

Tackling isolation and the expression of emotion in a virtual medium

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ABSTRACT

This paper discusses how virtual reality may be used as a medium for expressive communication and thus aid in tackling the problems of isolation faced by many people with disabilities. The principle causes and effects of isolation are explained, along with the strengths of the virtual medium that make it applicable to this problem area. The concept of a virtual meeting place is introduced, where users can overcome the physical problems of mobility and communication. The more esoteric problem of communicating emotion is addressed and a number of ways in which this may be tackled in virtual reality are proposed.

Keywords: disabilities, emotion, isolation, expression, awareness, multi-user

1. INTRODUCTION

Project DISCOVER is group of people with differing abilities who have been meeting over the past three years, to discuss ways in which virtual reality can help them overcome some of the problems they face. After analysing several application areas, the group has concentrated on tackling the underlying problems of isolation. Isolation may arise from a lack of mobility, the attitudes of the able bodied, or a physical or psychological inability to express emotion. The group has developed a number of concepts that show how the medium of virtual reality may be used to overcome some of these underlying problems. The problems of mobility may be partly overcome in a multi-user environment. This environment, along with the custom representation of users, could tackle shyness and help educate able bodied people. Multi-user environments are already being developed by many researchers. The emphasis of the DISCOVER group is to use virtual reality as a medium for the expression of emotion. A multi-user environment, that promotes the meeting of friends and allows them to build relationships through emotional dialogue, is not as fantastic as it sounds. Most of the building blocks are already in place, but are separated by the disciplines of their creators. By bringing together people of differing abilities with relevant backgrounds, Project DISCOVER hopes to provide the impetus to bring these blocks together.

1.1 Structure of the paper

The DISCOVER group is introduced in section 1 which summarises their aims, and both the problems they have been, and are now addressing. The emphasis of the groups current work is tackling the problems of isolation through representing emotion in a virtual medium. Section 2 discusses the principle causes and effects of isolation and proposes how these causes may be temporarily reduced within a virtual environment. The concept of a virtual meeting place where users can overcome the physical problems of mobility and communication is introduced in section 3. Section 4 addresses the more esoteric problems of communicating emotion and suggests a number of ways in which this may be tackled in virtual reality. Section 5 discusses how levels of emotions may be monitored provided the kind of emotion is known.

2. PROJECT DISCOVER

Project DISCOVER was founded three years ago with the aim of investigating the technology of virtual reality as a medium for expression for people with disabilities. The DISCOVER group consists of around ten active voluntary

members of various abilities and backgrounds. The various life experiences of the group members provides a strong backbone for discussing the issues faced by those with disabilities. A strong emphasis has been made to allow the people the project was meant to benefit, to not only steer the work but to drive it. The meetings combine working structure with a social emphasise which is aimed at bringing people together to share experiences. Although academic involvement has been present from an early stage, this has been primarily in a informal advisory capacity and to act as a gateway between the group and the developers of the technology.

DISCOVER defined three categories of human experience that would gain useful insight though the medium of virtual reality: basic everyday, emotional and educational. Everyday experience encompasses daily living functions including coping with the physical environment, picking up a kettle, opening a door, et cetera. Emotional experiences are those caused indirectly by the disability such as feelings of isolation, relationships and sexual needs. Education targets the attitudes of the able bodied through the promotion of awareness, and those with disabilities through addressing the lack of self esteem, often associated with disabilities, which must be overcome to achieve empowerment, control and independence.

The group came up with a number of possible application areas that they felt could be of benefit to those with disabilities. Four of these areas: Emotion artistic; Training of the able bodied; Construction assessment and Everyday living, where analysed by a separate sub-group for a period of around six months. By the end of this period it had become apparent that the area of greatest interest and potential was the representation of emotion as an aid to reducing the feelings isolation.

3. WHY USE VIRTUAL REALITY TO TACKLE ISOLATION

This section looks at the causes of isolation and the effects that it has on individuals. It then continues by suggesting the attributes of virtual reality that make it applicable for tackling some of these problems.

