

The Order of Passions — A Portrait of Polyphonic Canada

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Abstract

In this paper we discuss the Order of Passions, generative media installation that visualizes dynamism, disturbance and unity within the diverse set of human facial expressions that together create a collective and emergent polyphonic portrait of Canada. We discuss critical compositional, technical and meaning making strategies for the creation of this generative artwork. The discussion is positioned from the perspective of artist-creators dealing with computational media as a medium for both, creative production and presentation of the artwork. We describe the tools and processes that were used and developed to support the creation of the project.

Keywords

Media polyphony; Canadian hybrid culture; identity; generative art installation; facial expression recognition; media ecology; emergence; complexity.

Introduction

This paper looks at some critical compositional, technical and meaning making strategies in the creation of generative artwork, the Order of the Passions. As a multimedia audio-visual installation the work expresses hybrid Canadian cultural identity as unity within a plurality of ethnic codes and affective expressions embedded in the human face. This dynamic ethnographic media environment distributed in space and time consists of multiple screens and audio channels tightly coordinated to present an image of the hybrid human face with voice, reflecting the understanding of unity through diversity. The Order of the Passions renders the metaphor of the broken mirror framed as a dynamic cultural mosaic reflecting a hybrid portrait of Canadian plural identity that evokes feelings of belonging through an emergent composition and dynamic experience. The empathic connection between viewers and the multi-faceted community to which they belong is established through both the recognition of emotions represented in the composite face and diverse linguistic vocal expressions.

The discussion is positioned from the perspective of artist-creators dealing with computational media as a medium for both, creative production and presentation of the

artwork. We examine creative relationships between artistic composition and expression, the generative processes that articulate and animate the work, and the emergent meaning embedded in the work. The first portion of this paper discusses theoretical, practical and semantic implications of this generative installation. The subsequent section describes the creative process, its innovations as well as challenges, and the paper concludes with a reflection on the conceptual and design contributions of the artwork.

Canadian Poliphony

The notion of a cultural mosaic has historically been central in describing Canadian polyphonic culture, with that concept sitting forming the basis of the Canadian Multiculturalism Act (1988), which aims to preserve and enhance multiculturalism in Canada. One of the criticisms of a cultural mosaic as symbol of preservation lies in the promotion of a coexistence of apparently static and separate elements (Schneider, 2008) and in the politics of difference (Thompson, 1995) that inhibits the construction of a stable identity.

As an alternative to the concept of multiculturalism John Ralston Saul (2008) proposes that Canada as a hybrid nation, inspired by Indigenous philosophy. At the centre of this hybridization and the source of Canadian imagination, Saul argues, is the First Nations concept of the ever-enlarging circle that expands and gradually adapts as newcomers join in (Saul, 2008). This concept provides a capacity to welcome immigrants and integrate them into an emergent culture. It explains the degree of comfort around ambiguity, complexity, cultural plurality and negotiation embedded in Canadian culture that, in its ideal form, acts as a civilization of communities, organically formed at a grassroots level. This hybridity also explains a core value of equality and equilibrium between a celebration of individualism and celebration of communities and group rights.

The concept of an ever-enlarging circle celebrates plurality and differs from the idea of the multiculturalism, which legislates cultural diversity to promote preservation. It also differs from the metaphor of the melting pot, where different peoples are assimilated into a uniform cultural identity. Saul argues that an individual's culture, within

Canadian plural hybridity, is not necessarily given by membership of a particular ethnic group or nation, rather it draws from an Indigenous approach to belonging that is not racially rooted. The cultural ties for First Nations people are based on relationships with family, community and physical place — the land.

Saul identifies the challenge that contemporary Canada faces, in terms of how to express this hybrid reality, the reality drawn from a reading of Canadian history as an evolution of plural national character inspired by Indigenous philosophy (Deacon, 1933; Saul, 2008). The work we present in this paper is a direct response to Deacon's acknowledgement of the hybrid history of Canada and Saul's call for resolving our contemporary challenge to express this historical evolution. The Order of the Passions, as a hybrid media portrait, is a creative investigation into Canadian hybrid identity (Deacon, 1933; Parameswaran, 2002; Braz, 2010). This generative composition is a poetic visualization of Canadian hybrid culture.

