Interpretations: an inter-sensory stimulation concept targeting inclusive access offering appreciation of classical music for all ages, standing, & disability

A L Brooks

Software and Media Technology, Aalborg University Esbjerg,
Niels Bohrs vej 8, Esbjerg, DENMARK

tonybrooks@aaue.dk

http://sensoramalab.aaue.dk

ABSTRACT

'SoundScapes' is a body of empirical research that for almost two decades has focused upon investigating noninvasive gesture control of multisensory stimuli and potential uses. Especially targeted are disabled people of all ages, and a special focus on the profoundly impaired who have limited opportunities for creative self-articulation and playful interaction. The concept has been explored in various situations including: live stage performances; interactive room installations for museums, workshops, and festivals; and in healthcare sessions at hospitals, institutes and special schools. Multifaceted aspects continuously cross-inform in a systemic manner, and, in line with Eaglestone & Bamidis (2008), each situation where the motion-sensitive environment is applied is considered as a hybrid system. The presented preliminary work exemplifies the motion-sensitive environment and how it is used to elicit dynamic performance data from a situation that features the Orquestra Nacional do Porto. A goal is to complement the music by offering an experience of inter-sensory stimulation. Inclusive access is planned in order that all may have an opportunity to appreciate classical music. This paper reports on the background, the targeted experience, and future plans of the concept.

1. INTRODUCTION

'SoundScapes' is recognised as a motion-sensitive environment (MSE) and each situation where it is used is considered as a hybrid system consisting of networks of complex inter-connected subsystems comprising 'created technical systems' and 'natural human systems' (Eaglestone & Bamidis 2008, p. 19). The dynamic relationships between these systems facilitate inter-sensory stimulation and this is a focus of the created preliminary research situation that features Orquestra Nacional do Porto at Casa da Música, 11th Sept 2008.

SoundScapes has been explored in various situations over two decades. These include live stage performance, interactive room size installations/workshops at museums, and in healthcare – specifically with profoundly disabled people in 'therapy' sessions at institutes, hospitals or special schools. Each situation is considered as an Inhabited Information Space (Brooks in Snowdon et al. 2004), and this perspective contemporizes and integrates the earlier work such as Virtual Interactive Space (VIS) (Brooks 1999). The next sections present examples of the background and history from prior art and design perspectives. Many of the design issues will be implemented in the Porto preliminary research session demonstration.

2. CHOIR 1999

'The Circle of Interactive Light' (COIL) exhibition (Brooks 1998–1999, *video link*[1]) was a situated hybrid system consisting of a large multisensory interactive room installation – (VIS) – comprising multiple robotics, projections, image manipulations, music, effects and interactive sculptures that were affected via data being captured from people inhabiting the space via the motion-sensing technical setups.

The COIL toured leading Scandinavian Museums of Modern Art to approximately a reported 1.5 million people. The COIL exhibit resulted in contact from the Danish national TV and the European Film School, and following a jointly conducted survey that found a decline in classical music TV audiences, a

©2008 ICDVRAT/University of Reading, UK; ISBN 07 049 15 00 6

SoundScapes presentation and workshop was hosted at the European Film School to conceptualise solutions. A resulting situation was agreed where the author was invited to exemplify his concept in using complementary visuals with classical music where the image had a real-time relation to the live performance. A choir was recorded at the DR national TV in studio 12 and an interactive solution was tested (*video*[2]).

In designing for classical music I restrict the sensory digital feedback manipulations to non-auditory, in other words, I do not wish to affect the music so the focus is mostly on visual interpretation. In the case of a choir it is only their mouth and facial expressions that move. Therefore the focus is on the conductor as he is engaged throughout each piece and continuous motion is present. In this case he was requested to arrive early at the studio to test the system. He also agreed to wear a white paper overall that is sold for protecting clothing when painting. This enabled projections from behind to blend him into the multiple projection collage. Projections were from behind to include his shadows so that change of animation colour could be related to his hand gesture by the TV audience, especially when the selected broadcast camera angle did not show him in person. The animations were created as geometric stained glass window effects according to the 'gothic' feel of the music with a software programme called Bliss Paint[3] for the Apple Macintosh. Real-time interaction was via the conductor's gesture within three invisible volumetric zones emitted from a noninvasive infrared sensor (see figure 1). 'Digital animations' were improvised in real-time onto the white outfits that were worn by the choir members. The comments from the conductor of his experience align with the use of SoundScapes in rehabilitation training, i.e. an empowered unconscious augmentation of motivated movement (Brooks 2004, p. 104). Access to the choir broadcast was made available online (*video*[2]) and the result was an invitation from New Zealand artist Raewyn Turner who associated the work to her multisensory concept titled Four Senses which featured an Auckland youth orchestra. I accepted as I had not researched olfactory before or been to New Zealand and the commission was appropriate.

