

# **Interactive Painting – an evolving study to facilitate reduced exclusion from classical music concerts for the deaf community**

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## **ABSTRACT**

Exclusion from the joy of experiencing music, especially in concert venues, is especially applicable to those with an auditory impairment. There have been limited investigation into how to reduce the exclusion for this community in attending classical orchestra music concerts. Through utilizing computer technology and human machine interfaces (sensors and cameras) to stimulate complementary senses through interpretation it is possible to reduce this exclusion. Case studies are presented where the visual and tactile interpretation of the music is able to give new meaning and understanding for such people.

## **1. INTRODUCTION**

*Man, as yet, has no means of imagining the nature of his own experience in space. Until artists have provided him with adequate forms to express what he feels in space he will not know the meaning of experience.* - Herbert Marshal McLuhan.

Music is obviously a hearing experience which means that those with a damaged auditive mechanism experience music differently than those with their sonic attributes intact. This often leads to their self imposed exclusion from the joy of attending a full symphony orchestra concert. Others, for example from within a special needs community, are also often excluded from such experiences. There has been very limited research into making classical music accessible to members of these communities. In an effort to study this exclusion problem the author initiated an inquiry following a workshop that he was asked to chair by the National Danish Television station and the European Film School. This inquiry involved a commissioned study from a New Zealand organisation based in Auckland who was interested in the Deaf community being given access to classical music. These two case studies are referenced in this paper with examples of a suggested solution to reduce this exclusion problem for classical music concerts.

This paper presents a further element, another piece of the jigsaw if you like, of the author's ongoing body of work titled SoundScapes (Brooks 2004a) which is overviewed briefly for the reader's orientation in section 2 - subsections of the various aspects of the work are also referenced under this section. The two case studies are presented in section 3 & 4 with interviews. Section 5 informs of the sensor technology used in the case studies. Due to the success of the overall study the concept and methodology was subsequently implemented into the therapeutic aspects of the research and this is briefly introduced in section 6.

## **2. SOUNDSCAPES**

*The view taken here is that research in the area of Neuromuscular control, biomechanical aspects of performance, the link between cognition and action, together with recent developments related to pathology and adaptation can inform rehabilitation methods through implementation of this concept.* - Marshall, F.J. M.D. Neurologist

SoundScapes uses sensor and camera technologies so as to "activate" a volume of free air space where interference, in the form of movement by a human, creates events that result in changes to a multimedia environment. The human is positioned within the environment that is created from the use of a computer

workstation. The feedback is created to be “fun” for the human to interact with so as to attain an optimal level of immersed ‘presence’ from the *play scenario*. Philosophies from ‘performance art’ are exhibited alongside certain gaming psychologies within the concept and methodology and as such the research has often been referred to as a *research art form*.

The work is cored on human interaction and experts in the field have suggested potential closure of the human afferent efferent neural (sensorimotor) loop. The SoundScapes research is based upon a simple observable fact: Placing humans in an environment where they have “immediate” control (through movement) over sensual feedback of suitably interesting content (audible, visual, tactile...) is both aesthetically pleasing and capable of much therapeutic value that is ‘evaluand’ (a thing to be evaluated – the value to be determined (Lincoln & Guba, 1984)). The complementary observable fact is that nobody yet knows why in any individual case this should be so! (Beyond the anecdotal evidence that individuals given such control over their environment attain a level of self-motivation and coordination not expressed otherwise) – *Brain Empathy EU Expression of Interest*.

