ubiquitous computing could look at the ways in which digital art creation tools could be made smaller and more attractive. Ubiquitous computing could also provide the disabled artist portability for *plein air* creation in an outdoor environment.

CONCLUSION

This paper explores the findings of a user requirement study conducted as a part of a larger research project aiming to create a system that would allow artists with upper limb disabilities to create art. The findings indicate that digital tools provide independence, wider range and control for artists with upper limb disabilities. Advancing new technologies such as multimodal systems based on voice and facial feature interaction, affective computing and ubiquitous computing have further extended the possibilities for more expressive, intuitive, less tedious ways of art creation using more attractive, sleek and even portable tools. The authors intend to investigate the ways in which the physical qualities of voice and expression of emotion through voice combined with facial features may be used to manipulate form in visual art. The purpose of such a system would be develop a multimodal system offering greater control and freedom to artists with upper limb disabilities and synchronously preserving the individuality, and authenticity, of the artwork.

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