3. ORCHESTRA 2002

An important initial period of artist-artist 'getting-to-know-each-other' through presenting works, techniques and methods was followed by the build of the MSE (which involved sponsorship meetings, PR etc.,). The meeting of the team included the 'Aotea Youth Symphony', conductor, director, film crew, and supporters (*see online*[4]); the mixed ability dance company 'Touch Compass' led by Artistic Director Catherine Chappell (*see online videos*[5,6,7]), deaf signing choir, 'Hhands'; and sight-impaired vocalist, Caitlin Smith[8]. On the technical side the lighting rig supplied by Kenderdine Electrical was Martin Lights and included MAC 600™, MAC 2000 Profile II™ and their LightJockey 2™ (*technical review online*[9]). Tactile devices were Aura Interactor cushions and large balloons to hold in the fingers by the deaf audience members.

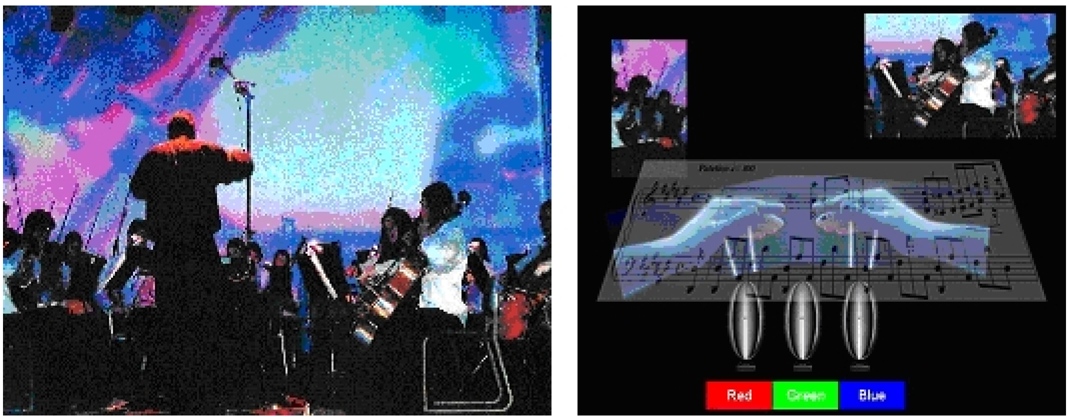

Figure 1. *New Zealand – Four Senses: Conductor is the main generator of motion data from within three infrared sensor zones that are mapped to Red, Green, and Blue animation sequence filters.*

Movement was taken from various sections of the orchestra – 3 x SoundScapes infrared sensors controlled an animated Red, Green, and Blue image filter system (figure 1). This was set up so the orchestra conductor's hands digitally painted as he moved so that he could digitally paint the floor to ceiling screen images on the back of the stage (see figures 1, 2 & 4). Images were selected and blended on the fly. A video-feedback system with double video camera enabled an analogue input to the image mix. Microphones captured the music from stage with the dynamic data used to manipulate images. Five static video cameras were setup on various stage performers (see figure 4). Three mobile video cameras with operators were instructed via a communication network of headphone/mic walkie-talkies. These various stage signals served a switching bay that was created with a bank of video monitors to observe image signals. Downstream were video mixers which then served 5 computers (Mac & PC) and following a final manipulation of the material it was blended to feed seven powerful projectors that were sponsored by Epson New Zealand. A sizable foyer installation was additionally setup on large bubble wrap where a "mini performance" featured the Touch Compass dancers triggering/controlling their own video image feedback & sound via the sensor/camera system. A sponsored Epson printer enabled shots of the dance to be printed and freely given to the audience.

