

Thesis Proposal for the Master of Fine Arts Degree

A computer vision system for doing interactive-creative musical installations: A portable computer vision system based on video projection that allows the interaction with the projection itself, with the physical space where it is projected and with multiple users.

By Berio Molina

Abstract

The thesis is about building a computer vision prototype for allowing interaction using a video projection in order to find new ways for playing sounds. The interaction is done between the projection and the physical surface where it is projected, the user and the content of the projection. It is done using the c++ Openframeworks library, a video projector, an infrared light, puredata or max/msp for manipulating sound and some kind of physical interface controller like Laser or wii. The areas that are going to be applied in this thesis are interactive installation, physical computing, GUI, computer vision, creative coding and new interfaces for musical expression.

Problem Statement / Background

Basically, what this thesis is achieving is transforming the video projection into a musical user interface. We are not talking here about the content of the video projection but the projection itself. Usually, the surface where a video, game, animation, interactive work, etc is projected is a solid plane without any kind of significant information. Normally it is a white wall, or a screen specially designed for receiving the light of the projector, but rarely the space where the images are projected is considered as one more elements that could be used with aesthetics purposes. This becomes especially true when we talk about musical interfaces. Therefore, this thesis will be researching about how the content of a video projection will interact with the physical space of the surface or object where this content is projected, and also how users can interact with both space and content projection for making music. In addition, the system must be mobile and able to adapt to different physical spaces fast, giving the idea of an autonomous adaptable system. For instance, imagine that somebody is projecting and interactive animation about several balls moving through the screen. Imagine that this animation is being projected on the facade of a building, and each time any ball hits a window, it change its direction and make sound. Also imagine that people from the street can create more balls just pointing with their hand where they want to create the balls, or that

people can use the windows like buttons. This is basically what this thesis is about, a system for developing interactive musical installations that will deal with the interaction between the projection itself, the physical space where images are projected and the people that is controlling what is projected.

For solving this problem, there will be used the concepts under the computer vision technology using infrared cameras, laser, video projectors and maybe other kind of physical interfaces like the wii remote. The software that will be used for mapping and interpreting the data from the physical space will be a c++ library called Openframeworks that is being developed by Zachary Lieberman and Theodore Watson, and that is being used for several creators for building interactive artistic works and for doing experimental creative code. Moreover, because this library is on its begging phase of development, it will be also an additional goal to contribute to extend its possibilities.

This thesis idea came after combine 3 projects about computer vision and interaction. The first one was the Graffiti research lab project, developed at the eyebeam lab by F.A.T (Free art and technology), and using the Openframeworks library. This project is about doing graffiti in public spaces using a laser and a video projector. The main idea that was interesting for the thesis is how people interact with the projector and what kind of physical interface they use. Moreover it is interesting the software that they use and because it is open, how easy is work with it to push it further.

The second one was the project called Artificial Dummies done by the Italian group called DOMO. This project is about a projection of some animations that interact with facades of buildings. The idea that was taken from this project is the interaction between the projection and the physical space upon which it is projected.

The last one was the project called Funky forest by Theodore Watson, where people interact with a video projection. The idea taken from this project is the interaction between the projection and people.

After doing some research, I found that the Graffiti research lab has done some investigations with the combinations of these interactions (physical space, video projector and people) that they applied in the project called Interactive Architecture. This is the reason I would like to push these ideas further, using this technology for also creating music and for playing not only with architectural spaces but also with other kind of physical surfaces.

Scope

The areas that are going to be applied in this thesis are interactive installation, physical computing, GUI, computer vision, creative coding and new interfaces for musical expression. I am going to deal with tools for doing physical interfaces like using laser for controlling graphics or maybe other kind of remote controls like wii. It will also be important dealing with

GUI concepts in order to design new interfaces for interacting with the physical spaces. The technology for taking data from the physical space is going to be computer vision, using infrared or regular cameras and concrete computer vision techniques like detecting bobs. Because this is going to be a kind of musical interface, it is interactive, uses new technology and force people to play music on a new different way. It can also be consider that this thesis project is also dealing with concepts from NIME (new interfaces for musical expression).