3.1 Isolation

One of the greatest problems faced by people with disabilities is that of isolation. This problem arises from several factors including the attitudes of other people, a lack of self confidence and difficulties associated with mobility, access and communication.

The attitudes of other people can make those with disabilities reluctant to communicate with them. Some people may be dismissive, wrongly thinking that people that do not adhere to what they consider to be the norm, to be of less value. At the other extreme and often with the best intentions, some people may treat anyone with a noticeable disability with patronising attention. Both these behaviours come from a basic misunderstanding of disabilities which itself stems from a lack of education and contact.

Many people suffer from a lack of self confidence or shyness. This is usually brought about by a lack of self esteem which in turn stems from the attitudes of others. People may often dwell on what they perceive as their own shortcomings which in turn increases their nervousness. This clearly becomes a recursive problem spiralling the individual into isolation. Living within an institution can often make a person become over reliant on the help of others and so lowers confidence and self esteem (Gwalter, 1995).

There may be many reasons why a persons might find travel difficult. Obvious examples include impaired sight or hearing, confinement to a wheel chair, ill health, shyness or perhaps a lack of energy. Furthermore, even if someone achieves his or her destination, there is often no guarantee that they will be able to obtain access or that the facilities will be available for them to comfortably participate in group activities. This leaves many people reluctant to leave the comfort and security of their own home and thus leads them to a solitary life style. Even though there might be others living in the same building, it is often more difficult to keep on good terms with people that one see all the time, especially when the building begins to give the impression of imprisonment.

Some disabilities may severely impair communication. The most obvious category being those that affect the speech. Communication may also be impaired by a lack of control in body movement. Where someone has both difficulty speaking and in controlling facial muscles, that person will find it harder to communicate emotion. This is of particular importance because it hinders the building of personal relationships at any level.

3.2 Applicability of Virtual Reality

Virtual reality has many features that make it suitable for aiding the fight against isolation. Most importantly it offers the potential for the cost effective creation and support of tailor made environments in which people can meet without leaving their own home. Although this might sound futuristic it should be noted that multi-user worlds containing many thousands of participants are already being developed by the military. Research at the Universities of Reading and

Nottingham is developing a virtual environment that may support large numbers of users connected over the Internet or Telephone lines. This project is sponsored by BT and Silicon Graphics and so has the potential to lead to low to medium cost systems on the market.

Virtual reality allows people to be placed in synthetic environments and thus almost any role may be played or scenario explored. Many every day experiences, for example not being able to get through a door, can be reflected with reasonable accuracy and effect. Although virtual worlds are computer generated and, as yet, lack some sensual stimuli such as inertia, taste and smell, they can offer a much greater feeling of 'presence' than watching a film. In practice the mind quickly adapts and the user stops worrying that the experience is not real. This feeling of presence is reinforced because the virtual experience is interactive, that is, the state of the world is affected by the user. As user actions will be in response to the world they perceive, it can be seen that a closed-loop effect will emerge where the experience of the user will depend upon their own actions.

Within a virtual environment, the user may choose an embodiment to represent the way in which they want to be perceived. People that are uncomfortable about communicating with those with disabilities might be able leave their prejudices behind when confronted with a neutral embodiment. This could then educate them that people are the same underneath.

Embodiment may allow people to escape from feelings of self conscious. There is no reason that a person in a wheel chair may wish to be represented that way in a virtual environment. Perhaps a small person might find they can communicate in an entirely different way if they take on a persona that resembles a body builder. This might seem negative and suggest that it would encourage an individual to rely on an "imaginary" self image. This has analogies with the film, *The Mask*, where the timid hero can only be brave when he wears a mask of special powers that transforms his body and character. One of the morals of this film is, however, that the hero begins to realise this and analyse why he relied on an image. Using a persona in a virtual medium might give someone initial confidence and after persistent use might help them realise that what they look like should not effect who they are.