Figure 2. *New Zealand – Four Senses: Aotea Youth Symphony and Touch Compass dancers generate inter-sensory stimulation data to affect the experience of classical music for deaf audience members.*

Pre-programmed light states were integrated into a lighting plan and a pc based stage-lighting program to make multiple sequences and cues for use in improvisation. In the performances improvisation took place within the bounds of the lighting states and smells created for each piece of music. Lighting change had an added dynamic as camera image software, being sensitive to lumen change, "exploded" and reset to an adjacent hue in the colour-chart. This was a wonderful find and promoted the eventual light performances to be mostly improvised in real-time as the computer programming was found to be too restrictive as subtle changes from one of us affected the other's input, so there was much talking on the headsets for timing etc. The orchestra was dressed in white and under lit with ultraviolet light to provide an image canvas. Divided into sound groups, each section was assigned a colour and it's complimentary to achieve high degrees of retinal stimulation, brightness, and afterimage. The efficient dispersal of smell was important to the comfort of a 'closed room' audience. Processed by an industrial chemist into aerosol sprays, they were applied direct to the air conditioning system which distributed the fragrances evenly through the auditorium on cue. The fragrances were mixed/cleared away using the air conditioning fans in the building. Warning notices were posted with the advertising of the event, informing audiences of the presence of smell. The computer software used was various image processing algorithms mapped to affect the eight stage camera feeds. Blended output was into live performance programs installed on the three upstream video mixer computers with the final composition through real-time improvisation manipulation of parameters of Eyesweb. The main output software algorithm was one that I initiated and supervised the creation of in Lund, Sweden, as a part of the European project called CARE HERE (Brooks & Hasselblad 2004). This 'bodypaint' algorithm is offered in the Appendix with notes regarding use in the Porto offering. Various other aspects of the New Zealand performances are reported via Turner (2003); Brooks (2004); Prime time TV documentary (*videos*[10,11,12]), and other online resources[13]. Direct information on the Four Senses is available from the Aotea Youth Symphony director and conductor detailed at the concert online link[14] and the orchestra web site.

4. SOUNDSCAPES: GENERAL CONCEPT – REVIEWED

As its name implies and examples illustrate[15], SoundScapes is focused upon multisensory stimuli and specifically design, translations, and intervention, especially of auditory and visual feedback (including Virtual Reality – see example online[16]). It has been used mostly with human participation but other life forms have been explored (see example online of fish painting as they move to the music[17]). Control data is mostly generated via free unencumbered reactive gesture. A selection of noninvasive input devices are used to capture various human 'feedforward' data that is mapped via a computer workstation to control immediately experienced selected multimedia. The multimedia can be selected from libraries of responsive content and adaptively programmed to suit participant(s) and situation. The manipulated audiovisual mediums are then delivered to be experienced by a speaker system (auditory) and/or a large screen (visual).

Usually, the design is such that the originator of the gesture experiences the sensory stimuli that is under his or her control and reacts accordingly with a suitable reactive gesture. This has been used in rehabilitation training and a patented marketed product realised. Findings show how feedback content design, input device programming, and physical setup can be prepared, adapted and later refined to stimulate specific feedforward targeted action. In all cases, the human's afferent-efferent neural feedback loop is suggested closed[18] and a cyclic stimulus-response chain established (Brooks et al. 2002).

According to the specific situation and the profile of the participant(s) and/or audience, decisions are made whether innate design parameters of response manipulation should be directed toward targeting a goal via the feedback content design, the input device programming, or input device physical setup. Alternatively a less complicated, freer content may stimulate the desired goal reaction without calibrations etc. In the preliminary stage of the research presented on this occasion we target an abstract interpretation where performance data controls the audience visual experience. Figure 3 illustrates the spectacular auditorium which is the venue where the situated opportunity to create for Orquestra Nacional do Porto will take place.

Figure 3. *Main auditorium and venue for the event at Casa da Música, Porto. ©Casa da Música.*

5. SPECIFIC CONCEPT

The VIS design that is proposed for Orquestra Nacional do Porto differs from my previous commissions at Casa da Música as the gesture originators are the musicians/conductor who are, for the most part, required to focus on the score. Also the strict structure of the musical form prevents musician distraction, e.g. changing articulation according to visual stimulus change. This design then approaches the Danish choir and New Zealand orchestra performances as in such contexts the musicians and conductor are not able to fully experience the visual feedback as may a jazz improviser who could interactively 'play the images'. Thus the orchestra role is maintained as the traditional mediating tool between the composer of the music, the agreed interpretation, and the audience. The receiver in this situation is the audience with the mixer operator as their visual experience facilitator. In a fashion this resembles the facilitator role in the therapy situations.