## 2.1 Performance Art

*Performance Art is now at the forefront of current art. An astonishing increase in the number of works and venues around the world testifies to this art form as the chosen medium for articulating ‘difference’, whether dealing with issues of identity, multiculturalism or globalisation.* - Goldberg (2001)

‘Performance’ is an accepted genre within conceptual art that has a long history and embedded philosophies that acknowledges articulation of *difference*. Goldberg (2001) has documented extensively on the form of “Performance Art” showing that from the early Futurism movement at the start of the twentieth century to the present time the manifestos and philosophies which have been stated are centred on a freedom of expression that happens at a specific moment in time (real-time). The author implements such philosophies into the SoundScapes manifesto so as to further articulate and celebrate differences in humans through their empowerment in being able to create in real-time through the arts. This is achieved through interactive systems that are used for research in the human sciences and which are used in this study with classical music. The results give new opportunities within the special needs field giving additional voice and meaning to ‘difference’ and the celebration of it. This fact is highlighted by the unsolicited communications written to the TV channels by viewers and audience as well as the study interviews with the audience, and performers, following the events.

## 2.2 Movement

Movement is an element of performance art and is an essential element of expression and joy which is often shown in response to music by humans. It is also an expression through movement that creates music, from the conductor’s baton gesture, the bowing of a string, striking of a drum or even at its extreme in respect of a singer. This mapping between movement and music translates the expressive cues via a computer workstation such that they are capable of manipulating digital multimedia relative to the input from the human participant (performer) in *real-time*. The multimedia content can be tailored in a computer workstation so as to be relative to the context, the individual and the goal of the interaction.

## 2.3 The Question of Inter-relationship of content

Can we achieve a satisfactory relationship between correlations of music and image? - Is it essential for the interpretation of the experience of the music for the goals of the study? - If so what strategies should be targeted? - Will composers of the future create with equal weight across complementary sensory stimuli? -

Perplexity has a parallel to these and similar questions throughout the history of audiovisual research. It would seem that through the history of audiovisuals and the many people investigating the phenomena of sound and image that nobody has achieved a satisfactory outcome to date. A one to one relationship of mapping is quickly tiresome irrespective of methodology used to stimulate the senses. Kapuscinski (1997) has probably come closest to defining what is required when in “*Basic Theory of Intermedia - Composing with Sounds and Images*.” he describes ‘structurally integrated intermedia composition’ where the unique property is the creative focus on the content emerging between the senses. In his PhD thesis he writes: ‘This intermodal dimension is accomplished by linking, which means that while the freedom and individuality are the base for each dimension, it is the relationships between dimensions that constitute the medium.’ Related to an Kapuscinski’s intermedia theory is an article titled “*Sense and Intersensoriality*” for the Leonardo publication *Intersenses and New Technologies*, where François Delalande discusses the more general problem of musical meaning where he asks as to how sound relates to something outside of the world of

sound. He relates to temporal form such as that of movement and the relationship to sound ‘forms’ (shapes, profiles) and this is clearly related to the earlier research involving the author (Brooks *et al* 2002) which featured movement relative to sound ‘forms’ that were used in therapy. Jean-Pierre Ternaux who discusses in the same journal the unusual phenomenon of “*Synesthesia: A Multimodal Combination of the Senses*” - where he investigates the pathological context of synesthesia as well as relating to it as a physiological behaviour that involves the multimodal combination of the senses and in so doing approaches it from the cerebral mechanisms angle. Also in the same issue Rolf Inge Godøy in his article titled “*Motor + Mimetic Music Cognition*” highlights the well known fact that there is more than just the auditory aspects that enrich the experience of music stating that “... in particular, images of movement appear to be deeply embedded in our perceptual and cognition of music. Explorations of mental images of music related movement could enhance our understanding of music as a phenomenon, as well as be of practical value in various music-making tasks.” In this study however, while being aware of potentials from such correspondences and relationships across the senses the strategy was initiated to resource the musical scores, audio recordings of the work (if available) and words, where appropriate, and use this material for the creation of various interpretable digital image libraries for real-time improvisation by the author.

### 3. DENMARK

The workshop in Denmark was as a consequence of a survey with members of the public who had an interest in classical music. The results from the survey showed that audiences watching classical music on television were declining in number. The workshop gave insight into potential ways to inspire the public to return as viewers and ways to increase the audience. The workshop study was hosted at the European Film School by the National TV station’s classical music production department.