Literature Survey

Books

Making things talk

by Tom Igoe

O'Reilly 2007

This book is about connecting several hardware and software in order to communicate them and share information. The final goal is helping on the technologic development of creative and interactive works. For instance, learning how to communicate two different softwares will help me to convert graphical data to sound data.

Physical computing

by Dan O`Sullivan and Tom Igoe

Thomson Course Technology 2004

This book had a special meaning for the independent artistic community because it put together the Do It Yourself (DIY) way of thinking and the new technology related to hardware. After reading this book a lot of people interested on art, began to develop interactive projects. So, this book talks about building physical interfaces to establish an interaction between machine and human. It was very useful to me in order to gain some basic knowledge about electronics.

Visualizing data

by Ben Fry

O'Reilly 2007

This book is about taking data from some kind of source and how to transform this data into something more readable for the user. This book is very useful for learning how to parse raw data, like for instance xml, csv or tsv files that are standards and everybody use them, in order to create interactive graphics for manage this data. It uses processing language (Ben Fry is one of the guys who is developing processing). It is also a very useful resource for building graphical user interfaces like buttons, maps,

networks, graphs, etc... It will help me to learn how to read data from a source and convert it to something more. Because during the development of my thesis I will be dealing with different ways of visualize the same data, the knowledge I will gain from this book will become essential.

Processing. A programming handbook for visual designers and artists

by Casey Reas and Ben Fry

The MIT Press 2007

This is a manual for the programming language called Processing. It is written by the people who develop the Processing library, Ben Fry and Casey Reas. This book is not only a huge tutorial about how to make computer graphics using code, but also it is a good reference book for learning concepts like movement, distance, time, physics, biology, color,... from the point of view of the math. Moreover, it is a good way for learning the basics of writing code. I have already read this book, and it was very useful to me because with this book I learned how to write code and its basic concepts.

Processing. Creative Coding and Computational Art

by Ira Greenberg

Friends of 2007

This book is very similar to the one written by Casey Reas and Ben Fry, that I referenced before. It is about the processing code and explains how to use it. This book was also useful to me because it allowed me to approach the same topic from a different point of view. This combination of using two similar books for a same purpose was very useful because when I didn't understand what one book said, I had another resource to look for the same information, which gave me a more wide view in some aspects.

Creative Code

by John Maeda

Thames & Hudson 2004

Creative Code is a book written by John Maeda, and it shows works that students did under the MIT Media Lab umbrella. It is a good way to see works where people use technology in a complete innovative and strange way, just because they are trying to see the aesthetic side of the technology. I think that this is the main idea I could see on this book. How technology's aesthetic can expand the creative side of the technology and make us see things from a new point of view. It helped me to expand my conceptions about technology and don't be afraid on thinking out of the box.

Online Documentation

Openframeworks: Documentation

Interactive Architecture

Graffiti Research Lab

October, 2008

http://graffitiresearchlab.com/?page_id=32#video

This project is about doing generative graffiti interacting between a video projection and a physical space. This is the base from where the thesis will be built. This is the only project that I have found that combines the interaction between the projection, the physical space and the user, and because they use open technology, it is easy to implement what they have done and push it further.

Artificial.Dummies: A.I. enhanced graffiti

TODO

October, 2008

<http://www.todo.to.it/projects.php?id=28&>

The aim of this project is extend the idea of graffiti interacting with the physical surface where images are projected. They use kind of artificial intelligence that is just some flocking behaviors that interact with the physical space. This is the project that was the main inspiration for doing this thesis, because when I realized that projections could interact with the surfaces where they were projected, a whole new world appeared in front of my eyes.