Conversely, a person might well be proud of how they look and in such cases a reasonably accurate representation would be chosen. Furthermore, it might be interesting for an able bodied person to masquerade as someone with disabilities to find if others treat them any differently.

4. OVERCOMING PHYSICAL CONSTRAINTS IN A VIRTUAL MEETING PLACE

Imagine a virtual meeting place that may be entered by anyone with a cable connection to their home and a personal computer. How would such a meeting place be structured ? A number of issues have to be tackled that would allow users to: find the people you wish to meet; find a good place to interact; and find suitable ways to interact.

4.1 Finding people

Just as in the real world, not everyone will want to talk to each other, especially at the same time. There must therefore be ways in which you as a participant may locate those with which you wish to converse or interact. Once you find them you might want somewhere to go that will suit the kind of interaction in which you wish to partake. If you want a personal conversation then you do not want to stand in a crowd. Also analogous to the real world, it is often easier to get on with people if you can join them in some activity. For example you might wish to play a ball game or go to the theatre. This suggests the concept of a city, but in a real city it is hard to find new friends and it takes a long time to get somewhere.

The concept developed by the DISCOVER group is a maze where people can wander around and find others of a similar vane. The questions that springs to mind is how do you find someone in a maze and how do you know what they are like. The answer is that the maze can be made up of sectors or neighbourhoods that reflect interests and personalities. For instance, some people might congregate around the football pitch which would be located in the sports sector. Others might wait in an ornate garden, in the park sector. Unlike a city the maze would be hierarchical. At the top level, sectors would be represented as miniature three-dimensional icons. Any of these icons can be reached in under a minute and when entered would expand into the sectors. This is a well used concept in virtual environments where icons are used as portals between worlds.

Once inside a sector, how do you find individual people ? If you had pre-arranged the meeting then you could have pre-arranged the meeting spot. Alternatively you might know where certain people can often be found. What about if you wish to find someone new ? The answer is that people can advertise. In the real world people use clothes to divide themselves into sub-cultures. This can be expended in the virtual environment to entire appearances. Perhaps a cat lover may take on the embodiment of a cat. The problem with physical embodiments is that you must be quite close to see them. Increasing there size would not be practical as everyone would do the same and the environment would simply

change scale. Furthermore, someone's appearance is not the best indication of his or her mood. The DISCOVER group propose that sound or music is a good way to attract initial interest. Once initial interest has been established, physical appearance, body posture and gesture are useful to gauge a more detailed impression of an individual. Music is strongly connected to emotion and so an individual could choose music that represented the way they felt. This is a natural thing to do and as such would require little or no training. An immediate problem that springs to mind is that this would create a cacophony of confused sound in the environment. This is however not necessarily true. Some virtual reality systems, for example dVS, incorporate sound that may be positioned at any point in a three dimensional space. Such a virtual sound source fades naturally as you move away from it in the environment.

4.2 Finding Somewhere to Go

When you find the people you wish to be with you may well want to go somewhere. You could perhaps just take a stroll around the sector or perhaps leave it and go to another. The maze is hierarchical and so each sector may itself hold portals to related meeting places. Perhaps one portal might lead to foyer from which any one of a number of theatres might be reached. Alternatively you might wish to take your companions to a personal place that may tailored to the kind of interaction you wish to take place or might just represent the kind of person you are. Such an environment is very important as an aid for getting to know people. We all feel more comfortable in our own home and its an important part of social interaction to occasionally act as the host. People typically decorate their home to reflect their self image. This is more difficult to do if you are severely disabled. As this is your own place you might as well carry it around with you as a turtle carries her shell. Imagine being a magician and able to conjure up a doorway into your own home no matter where you are.