#### 3.1 *The TV studio study*

A professional choir was selected for the TV studio. The music composition was supplied with text and a recording from the conductor. The resulting visual sequence was a series of computer graphics depicting a gothic cathedral window with coloured leaded glass. These colours could be morphed by the conductor’s hand gesture. The choir consisted of around forty singers of mixed gender and aged between 20 and 50 years. Instructions were given to the conductor that the experiment was with an invisible interface to a computer and that as he had forty singers relying on his conducting there should be no conscious effort to change any of his gesture due to the image manipulation.

*3.1.1 Technique and method.* Ultrasonic (Soundbeam®) sensors, a volumetric 3D infrared light sensor unit (author prototype) and cameras were used. The mapping of the data from the hand movement was programmed to open filters Red, Green & Blue in the computer image sequence. A gesture between sensor spaces resulted in proportional opening of the filters and a resulting blend of the colours. No movement within the active sensor space from the conductors results in black as no filters are opened.



**Figure 1.** Denmark classical choir – conductor (left - raised) gestures and digitally paints the background. The choir members (right) follow the gesture as directing their singing.

The conductor was set up on a raised podium in front of where the choir was positioned in front of a 12m wide x 8m high screen. The conductor was asked to wear a white paper painting suit to maximize his amalgamation into the projected images. The choir (who arrived for the TV shoot with tuxedos and black formal dresses for the TV broadcast!) was asked to wear white sheets with holes for their head so as to

maximize projected light reflection. Two LCD (Liquid Crystal Display) projectors were set up on the main floor space at approximately sixty degrees angle behind the conductor and angled at around twenty degrees from the horizontal. The projected image was thus raised above the heads of the choir so as to have a clear projection area, and to minimise projected light in their eyes. The two main projected images were vertically adjoined so as to extend the effect and to give the effect of one projection. This use of two projectors also gave two shadow images of the conductor at the centre of each of the projections, this was to give viewers the opportunity to observe the hand gestures even if the camera angle was behind the conductor and thus eliminating a view of his hand gesture. The conductor was advised to make a purposeful and defined entry into the active sensor space so as to give a dynamic opportunity for viewers to correlate the causality of the interaction. Similarly at the close of the piece he was advised to slowly remove his hands from the sensor space so that the last tones heard from the choir ceased simultaneous to a fade to black of image.

*3.1.2 Result.* From observing the conductor during the experiment it became obvious that his gestures were in fact becoming more emphatic, and animated. Interviews with choir members confirmed this but they agreed it did not detract from his guidance. Each subsequent reiteration of the piece of music was progressively initiated with a more vibrant entrance into the sensor space by the conductor. When interviewed after the sessions were completed the comments from the conductor stated that it felt "... like a power trip," and "... as if the air was electrically alive in front of my body."

## 4. NEW ZEALAND (NZ)

The study in New Zealand was with a symphony orchestra based in Auckland. The series of four concerts were titled "Four Senses" and had a defined target group of the Deaf community with the goals of giving opportunity for this group to have an improved experience of classical music. In addition to the orchestra there was a mixed ability contact-improvisation dance company, a singer (visually impaired), a signing choir (for interpreting the singer's text via New Zealand sign language). There were also vibration cushions in the first four rows in the auditorium that received the music from the orchestra via the sound mixer station. Balloons were also given to selected audience with impairment so that they could lightly hold and feel the vibrations from the music. The author was invited to participate by artist and lighting director Raewyn Turner who implemented her methodology of interpretation of music into light and olfactory stimulation via custom aerosol input to the air conditioned system of the auditorium. Publication of her methodology including use in this series of "Four Senses" concerts is documented (Turner 2003). The concerts are documented further in Brooks (2004a) and Brooks and Turner (2003).