Funky forest

Theodore Watson

October, 2008

http://muonics.net/site_docs/work.php?id=41

This is an interactive installation where the walls of a room are completely covered with video projections. Therefore, the people who enter the room interact with the projections, giving the sensation that they are interacting inside a new projected environment. I use this project as a reference on how the video projections can interact with people.

Zach Lieberman and Theodore Watson

September, 2008

<http://www.openframeworks.cc/documentation>

This is the documentation webpage of the Openframeworks library. The Openframeworks library was created to make easier write c++ code for doing

interactive and creative works. This is the library that I am going to use to develop the multitouch system and this is the software that I am going to use for receiving physical data and convert it to a graphical environment. This online documentation of the library is my primary resource that I look when I want to something about the library. It is like the Openframework's help.

Openframeworks: Forum

Openframeworks users

September, 2008

<http://www.openframeworks.cc/forum>

The Openframeworks forum is the way I keep in contact with other people that are using the same technology that I am. It is also very useful for keep myself updated with the new projects that people are developing. Moreover it is an indispensable place where I can ask for help, and also the first place where I will get feedback from my works. Depending on the interaction in the forum and what the other people tell me, my thesis change in several ways.

Touchkit

Nortd

September, 2008

<http://touchkit.nortd.com/>

Touchkit is a project developed by Nortd, a research and development studio from Austria and New York City. Working along with the Eyebeam lab in New York they have done a multitouch kit using the Openframeworks library. This multitouch system is open hardware and software, which means that everybody can make one by them. That is why this project was so interesting for my thesis, because it allowed me to build a multitouch system prototype for experimenting by my own and without spending too much money.

Vimeo

Vimeo users

September, 2008

<http://www.vimeo.com>

The Vimeo webpage is a social site where users can upload and share videos that were created by them. This is the place where I found most of the projects that are related to multitouch, Openframeworks, sound-visualization, Puredata, or interactive art. Moreover, this is the best way I found to track the new projects that people is doing with this technology, thanks to the rss tag syndication. For instance, I am syndicated to these three tags from Vimeo, which allow me to be informed of the new videos that

people have uploaded, and that are related to my thesis project:

<http://www.vimeo.com/tag:openframeworks>

<http://www.vimeo.com/tag:physicalcomputing>

<http://www.vimeo.com/tag:tangibleinteraction>

Project Description / Methodology

The methodology used for doing this thesis will consist basically in dividing the process in two big parts. The first one will be oriented to develop a very basic physical-hardware prototype, and the second one will be focused on building the software that will make things happen.

The first step will be building the physical prototype. For doing that it will be necessary setting up the video projector and the infrared cameras as well as make it interact with the physical space and the user physical controller interface. The resulting data of these interactions must be sent to audio software in order of making sound. Therefore, it will be necessary to write a very basic program for communicating all these parts together and for testing if everything is working fine.

The second step will be developing a more advanced program that could extend the possibilities of interacting with the space and the user. It has to be portable, so it can be adapted rapidly to different spaces, it also has to communicate well with other audio software and it has to have a computer vision implementation. For doing all of this I am going to use the Openframeworks environment, which is a c++ library specially designed for developing creative interactive and experimental projects. Also I am going to use the OSC protocol to communicate Openframeworks with Puredata, because this last one is open audio software that is specially designed for doing interactive and generative sound. For the computer vision part I am going to use the OpenCV addon for Openframeworks that works with the technology of “finding bobs” that is useful for tracking things on an image, like for instance tracking the color from a video.

Because this thesis is based on other open projects that are being developed, it will not be necessary to start the development from the beginning. So basically what I am going to do is continue the work that have been done by other people. That means that I am going to use the code and hardware development done by projects like the Graffiti Research Lab or Theodore Watson as the base starting point.

Limitations

The limitations that can be found while this thesis is developed are related to the controller user interface, the characteristics of the surface where images are projected and

how complex is the sound interaction.