4.3 Aids to Interaction

Many people may just wish to talk but that can be done in the real world with a telephone. Virtual reality opens up many more possibilities for group interaction. Perhaps you might wish to go as a group of spectators to a ball game or perhaps you would like to participate in the game. In the project under development at Reading and Nottingham, the first test application is a virtual arena in which the audience can watch the game and hold conversations with the people sat next to them in the stadium. Analogous to some television shows, members of the audience may even be invited down to participate.

Such group activities, although important, diverge from the work of the DISCOVER group and the emphasis of this paper. We are more interested in interaction scenarios that will encourage the communication of emotion.

5. COMMUNICATION OF EMOTION

The DISCOVER group has spent considerable time discussing the issues that the members find important. Of these issues those of difficulties in building relationships, isolation and loneliness where thought paramount. These arise from numerous causes including lack of self confidence; lack of opportunities for self expression; and the lack of control over ones life (Wood et. al, 1995). It is felt by the group that the medium of virtual reality has strong potential for addressing the issues by providing an environment, that when entered, partly alleviates these underlying causes.

5.1 Why use Virtual Reality to Express Emotion

So why do we want to communicate emotion, can we not do that in the real world ? The answer to that question is that some people can more easily than others. Just shyness or lack of self esteem can prevent someone from saying how they feel. More fundamentally, emotion is usually conveyed in the tone and volume of the voice and by facial expressions. Not all people have full control of these. In addition, people may wish to be able to communicate with others whom it is often impractical to regularly visit. Furthermore, the times when we need to convey emotion are usually not predictable and so long journeys are out of the question.

Virtual reality is a potentially rich medium that opens up many new ways of representing emotion. We are however not starting from scratch. Many lessons can be learnt both from observing the way the body exhibits emotion and ways in which artists and musicians have expressed emotion through the ages. The advantage with virtual reality over conventional artistic mediums is that it combines their qualities. Virtual reality can have the colour of paintings, the three dimensions of sculpture, the complexity and essence of music, and the dynamic nature of a performance artist.

5.2 The Human Body

The human body conveys as much information about emotion as the voice. Three aspects of the human form are of particular importance in judging emotion: the expression on the face; the movement and position of hands and arms; and the body posture. Many artists have used recreations of the human form to depict emotion. Egon Schiele, for

example, makes strong use on the face, hands and arms in self portraits that provide an emotive insight into his state of mind.

The human face contains many muscles and measuring and modelling it in real time requires considerable computational resources. One system controlled a virtual face representing the games character Super Mario (????). To control this representation, measuring joints were attached between main facial muscle groups and a light weight exoskeleton. This allowed the virtual head to give fairly realistic face movement when talking.

Fairly complex human figures are already used in some virtual reality applications. Most of these applications are presently supported by a human modelling system called Jack (Badler, et al, 1995). The movement of these figures may be completely controlled through external input such as tracking devices, be fully or partially autonomous. Fully autonomous figures are controlled solely by a computer program and do not represent the actions of a user. Partially autonomous figures may be commanded by the user to move to a goal posture or gesture. Natural movement is then achieved by either undergoing a pre-defined set of transitions or through inverse kinematic modelling. It can be seen how a set of expressions could be found to depict given emotions and off line interpolation used to provide natural movement between them.

Modelling natural movement however requires considerable computation restricting such simulation to expensive computers. The required computation may be reduced by only allowing pre-recorded movements, or by reducing the resolution of the figure in terms of the number of moving joints.

Other research has shown (Waldrop, 1995) that reasonable interaction may be achieved by the user, controlling through tracking devices, the head, arms, hands and orientation of the torso. This work did not however address the communication of emotion.

5.3 Colour

Colour is a particularly powerful tool in the representation of emotion. Just using basic colours such as red, blue and yellow, provides a good indication of basic emotion. A prototype system at Reading represented a user as a box with three simple facial expressions mapped to the above colours. Although primitive, this provided an obvious representation of happy, sad or neutral moods. Subtler blends of colour could depict a wider set of emotions as well as there level. For example, Klimt's painting of the daughter of the King who was locked in the tower to protect her innocence, but is then seduced by the devil disguise as an offering of gold, uses a colouring of the cheeks that leaves little doubt to her emotion.