In a sense this diminishes the problems experienced with camera latency and real-time interpretations as unpublished tests have shown how problematic this is for a trained musician to accept the temporal change associated to the visual stimulus delay.

To date the greatest success has been with using the infrared input device as opposed to camera in respect of real-time motion data captured-to-motion data visualised in 'real-time'; this is also the case where a defined field of interaction is desired as it is problematic to isolate depth of camera field from an activity that is setup parallel to the camera. Complexity of camera/graphics processing algorithm can also affect the latency. However, a balance is always targeted in the improvisation to offer audience association to where the data is captured from so that the image manipulation can be related. The data processing is also planned to affect the stage lighting via advancement to the Eyesweb algorithm (see Appendix) such that a direct link to the selected performer enables lighting change. This feedback loop between light and camera could have an adverse effect and thus the design incorporates a 'get out strategy' to bypass. No two performances are alike.

6. CASA DA MÚSICA SETUP

Data is sourced from the Orquestra Nacional do Porto live performance via a network of infrared volumetric sensors and CCD video camera sensors (figure 4). Microphones are also used to capture the music. The data is collected and monitored at a mixer station where mapping decisions are made in improvised visual collage creation which is projected on stage located floor-to-ceiling screens. Balloons are used for the audience to hold lightly in their finger tips to experience the dynamic vibroacoustic sonic properties of the music.

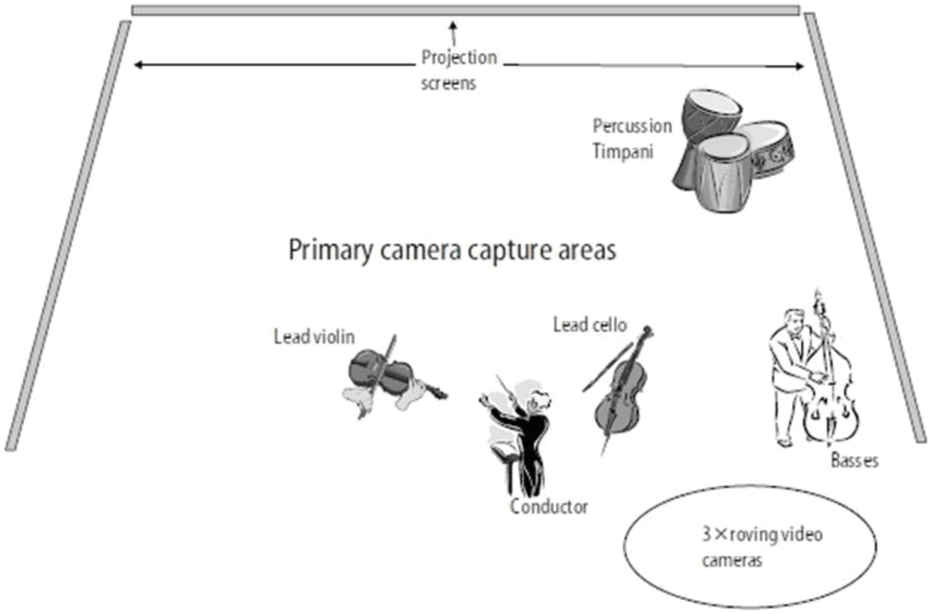

Figure 4. *Proposed stage capture area of data – Orquestra Nacional do Porto.*

7. TARGETED EXPERIENCE

The main auditorium in Casa da Música should be a spectacular venue for realising the eventual proposed inter-sensory event and time spend to experiment with the physical environment will be precious. Figure 3 illustrates the dynamic 'gold' wall patterning that should be responsive to dynamic light effects, Figure 5 illustrates the stage area overhead screen, the rear of audience area screen, and the end walls glass feature. The featured pieces will be 'Zapping' by Tinoco, and Symphony number 4, finale, by Nielsen.