With regard to the user controller, the Graffiti Research Lab has been using a Laser because they just need to track the position of the pointer, but we will also need to take other data from the user interaction, like kind of click events or some more analog information. For that reason maybe it is necessary to develop one more controller or simply add some buttons to the Laser. It will also be necessary the possibility of identify different lasers, so the system can interact with several independent subjects at the same time. One way to solve this problem could be use laser of different colors.

The surface where the images are projected can also be considered a limitation. But for this thesis it will be consider like another aesthetic element, that must affect how the interaction happen.

Another limitation is the sound interaction. There will be not possible doing complex sound compositions because the user interaction will not be so accurate. However, this is not the main purpose of this project, which is more an interactive art installation than a musical tool.

Marketing plan

Because this is an experimental project, once the prototype is finished and showed to the audience, it will be sent to several new media festivals like NIME(New Interfaces for Musical Expression festival), Sonar, Ars electronica, etc... Moreover, because I will use some kind of technology that is beginning to be developed (Openframeworks is still on a pre-release version (0.05)), I know some institutions that could be interested on showing some work built with these tools, like medialab-prado in Spain, Eyebeam in NYC, or MTG-UPF in Spain. Actually they were doing some workshops using these tools, and because no too much people know how to use them, it could be a good change to show these projects on such important places like the ones listed above.

Budget

Video projector	\$ 600.00
Infrared camera	\$ 154.00
Lasers	\$ 50.00
Sound system	\$ 550.00
Total	\$ 1354.00

Software and hardware requirements

- + Macintosh G5.
- + 500 MB free disk space and 128 MB main memo.
- + Openframeworks (free software).
- + Xcode (apple development software).
- + Puredata (free software).
- + Video projector (minimum resolution: 1024 x 768)
- + IR camera (Fire-i Board Camera B/W).
- + 4 laser pointers of different colors
- + A portable table

Target audience

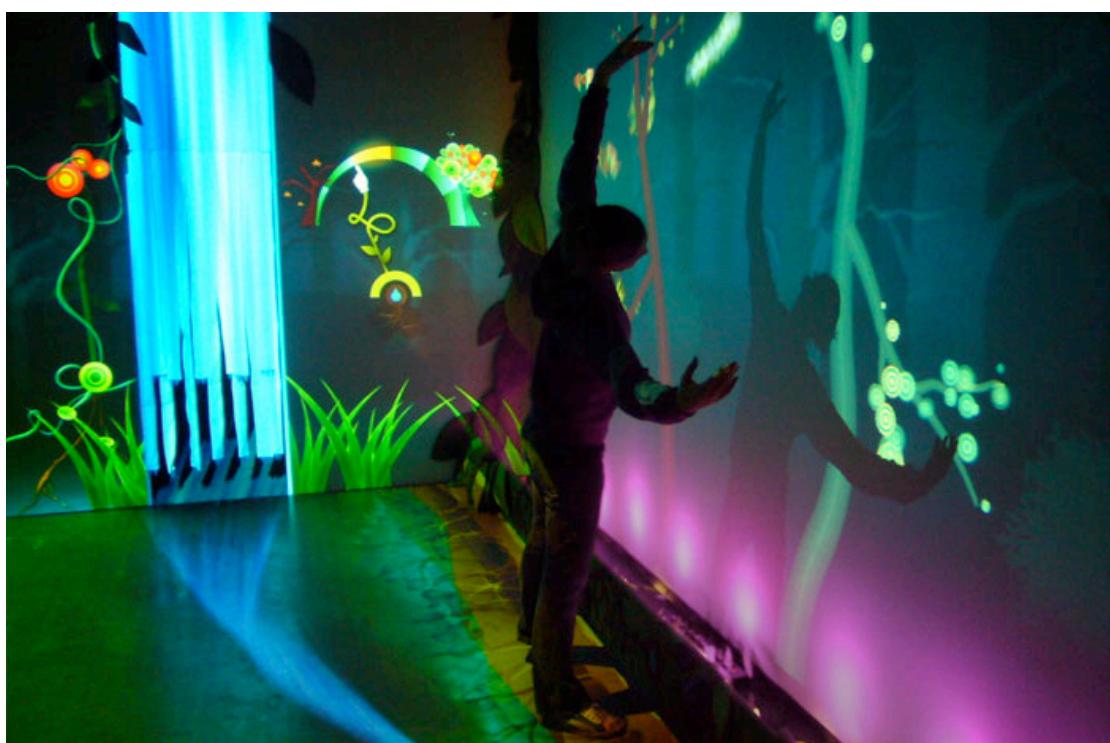
The target audience are musicians, artists, anybody interested in interactive art, multimedia art, performance art, sound art, music and new technologies. Specially, this thesis is related to people who have a special sensibility for free art and culture.