5.4 Sound

Speech is, for the majority of people, the primary form of communication. Emotion is conveyed in speech through its pitch, volume, speed and content. For people with full control of their vocal functions, the most effective method of communication through sound is simply to communicate their voice. Not all people are however able to convey emotion in their voice. Systems are already available that convert text to speech. These could be adapted to change pitch and volume with emotion.

Other sounds can evoke given emotions. It is thought that the brain has developed to produce emotional queues for the cortex that are triggered by given sounds and pitches (Peterson, 1996). The probable reason for this is that we must instinctively respond to given sounds. For example, anger or perhaps fear must be instilled by sounds of aggression, and a parent must be given incentive to respond to cries from his or her baby. Music is one of the most powerful mediums for the expression of emotion. This is probably because it combines these instincts with rhythms that resonate with the natural clocks in the body.

As mentioned earlier, it is relatively trivial to match music to given moods. For example, Vivaldi's Spring quartet gives a feeling of well being, Mahler's Resurrection instils strides of powerful moving emotion, whereas Ravel's Ballero changes the mood to romance and the making of love. What is more difficult is dynamically following the level of mood or even changing the mood entirely. Although a composer might be able to express such changes, it would be difficult to automate the creation such evocative music on a computer in real time.

Both colour and sound are good mediums for the expression of emotion. When combined the effect can become much greater. This effect can be seen at any night club or musical show. Kandinsky related the sound of orchestral instruments to colour, for example, green represented the sound of a violin. A prime example of the power of such combinations are the concerts by the rock band Pink Floyd. In these concerts the combination of music, icons, video and light controlled by music sensitive computer programs, brings powerful feelings of emotion, even to those of us that would not usually listen to the music alone. Pink Floyd have shown how changing mood through lighting and colour may be achieved through computer in the real world. It can be seen how this effect could be even more powerful in a virtual environment where the computer software can change any aspect of the environment it chooses.

There is no reason why colour may only be used on the face and body, or why sound must come from the mouth or an instrument the figure is holding. Virtual reality provides the potential for a persons emotions to be dynamically depicted in their clothing and even their surroundings.

5.5 Clothes

People often wear clothes that match the way they feel. In the real world, it is impractical to change our clothes with our mood. A user could build up a wardrobe of virtual clothes just as they would in the real world. In stead of choosing between each garment before changing they could catalogue outfits to map certain emotions. For example, a black shirt would probably represent a sombre mood, whereas a colourful tee-shirt would represent a more relaxed frame of mind. While in the virtual environment, the underlying system would then swap and change the clothing of the user to match their mood. Unlike in the real world, these clothes could be given predefined behaviours to represent the level of the mood they depict. For example, the tee-shirt could get brighter as the user becomes happier, or a dress might get shorter as the user becomes more ... well that can be left to the imagination.

5.6 Aura

It is sometimes possible to subliminally sense emotion emanating from a person in the real world. This could be represented in the virtual world by surrounding the figure with a transparent aura of colour, sound or a combination of the two. Although this is less natural than the methods discussed above, it does offer a simple and effective method of communicating emotion. The DISCOVER group has investigated the use of colour surrounding a figure. Mary Gyes pictures (Fig. 1) shows an easily recognisable iconic representations of a happy and an angry person surrounded by a supporting coloured auras. One can imagine the effect of animating such a figure in a three dimensional virtual environment.