It is appropriate that the 2007 RIBA award-winning concert hall and arts venue Casa da Música that stands on Rotunda da Boavista in Porto, Portugal, and which was funded through the European culture capital 2001 is hosting this event. It is also fitting as 'the generation of an effective environment with aesthetic resonance' was one of Rem Koolhaas' architectural concepts. Casa da Música has also been designed to address the relationship between the concert hall and the public by targeting involvement of the majority rather than a select minority. In-house departments focus on this by organising events and happenings to attract audiences and participants from all walks of life. This inclusive strategy is no more prominent than when annually in April workshops and public performances are conducted that feature disabled people. This bringing home to all that attend that all people are creative and all people have a right to express their creativity.

Figure 5. *Casa da Música – main auditorium architect features to consider in design.*

8. CONCLUSIONS AND FUTURE

Access to observe Orquestra Nacional do Porto rehearse the two selected compositions will be on the days preceding the presentation and in the main auditorium. This is optimal as the build can commence immediately following the initial observations so that a plan of action is established between the artist, director, and crew. The Casa da Música crew is one of the best I have worked with in the world so I am confident that we will together approach what is possible with the available equipment. An opening introduction will be given by the author in line with the background, history and issues of design that are presented herein. Anticipated are audience comments and reflections as a closure to the presentation. Providing the preliminary research is accepted by the parties concerned as an indication of what may lie ahead it is planned to begin drafting a proposal for funding the building of a team of artists with the capacity to improvise with their medium so as to collaborate together to push the boundaries of the genre. Further cross-informing is anticipated to evolve parallel work. The systemic overview involves the creation of specific compositions that innately embrace the multisensory aspects of the work – not, as in the case of the presentation, where an interpreted improvisation is offered post musical composition. In this way the concept is envisioned as potentially adding to the body of work of those composers who have composed in this way before – Alexander Nikolayevich Scriabin, the noted Russian composer, who was born in 1871, comes to mind. Rather than a single composer the proposed team design will involves interchangeable invited artists with inter/multidisciplinary competences. This is so collaborative compositions will specifically target inter/multisensory stimulus, the environment, and the situation of presentation from the outset – such a combination could be great or doomed to failure. Archives are proposed to be packaged and emitted via a space craft to enlighten whoever may be out there…watching… listening… and feeling, as it is posit that even in space one can aesthetically resonate!

Acknowledgements: Orquestra Nacional do Porto & director Andrew Bennett, Paulo Rodrigues, Luis Miguel Girão and Rolf Gehlhaar; Casa da Música crew led by Ernesto Costa, especially Francisco Moura, Bruno Mendes, José Torres, and Marco Jerónimo; Casa da Música educational dept. Paulo Rodrigues, Joana Almeida, Anabel Leite, Inês Leão, Teresa Coelho, Ana Rebelo, and translator Paula Oliveira; Thanks to Casa da Música management who continue to support our 'empirical adventures'; Photographs with permission (NZ Milan Radojevic)..

9. REFERENCES

A L Brooks (1999), Virtual interactive space (V.I.S.) as a movement capture interface tool giving multimedia feedback for treatment and analysis. The *13th International Congress of the World Confederation for Physical Therapy*. Science Links Japan: [online] http://sciencelinks.jp/j-east/article/200110/000020011001A0418015.php

A L Brooks, S Hasselblad, A Camurri, and N Canagarajah (2002), Interaction with shapes and sounds as a therapy for special needs and rehabilitation, *Proc. 4th Int. Conference On Disability, Virtual Reality, and Associated Technologies (ICDVRAT)*, Veszprém, Hungary, pp. 205–212.

A L Brooks (2004), Interactive Painting – an evolving study to facilitate reduced exclusion from classical music concerts for the deaf community. *Proc. Intl. Conf. Disability, Virtual Reality and Assoc.Tech. ICDVRAT*, Oxford pp. 101–108

B Eaglestone and P D Bamidis (2008), Music composition for the multi-disabled: A systems perspective. *Intl. J. Disabil Hum Dev.*, 7(1), pp. 19–24.

D N Snowdon, E F Churchill and E Frécon (eds.) (2004), *Inhabited information spaces. Living with your data.* Springer

E Petersson and A L Brooks (2007), ArtAbilitation®: An Interactive Installation for the Study of Action and Stillness Cycles in Responsive Environments, *Proc. Computers in Art Design Edu. CADE*, *Perth,* pp. 159–170.