ANNEXES

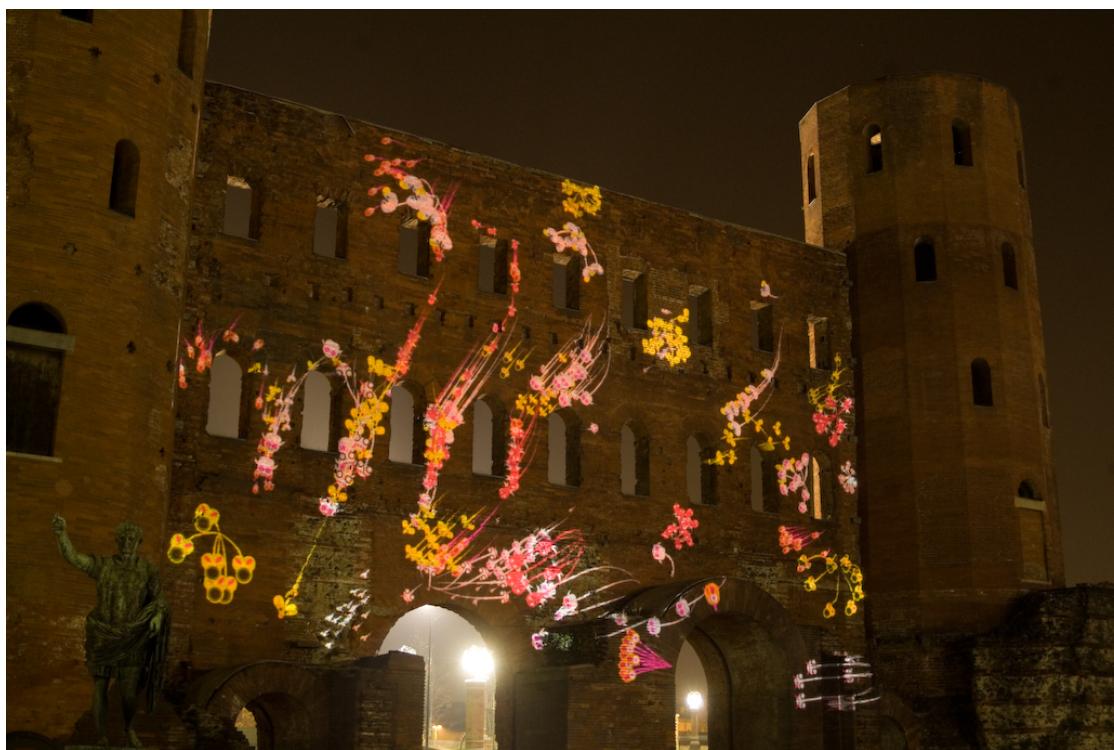
Interactive Architecture by Graffiti Research Group



Funky forest by Theodore Watson



Artificial.Dummies: A.I. enhanced graffiti by TODO



Sketch.

This is a first sketch about what could be done with the thesis. The balls hit the windows and make sound, when they hit the windows, an image appear inside the window, etc...