### 4.1 *Technique and method*

The set up is described in the publications mentioned in the previous paragraph but suffice to say that the expressive information from the performers were collected via the cameras and sensors and manipulated by the author into a real-time free interpretation of the music juxtaposed to the lighting changes. In the Denmark study only the conductor was involved in the digital painting. In New Zealand it was also members of the orchestra, the dancers, the singer and the signers that were involved. The goal was to show how the emotive expression that occurs as a result of performing music could be translated through interpretation for the audience in a large 'live' environment.

*4.1.1 Result.* The conductor in Auckland was observed to again very quickly be at ease with the system and there was no interference reported, however the use of sheets of music notation (turning over) in certain pieces of music disrupted the sensors continuous data stream capture of expression. Initially it was thought to distract from the objective of the exercise, however it did in fact become an integrated aspect, as that was also his expression at that moment relative to the interaction to the orchestra.

The interviews of some of the audience were included in the National TV broadcast. A number of letters was sent to the TV station (three examples below), which was an unexpected addition to the interviews. The orchestra performers on stage stated that they would have liked to be in the audience to experience the event. One musician in particular who herself had a hearing impairment expressed this very strongly and that all she had spoken to in the community had only positive remarks.



**Figure 2.** *The New Zealand mixed ability dancers (left) and orchestra members (right) – all interactively digitally painting the backdrop from their expressive gesture.*

Three examples of the mails received (published with permission – addresses deleted):-

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*I accompanied five people with varied degrees of deaf blindness and their caregivers to the Friday performance of the 'Four Senses' concerts. I was impressed, moved and delighted at everything that I with my senses intact and unimpaired could experience. More importantly, it was so rewarding to observe how much of the music, lights, smells and movement our disabled friends were able to enjoy in the extraordinary ways your team made available. At a meeting of parents this week we heard from the caregivers of the gratifying response that their very handicapped charges made to this fantastic sensory experience. Delight was the common reaction, it seems, and also a stillness that they rarely show that indicated they were receiving the stimuli. I have been asked to express the heartfelt thanks of all members of the Quality of Life Trust for your gift to the sensory-impaired people of Auckland. May you be able to repeat the concerts very soon!*

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*Today I was deeply moved watching the enjoyment that the audience experienced in an outstanding and innovative concert. The tears rolled down my face as I watched the expression on the faces of those who participated. Not only was the concert beneficial to those with disabilities, but it was also inspiring to people such as myself who have an empathy for those less able. Please give me the contact names and addresses of those involved in the technical & visual production as I would like to organise a similar concert for people in the Wanganui, Palmerston North & New Plymouth areas. Armed with this information I will challenge local Rotarians to put on a charitable concert that will involve school orchestra's and other community organisations. I look forward to receiving any information you can provide. This will be the first step in realising a vision. Thank you for screening such a wonderful show.*

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*To whom ever this may concern I watched your programme which aired 16/06/02 on Sunday, it was great and I was wondering if I could get further information on who was involved in putting a visual and feeling concert together, as well as info on how they did it, and in particular the aids which were used by the audience, i.e. vibrating cushions. I believe that, a show such as this would be great in the region of Southland, where I come from, although, being so far from the main centres, persons with disabilities can become isolated from such beneficial and fun activities.*