R Turner (2003), Olfactory Translations and Interpretations, Int. J. Performance Research, 8, 3, pp 104 –112.

[1] http://www.youtube.com/v/3W4VznlgiU4

[2] http://www.youtube.com/watch?v=65gAT_RAfvU

[3] http://www.imaja.com/blisspaint/index.html

[4] http://www.aotea.org.nz/

[5] http://www.youtube.com/watch?v=DfyosGOuED8;

[6] http://www.youtube.com/user/touchcompass; http://www.touchcompass.org.nz

[7] http://www.youtube.com/watch?v=w2gVC-pnyFo;

[8] http://www.caitlinsmith.com/

[9] http://www.martin.com/casestory/casestory.asp?id=572

[10] http://www.youtube.com/watch?v=gTjvCh-XB2o

[11] http://www.youtube.com/watch?v=iDX8K6Vq4kk

[12] http://www.youtube.com/watch?v=RmiWYTytf_0

[13] http://netzspannung.org/netzkollektor/digest/02/multisensory_spaces

[14] http://www.geocities.com/the_four_senses/

[15] http://www.soundscapes.dk

[16] http://www.youtube.com/watch?v=m5-I9NHPt2I

[17] http://www.youtube.com/watch?v=CTV6s3oTC2I

[18] Fred Marshall, M. D. Rochester University Hospital, Harvard: personal communication

[19] http://www.bris.ac.uk/carehere – bodypaint programme, Trocca & Volpe (DIST University Genoa, Italy) when at CAREHERE Lund meeting: conceptualised and initiated by Brooks.

APPENDIX

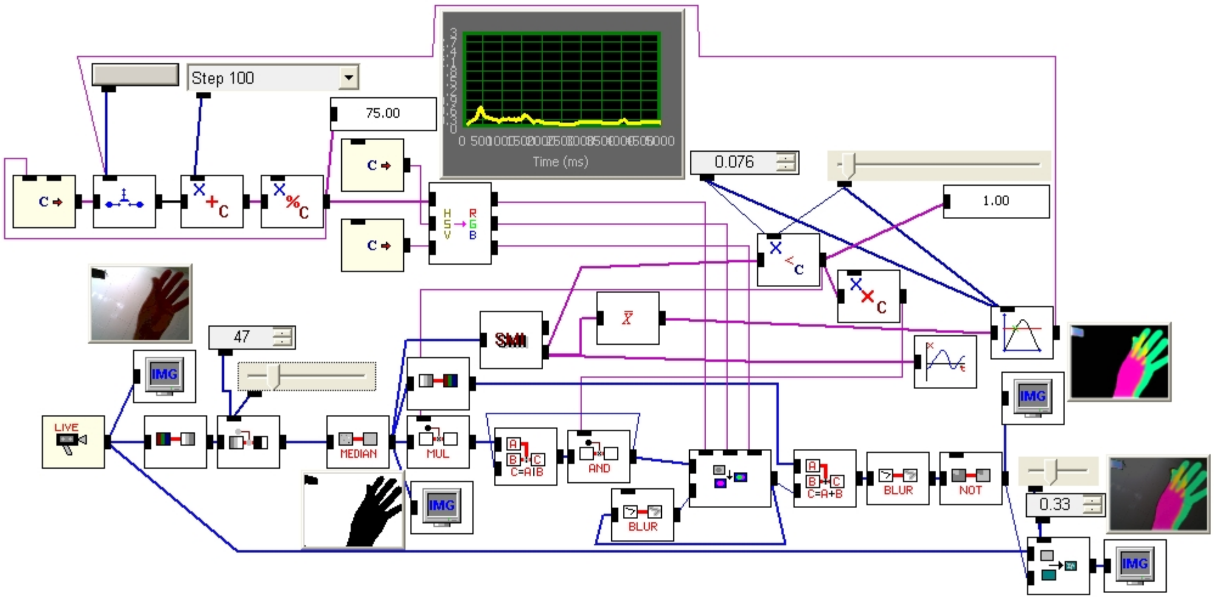

Figure 6. *Eyesweb Bodypaint patch. Eyesweb 'bodypaint' algorithm created in Lund, Sweden as an outcome of the CARE HERE European Project IST-20001-32729 (Creating Aesthetic Resonant Environments for Handicapped, Elderly and Rehabilitation). This will be a used tool in the presented work with the addition of data streams that will map motion to MIDI control of lighting. A full list of the patch parameters is available from the author. Image windows represent from left to right – source – background subtracted – bodypaint output – video mixer output. Real-time control can be assigned to MIDI control input to operate sliders to determine contrast and mixer blend. 'Step' box determines colour differential chart. If you utilise this patch please acknowledge accordingly.*[19]