Shattered mirror

A mirror is being broken and in each shattered piece different faces are reflected. No longer can you view your image in a single mirror. And a shattered mirror cannot be reassembled.

Toru Takemitsu, Confronting Silence (1995:70)

The Order of the Passions examines the notion of Canadian identity building on the idea of a mosaic but extending it with the metaphor a broken mirror whose pieces are positioned as if captured in the moment of breaking within the gallery space. The image of a broken mirror is inspired by Takemitsu's discussion of the shattered dominance of Western thought and further underlined by postmodern philosophy. The metaphor of broken mirror signifies the postmodern thought, with the idea that the truth can only be accessed when viewed from multiplicity of perspectives. The mirror is broken and each broken part reflects different face, a different point of view. The reflections in the individual pieces of the mirror can be grasped only through the whole, through multiplicity and diversity of all colours characteristic for the balanced plurality.

The symbolism embedded in this dynamic shattered mirror image, moves immobilized constituents into active, hybridized, ever evolving participants in the discourse on plural identity. By representing the polyphonic fabric of our Canadian experience through human faces, emotions, voices and languages this work reflects and points to an idea that we are all part of one body, one ecology and one planet. We therefore create a portrait of a human face that reflects the notion of humanity as one organism whose delicate ecology and health depends on balanced complexity, pluralism and diversity. One of the readings embedded in the work is that we are all one, rendered through a focus on basic form of human face and common character of facial expressions. A parallel reading points to the notion that we are each multiple, every one of us is composed of many influences, memories, and histories swimming in a

river of rich and diverse world cultures. This work reflects the multiplicity that we live in today.



Figure 1: Detail of The Order of the Passions Installation

Visually, the diversity is reflected within differences in facial appearances. In the aural sphere, the linguistic richness of diverse cultures and their dialogic interactions is expressed through the representation of a Canadian multilingual environment. The resultant whole reflects a multiplicity of different voices singing simultaneously, not only in dialogue, but also with an ear to each voice's uniqueness and interdependence (Bringhurst 2009).

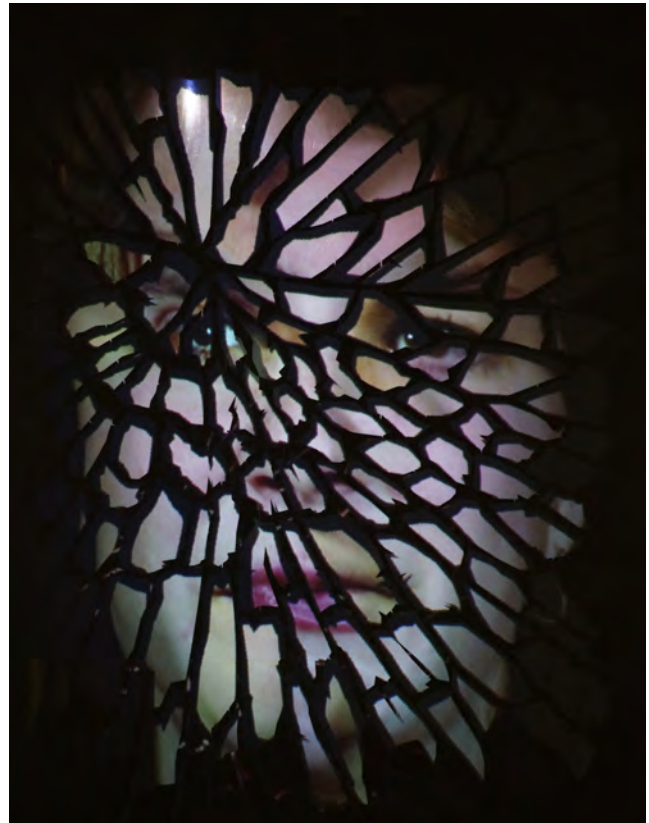


Figure 2: The Order of the Passions Installation view

Different people, their faces and voices, are projected across one hundred and thirty screens shaped as broken mirror pieces and eight audio channels. Those portraits, set beside each other, reveal difference and individuality. The perception of a collective identity emerges through a process of hybridization and transformation within a composite image that reflects to the viewer an image of multiplicity. The changing nature of the work allows for an active engagement in the construction and discovery of our identities as we observe this emergent portrait.