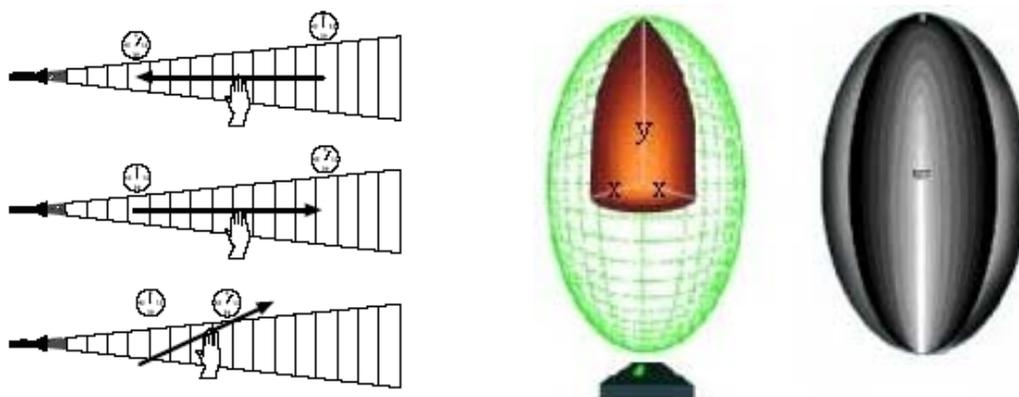
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The response in the many interviews from both the Danish and New Zealand study gives credence to the concept of utilizing interactive complementary sensory stimuli in live performance to give accessibility to audiences that may otherwise be excluded. The Interviews point to the fact that multi-sensory stimulation does enhance the experience for not only the impaired community but also, as can be read in the mails included in this paper, for others. Further consequences are suggested as more composers in the twenty first century are becoming more aware of the studies that are underway exploring such enquiry and they begin composing specifically to account for mixed phenomena opportunities. Such explorations in composing could result in their writing with a specific inclusion of sensory stimulus beyond solely sonic. Scriabin with his synesthesia related composition *Prométhée, le Poème du Feu* is an example of such earlier explorations by composers. As a result of the case studies which was built on earlier work with multi-sensory multimedia interaction in therapy (e.g. Brooks *et al* 2002) the author suggests this study further adds to the field of rehabilitation and habilitation where environments that are pleasing to the patient are able to be successfully

controlled by the patient. This success is a factor of the immersive ‘presence’ and alongside the embedded layers inherent to the system where various elements can be quantified a platform for future collaborative research is suggested. The quote from Marshall above, who is a leader at one of the top movement disorder Centres in the World (Rochester University Hospital) highlights the interest from the medical side.

## 5. SENSOR DETAILS

The Soundbeam® (below left) is a mature and sophisticated ultrasound movement sensor that is detecting movement along its linear axis. The system enables accurate reproduction of desired events. It translates movement to MIDI and is capable of responding to any MIDI control message and program change. This enables remote change of sensitivity which is a main factor when working with expressive gesture interpretations. The Soundbeam® is stable under varying light conditions and in a theatre auditorium with light shows this is important (as for these case studies). There is a minor problem with an auditive buzz which is common with such devices but this did not interfere in any way from its use.



**Figure 3.** (Left) Soundbeam® sensor where various gesture along linear axis articulates various predictable feedback. (Right) 3D infrared sensor ‘active’ space.

The infrared sensors (above right) utilized in the studies are volumetric 3 dimensional (3D) and like the Soundbeam® use the MIDI protocol. The maximum resolution of the sensor is 0 – 127 along its central “core” axis (Y) and 0 – 127 from the centre axis to the “skin” (X). The depiction in the figures is to illustrate the shape and maximum resolution of the active space. The beam is sensitive to lighting change which was a problem in the auditorium where light changes were inherent to the production. If a specific event is desired then one must traverse through the outer skin to the point in space where the desired note resides – this is not ideal. Programming can alleviate this. Further detailed in Brooks (2004e).