Label	Type	Comment
LinearFilterBlur_1	Imaging.Filters.LinearFilterBlur	Blurs the input image.
CopyColouredMask_1	LundCareHere.CopyColouredMask	Copies the bw image passed, colouring it according to the implicit mask in the image.
Generator_1	Math.Scalar.Input.Generator	Generates various type of signal.
Generator_1	Math.Scalar.Input.Generator	Generates various type of signal.
Display_1	Math.Scalar.Output.Display	Display the input scalar value.
HSVToRGB_2	Imaging.Conversion.HSVToRGB	This block converts a value from HSV to RGB.
ColorToGray_1	Imaging.Conversion.ColorToGray	Converts a color image to gray scale.
Threshold_3	Imaging.Operations.Threshold	Thresholds the source image.
NonlinearFilter_1	Imaging.Filters.NonlinearFilter	Performs a nonlinear filtering on the input image.
GrayToColor_1	Imaging.Conversion.GrayToColor	Convert a grayscale image to a rgb image.
DyadicArithmeticOp_1	Imaging.Operations.DyadicArithmeticOp	Performs a dyadic arithmetic operation on the two input images.
LinearFilterBlur_1	Imaging.Filters.LinearFilterBlur	Blurs the input image.
ConstOp_1	Math.Scalar.ConstOp	Execute the selected operation with a constant.
Trigger_1	Generic.Trigger	Propagates the input to an output, whenever a pulse command is received.
Generator_1	Math.Scalar.Input.Generator	Generates various type of signal.
ConstOp_1	Math.Scalar.ConstOp	Execute the selected operation with a constant.
Display_1_camera	Imaging.Output.Display	Display a IPL image in a popup window. Camera input.
Display_1_background_subtract	Imaging.Output.Display	Display a IPL image in a popup window. Background subtract image.
ThreshCrossing_1	Math.Scalar.ThreshCrossing	Output the input value every time it crosses (upward, downward or both) a threshold value.
XvsTime_1	Math.Scalar.Output.Graph.XvsTime	Plots the input scalar value versus time, using a 2-D carthesian graph.
RunningOperation_1	Math.Scalar.RunningOperation	Calculates running operations on the last N samples.
SMI_2	LundCareHere.SMI	This block calculates the Silhouette Motion Images and the quantity of motion on the input image.
MonadicArithmeticOp_1	Imaging.Operations.MonadicArithmeticOp	Performs a monadic arithmetic operation on a single input image.
ScalarUnaryOpLogical_1	Math.Scalar.ScalarUnaryOpLogical	Perform a logical operation on the input scalar value against the parameter 'Value'.
Display_1	Math.Scalar.Output.Display	Display the input scalar value
Display_1_bodypaint	Imaging.Output.Display	Display a IPL image in a popup window. Bodypaint output.
MonadicLogicalOp_1	Imaging.Operations.MonadicLogicalOp	Performs a monadic logical operation on a single input image.
DyadicLogicalOp_1	Imaging.Operations.DyadicLogicalOp	Performs a dyadic logical operation on the two input images.
MonadicLogicalOp_2	Imaging.Operations.MonadicLogicalOp	Performs a monadic logical operation on a single input image.
ConstOp_1	Math.Scalar.ConstOp	Execute the selected operation with a constant.
FrameGrabber_1	Imaging.Input.FrameGrabber	Grabs image continuously from a frame grabber device.
VideoMixer_1	LundCareHere.VideoMixer	A video Mixer
Display_1_mixer	Imaging.Output.Display	Display a IPL image in a popup window. Mixer output.

Figure 7. *Eyesweb Bodypaint patch list for cross-reference to image in Figure 6.*

©2008 ICDVRAT/University of Reading, UK; ISBN 07 049 15 00 6