The human face and voice are core aspects of our communication; they are the instruments through which we present our selves to ourselves and to the world. Facial features and linguistic character of a voice allude to our ancestry, genetic heritage and our origins. Together, they paint an audio-visual portrait of a person's history, their familial background and upbringing. They are imprinted with our family histories and a sense of our ethno-cultural background. This composite portrait reveals at once unity, plurality and individuality.

The work reflects how our cultural, ethnic and linguistic differences collapse when we are presented with the expressions of basic human emotions. Despite cultural and ethnic differences, people are bound by the ability to read faces. Facial movements betray our emotions. In recognizing our own varied emotions expressed in the composite mosaic, we see our own multiplicity reflected in the mirror. The mosaic reflects our fluctuating self-identities and emotions as well as the comparable identities and emotions of our larger diverse ethno-cultural community. This allows for empathetic connections between constituents and reinforces the idea that shared emotions can enable understanding of shared identities. The empathic process can be understood as one of mirroring the emotions of another, and so the joining of many faces in a single expression is a visual representation of the mirrored emotion and empathy that must be present for a functioning plural community. The multifaceted identification through unity and difference provides an ontological ground that has ability to shift conceptual understanding of self and world in a transformative way, reflexively. As the image that activates the mind while speaking to the heart, this portrait is embedded with the accommodation and continuous negotiation drawn from Canadian plurality. As an artwork concerned with hybridity of culture the portrait can operate within the larger global context.

Complexity and emergent meaning

*Could I ask you to explain the music of heaven?
Sounding the ten thousand things differently, so each
becomes itself according to itself alone...
Who could make such music?
Chuang Tzu, A Little Talk About Evening Things
Out, (Hinton, 2013)*

The computer as a medium for artistic composition can take a role of a collaborator with creative inputs on its own, inspiring, provoking and challenging new modes of ex-

pression and meaning making. It enables a meaningful and creative dialogue not just with the artwork creators and the computation as a medium for poetic articulation but also with viewers that experience the semantic media space of the work.

The generative approach for art making offers modes of ambient media experience that are based on the incorporation of computational processes and system dynamics into the production of artistic whole. The complex output generated by the Order of Passions artwork provides both methodology and source of inspiration for meaning making. The processes, algorithms and mechanics that generate the work provide the artistic materials with which the work is crafted.

Computational process enables affective visualization of complex emergent collective thoughts that can be expressed through interrelationships among the parts within the whole — individual and explicit characters form connections that merge into a collective hybrid image. The computational media that enable this artwork reveal collective identity through a dynamic and infinite compositional process. Emergent visualization of this portrait allows creative engagement in exploration of and reflection on this collective image. The computational processes that drive this work bring together the concept of emergence in terms of how things come into being, through the notion of plurality, which is always becoming and never fixed. As the composite portrait and soundscapes emerge and transform, so do the meanings. The constantly transforming emotions written into this collective portrait created by the dynamic system, are sometimes peaceful and life affirming and at other times horrifying or grotesque.

The generative processes that drive this work act as a core rhetorical device in the composition that defines the experience of the work. The Order of the Passions artwork combines the diverse perspectives of subjects into a composite whole that suggests how we can see ourselves as cohesive community. It also reveals tension, antagonism and friction between elements that provide force and move the image into a full spectrum of experience.

Content and form: designing transformation

The Order of the Passions artwork draws inspiration from the concept of an infinite game (Carse, 1986), in which the sole purpose is continuing the play. Players engaged in an infinite game are continually transformed through engagement with the infinite game of life. As an action that reaches toward an open horizon, engagement in an infinite game is a creative response to changing conditions of life. By focusing on the quality of engagement, an infinite game is about the process and understanding through experience. Infinite games are not prescribed; rather they are open to exploration within the soft limits of a set of flexible rules that can shift in order to continue the play. Infinite games cross the boundaries of the past and confront opportunities of the present moment.

