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WATERFORD
INSTITUTE OF
TECHNOLOGY

S.A.R.I.
SPATIAL AUGMENTED REALITY INVESTIGATION

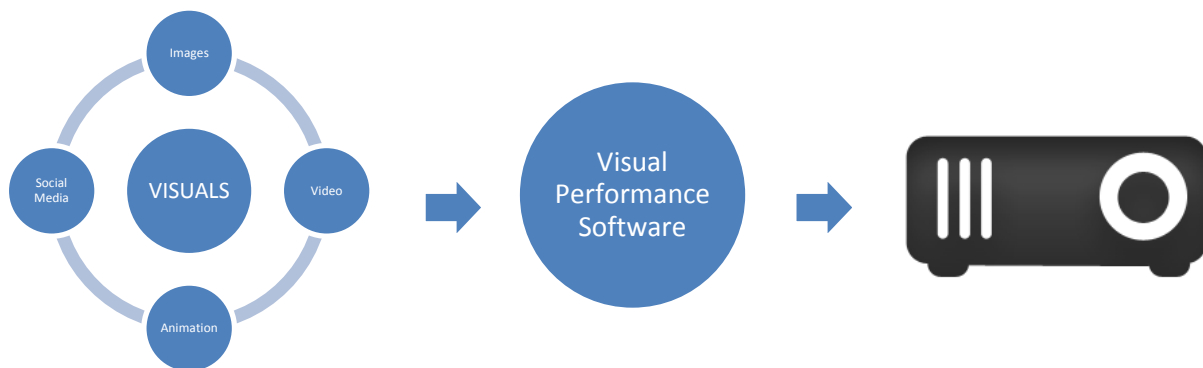
DECLARATION OF AUTHENTICITY

Unless stated otherwise, the work represented by this report is my own. I have not submitted the work represented in this report in any other course of study leading to an academic award.

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ABSTRACT



Spatial augmented reality, also known as projection mapping, is a technology whereby video projectors overlay video and image content onto physical objects. This project is an investigation into projection mapping, exploring all aspects of the technology. Topics under examination include the differences between internal and external projection, how the size and type of the object or surface affects the projected media and the hardware and software required for various scenarios. The project investigates and details projection parameters such as size, distance, lumens and power. The project also investigates content creation tools, graphical programming environments and visual performance software. We use these tools to process social media feeds and to create reactive and generative visuals.

“Generative art is a term given to work which stems from concentrating on the processes involved in producing an artwork, usually (although not strictly) automated by the use of a machine or computer, or by using mathematic or pragmatic instructions to define the rules by which such artworks are executed”, (Ward, 2005).

Jeya’s (2009) examples of generative art (Figure 2, 3) were created using Flash/ActionScript.

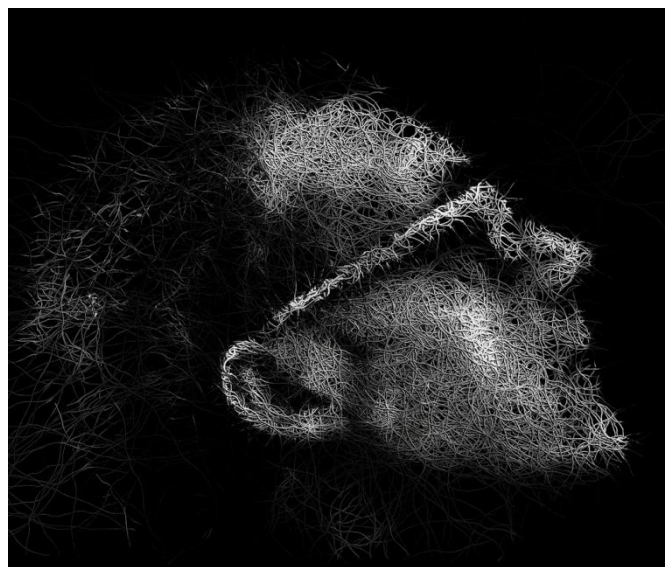
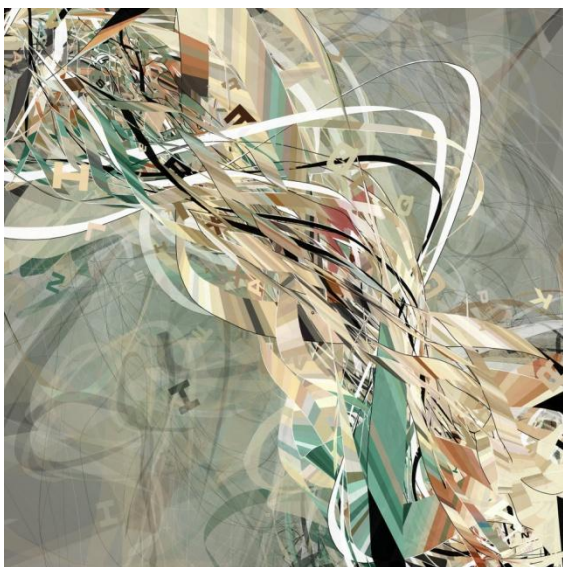