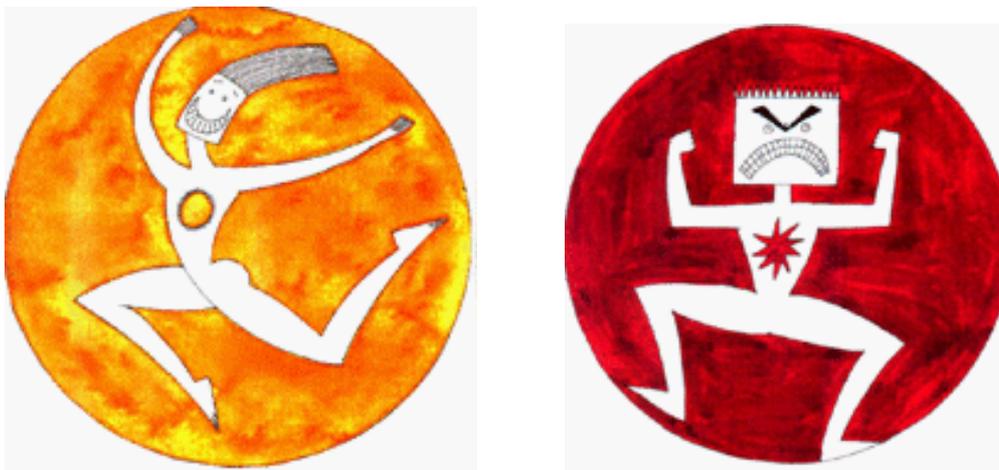


Figure 1. *Happy and angry icons*

5.7 Dynamic emotional environments

The previous section introduced the concept of interacting in a custom personal space within the environment. The esoteric of this environment could be chosen in advance to represent or encourage a given mood. In virtual reality any object may be given behaviour and may interact with the users. This suggests the concept of the esoteric of the space dynamically changing with the mood of those that occupy it. At the most natural level, the music and level of lighting could change.

Taking a leap away from what we are used to, why not have the surrounding environment subtly changing its own essence. For example, the colour of the walls and furniture of a room could change. In a landscape environment, sun could represent a feeling of well-being. If the conversation starts to anger the participants, the sky could cloud over. Extremes of emotion could drive clouds racing across the sky or even evoke thunder. Claire Woods picture of the Cloud Room (Fig. 2) combines the concept of a physical structure surrounded by clouds to give a picture of tranquillity. Many readers will dismiss this as a fantastic exercise, but there is little doubt that such phenomena would be emotive. It must be remembered that the virtual representation of a human is limited in the underlying emotion it can instil in others. Using the environment could act as an amplification of impressionism that could make up for these deficiencies.



Figure 2. *The Cloud Room*

Members of the DISCOVER group have produced portraits that clearly depict given emotions in the scene and have discussed ways in which these scenes may be enhanced in an interactive virtual environment. For example, Eric Phipps depicts his feelings of isolation as a baby devoid of human contact and left in a colourless, machinery packed factory. In the virtual environment, the machinery would relentlessly whirr and just before another user comes into sight of the baby he will hear it crying. If the user decides to approach the baby, the human contact would slow the machinery and the colour of the environment would lighten. Were the user to interact in some way with the baby it would stop crying. In a similar picture, Eric depicts isolation as a child on the top of a skyscraper being watched by distant bystanders (Fig. 3).

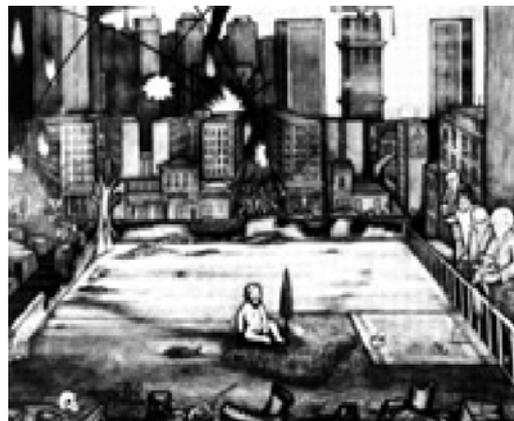


Figure 3. *Isolation of a baby*

Michael Solomon depicts isolation in a portrait that places himself in a wheelchair at the center of an empty stage in a packed theatre (Fig. 4). This picture of isolation would quickly change if members of the audience joined him on the stage. In another painting Micheal represents fear and perhaps feelings of a lack of control as being pushed away from his companion and down the side of a mountain (Fig. 5). In a dynamic virtual environment, the slope of this mountain could perhaps represent the sum of Michael's anxiety and the anger of his companion.