As an infinite game, the Canadian cultural polyphony is open-ended and dynamic. The Order of the Passions sets

up an exploration and experience of a social space drawn from our Canadian cultural plurality. The work is situated within our Canadian cultural reality to form an artifact where contextual, place-based and temporal conditions are braided together into an infinite composition of present. The cultural context situates the work, yet it remains deliberately open to different interpretations on the part of the audiences and readers (Eco, 1989). The strategy employed for this openness is enabled by computational form, which pulls and continually shifts diverse voices drawn from the community of participants into the composition.

While the multimedia content deals specifically with cultural identity, the concepts of situatedness, infinity, and open composition are deeply embedded into the form of computational composition. The element of multiplicity, enabled by the generative process, and the consequent effect of this processes on the reception of the work is a core formal element that defines the rhetoric space of the composition. As Jim Campbell (2000) points out, "If the new element particular to the medium of film was time, then I think that the new element to interactive art is the present. And it is the program that connects the present to the past." The use of computational strategies such as metatagged and coded databases of media to create interactive and generative art provide a medium for the infinite expression of rich differences embedded in our culture. The linear media production strategies — video and sound recording — in this work provide important compositional processes, but their effect is amplified by the inclusion of the recordings in a tagged database which is then used to dynamically compose the image.

How can computational media enable the artistic expression of infinity, situatedness and openness? Meta-tagged audio-visual databases used with dynamic computational composition enables modeling of the complexity, emergence and dynamics of the world in a way that can poetically reflect daily interactions, experiences and understandings. The system responsible for visual rendering of the artwork links a database of images within the structure of the composition. Each face image in the database is structured to consistently align key interest points — the eyes, nose and lips — to the same location on a 2-dimensional grid. This approach ensures the consistency of the overall composite face and its emotional expressions are visible in within the whole. The markup of an images database is the second step towards the development of grammatical structure of the composition. Each image is coded for specific facial movements — called action units — that identify basic variations in facial expression, for example raising the outer portion of an eyebrow. This ensures that the composite portrait can draw from multiple faces that share the same action unit and combine them to develop a cohesive overall facial expression.

Non-linear access to the database of faces enables surface variation of a deep compositional structure in expressing an infinite artwork composition. The surface variations are rendered by the compositional system, which can take different pathways through coded media elements. The

generative software program enables this infinite exploration of affective face space.

Interactivity embedded in this work recognizes that interaction is ultimately about the connections among people and their environments. The work draws from source images of individual faces within the community to reflect an emergent community image. The computationally mediated interaction builds on the image of the community, but through the triggering of media composition, provides a sense of being in the right place at the right time. This computer-controlled interaction across the artwork and visitors further dramatizes the relationship between the image and the viewer. Interaction with the computational system of artwork is used here as dramatic strategy to reinforce the metaphor of the mirror. As the viewer approaches the artwork the new emotional expression of the collective human is reflected to the viewer. As the viewer approaches the screen, the system generates new and unique composite image from the image database.

The artwork visualizes the multi-directional space spanning individual uniqueness and cultural complexity that configures the fabric and the texture of our daily experiences. This complex mosaic brings together collection of individual characters who themselves are at the heart of the complex cultural interactions and understanding. Creative and dynamic exploration of the face space also encourages the sense of agency in the formation of collective understanding of our plural identity. Agency emerges through recognition that each individual is critical to the construction of a complex whole and adds to the individual sense of contribution to the outcomes and solutions of the emergent plural identity.

In this artwork the form and the content are tightly integrated and influence each other to form rhetoric space of the artwork. The compositional system that we designed enables exploration of the image as an ever-transforming process. We developed specific tools and a compositional system to enable us to visualize this collective portrait. The concept and artistic strategy informs the tools that we developed to enable the flexible and dynamic composition. This process-oriented form enables the content to be expressed in such a way that articulates the overall meaning and the concept. The computational composition enables articulation of meaning through the dynamic process. The process is always evolving within a set structure and the overall composition is re-combinatory and continually shifting. The evolving composite portrait dynamically draws from a deep pool of people so that the emergent quality of the community interactions can be visualized. Strategy, design, form and content are all integrated to reflect the emergent meaning of collective hybrid identity. The emergent phenomena enabled by generative art composition, as a basic development strategy for poetic articulation, renders the meaning embedded in the artwork.