Figure 1, 1: Generative Art

The project looks at the methods and tools for creating generative art, in particular the area of creative coding. **Creating Coding for Live Visuals** (2013) describes creative coding as involving “the creation of high-tech interactive digital artworks by using open-source as well as affordable commercial tools and hardware that was not available before. The creative coding philosophy is also about how to make programming and computer technology more accessible to artists and designers, thus allowing them to create artworks and design prototypes faster, cheaper and with less effort than before”. Products of creative coding include art installations, interactive video and large-scale public projections. It translates the world of computers and code to everyday experience and has an active community of people who write libraries, create tutorials and teach with it (Kirn, 2013).

GOALS

This project analyses the requirements and variables associated with projection mapping technology. The major goals are outlined below:

1. To build an internal projection mapping system onto objects and surfaces of different materials.
2. Utilise social media feeds in a 3D projection mapping performance.
3. Create/program a reactive visualizer to utilise social networks, feeds and audience participation through mobile devices.
4. Experiment with using creative coding to generate live visuals.
5. Build an internal projection mapping installation demonstrating goals 1-4.
6. Create an instruction manual and video for projection mapping.

FEASIBILITY STUDY

The basic feasibility of this project is determined by whether or not I can project media onto a surface. This has been achieved (internal) and I can therefore state that it is feasible.

Further study can be done on the feasibility of external projection mapping.

“The main technical issue with successful outdoor projection is the brightness and contrast of projection needed to overcome ambient light”, (Head, 2012).

Before the problem of ambient light, there is the issue of obtaining the correct hardware for external projection. In his report on the issues associated with outdoor architectural projections carried out at the Illuminate Bath 2012 festival, Head (2012) also offers information on projector types and costs. For external projection the main types of projector used are LCD (Liquid Crystal Display) and DLP (Digital Light Processing). They range from 15,000 lumens to 33,000 lumens and cost between £1,000 and £7,000 a week to rent. For financial reasons it is not possible to hire the necessary projector for outdoor use and so it can be said that external projector is not feasible for this project.

RISK ANALYSIS

REQUIREMENTS RISK

An elementary requirements risk was getting a projector. I have obtained the use of a projector for the duration of the project. With regards to software, there are many open source tools which intend to experiment with and there are commercial tools which have a free version for non-commercial use. Some software tools are platform specific. I have a Windows laptop and an iMac. In a performance situation a laptop is preferable over a desktop machine for portability reasons. If the software required for a demonstration is Mac specific, I would need access to a suitable laptop running the desired software. In order to maximise the time to work on the project, a space/room is required so that the equipment can be set up and remain in place.

SKILLS RISK

Programming

Programming skills are required to use the social media APIs. I have sufficient programming skills to implement the APIs and have experience using the Facebook developer's API and authentication system. Scripting languages such as JavaScript and ActionScript are used in some of the graphic programming environments. Others use programming languages C++ and Java. I have experience using all of the above languages with the exception of C++.

Graphic

The creation of graphic/image content requires a knowledge of both the software to produce it and the formats to export to.

Video

Video recording and editing skills are necessary for the visual documentation of work completed and also for the tutorial.

Creative

This is very much a creative project with an emphasis on generating visual content and interactive media. Creation and editing skills with graphics and video are required to produce quality material.

Writing

Writing and composition skills are required to create the instruction manual on projection mapping.

TECHNOLOGICAL RISK

Some of the experiments planned have an element of technological risk in that I do not know if some of the surfaces are suitable for projection. It is, however, the purpose of the experiments to find out what works, what doesn't work and to discover new methods of

projection. Projection mapping is a relatively new technology and part of this project is to see how it is achieved.

EXPERIMENTS

For the purpose of this project I will refer to the focus of each iteration as an 'experiment'. Each experiment will have an outline, report and a video. The outline will detail the subject matter of the experiment, the materials needed and the steps to be taken to carry it out. Materials can be both software and hardware. The report will contain the results of the experiment, an analysis and a conclusion. The video will show the experiment in progress and provide visual evidence of the work completed.

WATER

Change the surface to water.

GLASS

Change the surface to glass.

AIR

Change the surface to condensed air/fog. Experiment with holography.

QUARTZ COMPOSER

Quartz Composer is a visual development environment. I plan to look at the areas of content creation and visual programming.

TWITTER

The Twitter API allows a developer to access tweets and trending topics. I aim to access live comments and project the text around a 3D object.

YOUTUBE

Use the YouTube API to access a video stream and use it as media.

VIDEO CAMERA

Take in a feed from a video camera and use it as media.