## 6. THERAPY

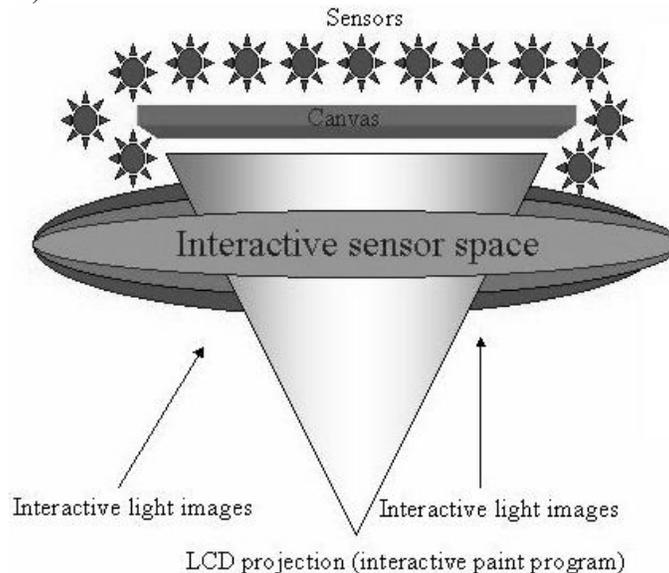
As a result of the two case studies the methodology was adapted for various sessions within the disabled community. The digital painting was supplemented by control of intelligent robotic devices (Brooks 2004d) which proved a powerful physical feedback for motivated interaction which can be seen in figure 4. It was also adapted into cross modal painting as detailed in Figure 5.

Interactive digital technologies which capture movement and subsequently control audio visuals from the interface have been investigated primarily for dance, performance and music with the result from the research of a number of cross platform programs available for consumer exploration (Appendix 1). This gives opportunities for parents and interested therapists to create specific tools for their needs.

The “Interactive Painter” concept and method is presented in “*Inspiration Day*” therapist training seminars in Denmark as well as in the author’s SoundScapes global presentations and workshops. Brooks (2004a) informs of a similar set up that was used in an art performance in New York. The initial therapeutic use is detailed in Brooks (2004b). Custom systems and training are available from the author on request. Research collaborations are welcome as are presentation and workshop invitations.



**Figure 4.** (Left) a session where father and brother look on as the girl makes music and paints. (Right) The boy watches his digital painting and robot control with just his hand (sensor assembly above).



**Figure 5.** Adapted to Cross Modal Painting where traditional water colours are used with canvas and brush in conjunction with the digital “Interactive Painter” for therapy within the disabled community. Movement with a paint brush is detected by the sensors as it enters the proximity of the canvas. This triggers dynamic multimedia that is affecting and motivating for the user. An interactive causal loop is thus established where proprioceptive sense (body awareness) is amplified so as to aid in therapy.

## 7. CONCLUSION

To summarize the contribution of this paper it is left to an episode extracted from the TV production from New Zealand. As mentioned in the text a hearing impaired member of the orchestra from the New Zealand event is interviewed in the TV production. The conductor (and musical director) is also interviewed and purposefully enlightens the TV audience to an episode when the same member of the orchestra exits the stage in tears following one performance. When confronted about the problem by the worried conductor the young musician says that “*You don’t know what this means to people like us*” – the conductor concludes his interview emotionally by stating – “*I think that says it all!*”

**Acknowledgements:** The author wishes to thank all involved in the Danish and New Zealand productions. Thanks also to the public cited (and not cited) in the text who wrote about their experiences - and those involved in the taped interviews – *Sorry but I could not include them all in this paper!*

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## APPENDIX

Dance and Music research technologists and developers with commercial audiovisual interactive programs:

- Camurri, A “Eyesweb” <http://www.eyesweb.org>
- Siegel, W. “DIEM Digital dance System” <http://diem.dk/english/diem/digdance/info.php>
- Rokeby, D. “Very Nervous System” <http://homepage.mac.com/davidrokeby/articles.html>
- Coniglio, M. “MidiDancer” <http://troikaranch.org/technology2.html>
- Weis, F. “Eyecon” <http://www.eyecon.de>

*Disclaimer Statement:* As stated in the text this paper is a further piece of the evolving SoundScapes research jigsaw. In presenting new and unpublished aspects of the concept and methodology it cross-references the author’s prior art which is detailed in the referenced publications list under his name. Such cross-reference is deemed unavoidable and in an attempt so as to minimise duplicate publication the reader may experience brevity of various sections in this paper. Hopefully this does not deter from the flow of the piece and the understanding of the content. TB.