Artistic inquiry

This work provides space for 'ontological reflexivity' (Dieleman, 2008) that involves understanding using lateral

thinking and intuitive methods of exploration within the experience of the work, focusing on a capacity to illustrate constructs rather than absolutes and invite an imaginative conversation with novelty, surprise, and improvisation as a way of reflecting on our cultural reality. Such reflexivity is dependent on a conception of generative art as a way of understanding the world, and as a methodology for exploring, understanding, and building realities. Sociologist Hans Dieleman (2008) makes a case for the unique role of the arts for creating a space of ontological reflexivity. He argues that artistic inquiry engages reality at a foundational or epistemic level, creating dialogue around habits of perception and action. Through sensory experiences, people have the opportunity to examine normative and alternative ways of being. The power of artistic and poetic articulation lays in its capacity as means of inquiry, as a way of knowing and understanding the world. Artistic inquiry provides awareness that reaches beyond conceptual framework, building on the capacity to know the world, which exceeds the capacity to categorize the world. The epistemological dimensions of artistic inquiry have the capacity to present realities as constructed, rather than fixed, in order to invite new cultural dialogues and construct new cultural narratives. The artistic inquiry in Canadian polyphonic culture positions the Order of Passions artwork as a unique conversational space, utilizing the capacity of artistic inquiry to provide an imaginative space of engagement and reflection on the multiple realities embedded in our culture and daily life.

Composition and design process

The form, content and creative process by which The Order of the Passions came about enabled the resulting meaning. In order to fully expose the bases and implications of the work, what follows is a description of our artistic design process.

Video recording

The visual material for The Order of the Passions was recorded at the University of British Columbia's Centre for Culture and Technology at the Okanagan Campus in Kelowna, Canada. Ethnographic interviews were conducted with 24 students, staff, and faculty at the university. The audio-visual recordings formed a database of faces employing an ethnographic film methodology to collect and develop strategies for recording authentic as well as dramatized emotional expressions. The recording processes expanded on techniques developed in previous artwork by Dulic and Newby (2008), where multiple community images were individually collected and brought together in a single installation environment. The recording environment was a black box studio with professional lighting and media recording equipment.

Each session lasted between twenty minutes and half an hour, and was attended by a camera operator, the interviewer and the subject. In each interview the subject was asked to recall and respectively recount moments in their

life when they experienced six basic emotions: anger, disgust, fear, happiness, sadness and surprise. Subjects were also led through visualizations in order to elicit emotional responses that would register in their faces. They were asked to let their responses emerge not only in words but also in their facial expressions. In each session, the camera focused tightly on the subject's face to record the nuances of emotional responses in the highest possible resolution.

It was sometimes difficult to isolate a single emotion because responses would be complex and quickly play across a range of physical reactions. On occasion, subjects would be asked to repeat the description of an experience, in order to fully enter into an emotional state. As many of them were performance students and practitioners, this process resulted in more identifiable emotions that concentrated in their faces rather than body gestures. The ethnographic interview strategies were successful in recording the similarities in how faces register basic emotions despite the variety of experiences that were shared in the interview process.

Frame selection

The automatic facial expression recognition (FER) and processing system, developed by Kadish and Najjaran, enabled the rapid expansion of the database of facial images by eliminating much of the overhead work involved in selecting and aligning interesting frames from the recorded interviews. The system operated in 4 stages: robustly detecting faces in the frames, finding the facial action units shown, discarding repeated combinations of facial actions, and then aligning the remaining images.