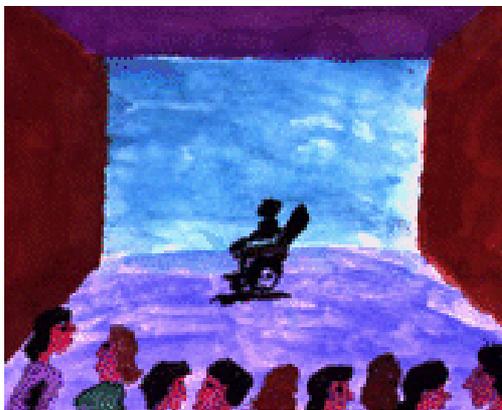


Figure 4. *Isolation of a stage*



Figure 5. *Anxiety of a hill*

6. MEASURING EMOTION

We have discussed how emotion may be both statically and dynamically represented within a virtual environment. What is left is the question of providing the system with an indication of the emotion of the users. Furthermore, would a user necessarily want their emotion to be reflected automatically or would they want some control. Considerable research has been undertaken by psychologists in an attempt to measure emotion. Ekman used three psychophysiological measures: heart rate, finger temperature; and skin conductivity (Ekman et al, 1990). These give a good measure of the level of emotion with finger temperature and skin conductivity also helping to distinguish between fear and anger.

Although varying levels of emotion can be monitored, it is in general difficult to distinguish between given emotional states. A current undergraduate project at Reading is developing a prototype system that when told which emotion the subject is undergoing will measure its level and represent this with a simple iconic face in a virtual environment. A set of buttons will allow the user to select the emotion they are feeling and the above measures will be taken to determine the level.

7. CONCLUSION

The DISCOVER project has brought together people of different abilities, background and experience to discuss ways in which virtual reality could help those with disabilities. From a number of application areas, the group has chosen to concentrate on tackling the problems of isolation through the expression of emotion in a virtual medium. The concept of a virtual meeting place was proposed, where people could overcome the problems mobility, access and self consciousness. Many people find it particularly hard to express emotions. This may be brought about by psychological problems such as shyness, or physical problems such as voice and muscle control. The proposal of a virtual meeting place was developed into a novel concept for facilitating the expression of emotion with others who might be separated by a considerable physical distance. A system supporting such a concept could potentially tackle many of the underlying causes of isolation. Although no such system exists, it was shown that all the building blocks were either already available or under development. It was shown how colour, sound, music, body posture and the environment itself could represent the emotions of the participants. Finally, methods for a system capable of ascertaining a persons emotion was investigated and the principles of a prototype emotion monitoring system introduced.

Acknowledgements: The authors would like to thank Phil Clark of BT; Roger Allison of Silicon Graphics; and Ambitron Ltd. for providing loan of, or access to, equipment. Thanks to Phil Smithe of BT; and Paul Sharkey, Paul

Sandoz and Martin Cooper of Reading University's Department of Cybernetics for facilitating a workshop that provided the impetus for this conference. Thanks to Michelle McIntosh and Andy Richardson of the Department of Cybernetics for their input on the measuring of emotions; Thanks also to John Ladle and Linda Bunn of Acting Up; and to Mr and Mrs Wood of the International Cerebral Palsy Foundation. Finally thanks goes to the other members of DISCOVER: David Angus, Toby Brandon, Malini Chib, Chris Gilliard, Mary Gye, Ian Gwalter, Eric Phipps, Sarah Potts, Steven Ocane, Michael Solomans, and Stuart Turner.

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