METHODOLOGY

While the primary focus of this project is not on software development, I researched several software development methodologies to determine a project management lifecycle that would suit my needs. In the end, I came up with a hybrid process combining elements from the Prototype methodology and the Agile methodology.

Following the Prototype model (Figure 1), the project will begin with the design and construction of a prototype. This will demonstrate 3D projection mapping onto a simple object using basic graphics/video. The plan for the end of the project is to have explored all

aspects of projection mapping. This will be achieved through compiling and carrying out a series of experiments and revisions to the original prototype. In keeping with the Agile model (Figure 2), each experiment or revision will make up an iteration. Instead of a finished product at the end of each iteration, I will have an altered version of the original prototype.

I chose the Agile methodology because it accommodates for change by allowing decisions to be made during the course of the project. As there is an emphasis on practical work in this project, the Prototype methodology gave me a starting point to work from.

Figure 2: Prototype model

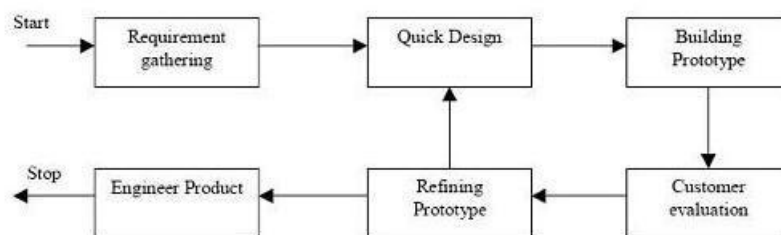
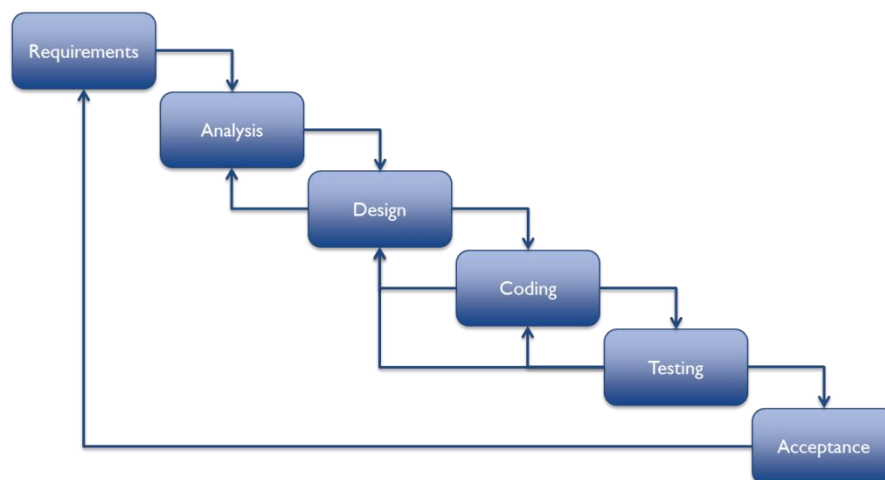


Figure 3: Agile model



USER EXPERIENCE

AUDIENCE DEFINITION

The primary audience for this project is the visualist community (VJ). The project is also of interest to educators with regards to the projection mapping manual.

SCENARIOS

These scenarios or user stories detail the characters' experience of the system. There are two characters in these stories. **John** is the projection designer. **Anna** is an observer/ audience member. **Mick** is the social media aggregator.

John arrives at the venue and gets access to the space. He gets his equipment out of the van: laptop, projector, extension leads, cables/connectors and object. He finds a source of power and sets up his equipment. This involves connecting the laptop to the projector, opening the software and ensuring the projector is angled correctly onto the cube object.

Anna tweets including #LPT2013. Mick the social media aggregator sees Anna's tweet in his feed reader and selects the tweet to be passed on for graphical treatment and incorporation into the projection mapping installation. John receives Anna's twitter profile image and projects it onto the top of the cube object. The text for her tweet scrolls across and around two sides of the cube.

NAMING STRUCTURE

Project Files

<studentNo>_<StudentName>_<module>_<filename>

e.g. 20046704_SarahLoh_P1_report1, 20046704_SarahLoh_P1_abstract, etc.

Iteration Files

<studentNo>_<StudentName>_<module>_<iterationNo>_<filename>

1. 20046704_SarahLoh_P1_iter1_outline
2. 20046704_SarahLoh_P1_iter1_report
3. 20046704_SarahLoh_P1_iter1_video

GLOSSARY

External projection: Projecting media onto a surface out-of-doors.

Internal projection: Projecting media onto a surface inside with little or no sunlight.

Iteration: A single revolution of the project lifecycle. Each iteration has a design document at the beginning and a product at the end.

Mapping tool: A software application for mapping media onto an object.

Media: Video, images, text, and camera feeds for projection.

Object: A 3D item such as a box. An object is a type of surface.

Product: The resulting video and report at the end of each iteration.

Surface: The substance or material that media is projected onto.

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