Although the camera was trained on the subjects' faces, not every frame contained a full face. In some frames, the face was obstructed by hands, the head was turned out of the plane of the camera, or the subject moved resulting in a portion of the face being cut off. To ensure that each selected frame actually contained a face, two different face detection algorithms were used. First, a face detection system based on Haar wavelets Viola and Jones (2001) was used to identify the bounding box on the face, eyes, nose, and mouth. A bounding box defines rectangular limits on the position of a visual element, so that a bounding box for the face would mean that the entire face was contained within the box. If all of these elements are positively identified, then a second algorithm called FaceTracker Saragih et al. (2011) was run to detect 66 unique points on the face. If the results of the two algorithms overlap — for example, the eyes from the Haar-based algorithm were found to be in the same position as the eyes from the FaceTracker algorithm — the frame was passed to the action unit detection system.

The next step was detecting which action units were present in the image. Action units are the result of an attempt by Ekman and Friesen (1978) to identify the smallest units of facial motion, upon which all expressive facial movement is based. The units are motions such as "cheeks raised" and "lip corner pulled" which together form one of

the “happiness” expressions, according to Ekman and Friesen’s method. The action unit detection technique, based on a technique by Valstar and Pantic (2007), analyzed the position and motion of the points detected by FaceTracker. A second set of video clips, in which expression coding experts had pre-determined which action units were present, were used for comparison. If the position and motion of the points in the frame that we filmed matched the position and motion of points in the expert-labelled frames, our frame was determined to contain those action units.



Figure 4: Two images (left and right) from The Order of the Passions Installation, showing different composite facial expression

This process was successful, but resulted in too many frames for each subject. To reduce the set of images, the list of action units found in the image was checked against the sets of action units that had already been detected for the subject in question. If all of the action units had already been found for that subject in other images, then the frame was removed from the set. Finally, the remaining images were aligned so that the eyes, nose and mouth of each subject appeared in the same place in each image. This was essential for the final projection to appear as a complete face.

Once the images were collected from the automatic processing system they were assessed by hand for their artistic quality and to ensure that they were free of blurring and interlacing effects. The list of action units generated by the FER system was also verified and modified as needed.

Media diffusion and screen production

The Media Diffusion System has been under development since 2004 by Dulic and Newby. The system is an integrated software environment for interactive multi-channel video and audio composition. The Media Diffusion System supports an unlimited number of coordinated discrete screens and sound sources that can be correlated with the machine vision and listening module through A/V capture and analysis. The creative potential of the facial analysis data for representation of emotion in a novel context was explored in The Order of the Passions as follows:

Given an ordered database of photographs of faces categorized by the analysis of action units, an emotion synthesis system was designed in MaxMSP that constructs a mo-

saic representation of a face in a specific emotional state. With the available analysis data it was possible to reconstruct, or re-synthesize, six discrete emotional states: happiness, sadness, surprise, fear, anger and disgust. Happiness, for example, can be described by the presence of two action units, one describing cheek raising, and another describing lip corner pulling. Selecting photo elements from the database based on queries for images with these two action units present — all other action units being neutral — resulted in a composite facial mosaic that presented this emotional state. By selecting the appropriate action unit combinations for the other five emotional states we were able to modulate the emotional state of the mosaic face accordingly.

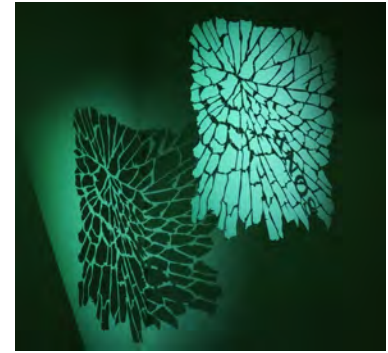


Figure 5: Positioning of screens

Media diffusion system is created in the Max/MSP programming environment and has the ability to communicate and accesses the database of images created with the FER system. As special database object was created for Max to be able to manage image feed crated and tagged by FER and distribute them to 130 screens via projectors that display the image. It determines which emotion or set of action units to display at a given time. Kinect motion sensing input device by Microsoft is used to detect if someone approaches the installation. If the presence is detected the system selects on hybrid emotional expression and reflects it to person in front of the screen. This approach is used to further emphasize the metaphor of a mirror.

A photograph of the shattered mirror image was traced and converted to the vector graphic. The vector graphic image of a broken mirror was used to guide the cutting of the screens out of thin white acrylic material using laser-cutting system. The 130 screens are cut, positioned and connected within a single 2D plain in order to be bale to hang it in a gallery space and apply projection mapping. Then the screens were positioned in a gallery space to create an illusion of the mirror shattering and freeing in the gallery space. The media diffusion system was used to do accurate projection mapping across multiple screens in the gallery space.

Audio recording and diffusion

The audio content of The Order of the Passions takes the form of a layered collage. The audioscape is rendered from a database of statements drawn from a variety of literary and poetic sources all revolving around the metaphor of a broken mirror and cultural plurality. All of the statements share semantic focus on the concept of the mirror in relationship to identity. Each statement was recorded in a variety of languages including English, French, Oneida, Mandarin, Malay, German, Spanish, Serbian and Japanese. It is

important to note that the selection of languages merely represent the community of project participants and their native languages. Each statement is recorded in normal speaking voice and in a whispered articulation. The diffusion and mixing of these statements poetically reflect the changes in emotional state of the mosaic image and modulated according to rules for mixtures of language and articulation. The voices are projected through eight channels of audio diffusion. The sound projectors are shaped and painted as leaves on of aquarelle paper. The paper leafs act as sound projectors created from the speaker-screen system, developed by Alex Stahl and Patricia Clemens. Building on their speaker-screen design during their stay at the Centre for Culture and Technology (CCT) we developed an audio mobile speaker system that uses aquarelle paper to act both as sculpture and as speaker channels.

Canadian cultural dialogues are expressed with these diverse voices, projected across eight audio channels, to signify a forest of linguistically complex environments that together build an image of diversity. Different voices, in different languages recite words about multiplicity of reflections seen in a broken mirror as a metaphor for a holistic understanding of diverse community.



Figure 5: The Order of the Passions Installation: view of audio projectors (leaf shaped speakers) in relationship to screens.

Excerpts form recorded text:

A mirror is being broken, and in each piece different faces are reflected. A shattered mirror cannot be reassembled.

Everybody took a piece of it. They looked at it and thought they had the truth. The truth was a mirror.

It fell and broke into pieces. No longer can you view your image in a single mirror.

We are the mirror, as well as the face in it.

Take a rock and shatter the mirror we reside in.

Conclusion

Cultural plurality is an important framework for living in diverse societies, and our multimedia installation disturbs the notion of cultural preservation embedded in Canadian multiculturalism and moves it towards the unity within cultural plurality by envisioning the face as a dynamic,

expressive entity in which we can each see ourselves and others reflected.

In producing the project, we have developed innovative new tools and methods. The interview process used to collect emotional video recordings was highly experimental and resulted in valuable techniques for eliciting non-posed emotional expressions. The automatic facial expression recognition system combines known methods in a novel way to create a productive human-computer system for identifying artistically viable facial images. The Media Diffusion System builds on past work to introduce a new way of composing with audio-visual data using complex image mark-up to create an integrated moving mediascape. We look forward to the further development of these tools and the project as a whole as we continue to build and expand this work.



Figure 6: Detail of The Order of the Passions sound projectors

Future directions

The next step for this project is to develop mechanisms for collecting user-generated content via Internet and mobile applications to enable composition from a much larger database of community portraits and their emotional expressions. With this addition we would be able to engage a much broader public around the question of cultural pluralism, identity and belonging in Canada and beyond.

A parallel development for this project involves collection of images of non-human animal species and integrating them in this collective portrait. The strategy here is to explore environmental complexity across human and non-human animal relationship and the ultimate importance of biodiversity for human health and well being.

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Dr. Homayoun Najjaran is Director, ACIS Laboratory and Associate Professor, School of Engineering at UBC. His research focuses on the analysis and design of advanced control systems in a variety of applications.

Kenneth Newby is Associate Professor at the University of the Fraser Valley. He is a media artist, composer, performer, educator, interaction designer, and audio producer whose creative practice explores the use of computational media art.