Cage of Thoughts

A Fontys BeCreative GLOW project

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***Abstract*— In this document there will be described what Cage of Thoughts is. How the design is chosen and what the technical aspects are. Finally the results of the project will be shown.**

Keywords—GLOW; Fontys; BeCreative; Cage of Thoughts; GLOW artinstallation; Eindhoven; Light art;

I. Introduction

Every year the university of Fontys gives students an opportunity with the BeCreative minor to do a project for GLOW. GLOW is a light festival in Eindhoven that has been held for about 15 years. GLOW is a light festival that combines technology and art. The light festival takes place from November 7th until November 14th 2020. Unfortunately, due to COVID-19 GLOW will be held in an alternative way. This is the reason that the project will be placed at GLOW next year. The project team is given the task to create a art installation for GLOW. This years project contains a main device and several filters. The filters are other glow installations scattered around Eindhoven. The filters are connected to the main device, which collects data that is going to be shown on the machine. The team is focusing on the main device. The first goal of the project was for the team to make a decision to undergo either the filter or main device as the minor project for 2020. Once the decision was made, the team was tasked with brainstorming about possible concepts relating the project. One of the main requirements is outlined during the analysis was concerning the further developments of this project in the next upcoming years.

II. Brainstorm & concepts

A. *Brainstorm*

The project team this year has been blessed with the presence of an artist, that set the standards higher in the department of brainstorming and creative design.
The theme is Urban Skin, which the team has deduced and ran though different associations and subthemes. With the help of several mind maps of both "urban" and "skin" have been thoroughly dissected. After that, mood boards have been made regarding the favourite subthemes, research has been done about GLOW and about it's history together with the history of Eindhoven city; where do these two meet up and how The City of Lights got her name and how the GLOW festival found it's home there.There was also the challenge to create a design that is neutral enough to be reused with different themes for future GLOW festivals.

The team first agreed on the outside texture and light effects for the installation before settling on the Brain, which lead to many different construction discussions in regard to making it in layers or building a large frame. Democracy has been instilled to help streamline the brainstorming to efficiently move forward, rather than constantly bringing up past rejected ideas.

B. *Concept creation*

After the team did the brainstorm on various themes, techniques, principles and other information, the team started making concrete concepts. These concepts are a result from several brainstorm sessions. For example: the history of Eindhoven. The team came with the idea of the light match factory. Other examples are: glow in the dark or optical illusions. The requirements that were written down, were taken into account when coming up with the concepts. There were many different concepts and each with their own message, techniques and shapes. In the end, there was a meeting with Tom from the GLOW management to come to the two favourite concepts. The two favourite concepts are a brain or a large construction. The preference was for the brain so the team decided to go for the brain concept. This was mainly because of the story: Brainport Eindhoven, central machine and the recognizable form. The team started thinking about the construction and came up with: 2D layered stacking to make a 3D shape and a 3D wire frame as base with different infills. Each construction has its own advantages and disadvantages. Based on the previous ideas and points, the team made a choice and created a construction.

III. DETAILED DESIGN

A. Chosen concept

The final design is a brain built from a 3D wire frame as a base. The brain is covered with an opaque material as its skin. Different effects are placed on the inside of the brain and illustrated and projected on the outside (Figure 1: Chosen conceptFigure 1). This construction is appealing to the team because you can take a closer look on the inside. This first designed was further developed together with Tom from GLOW and Peter Torpey from MIT Boston, Frank from Summa college and Marcel from Vanderlande. This installation has to be transportable and used in other light festivals.

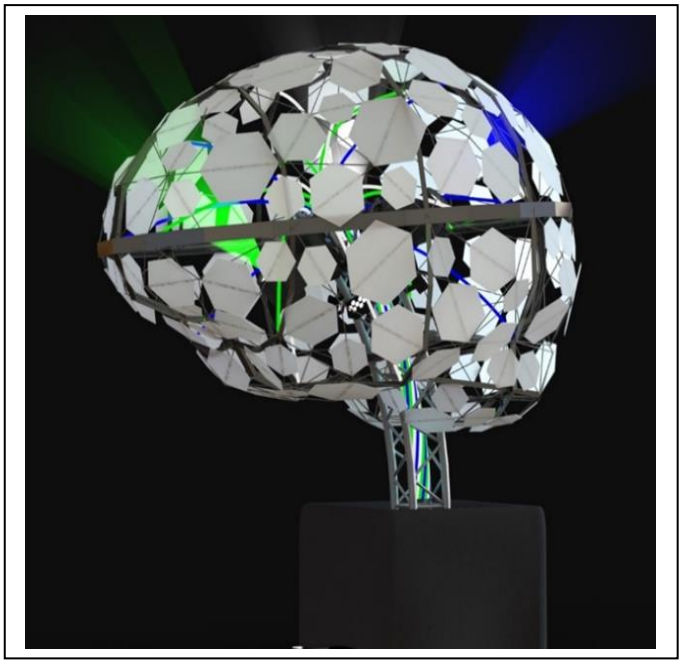

Figure 1: Chosen concept

B. Construction Design

The research involved in this project will be focused on three metals and a plastic, which will be combined to create the outer section of the design.

Angled iron is formed into a 90-degree, it is designed to be extremely stable and capable to handle amounts of pressure and load. It is easy to work with, in respect of welding or bolted pieces to create even more stability. Making its an ideal material for this project due to its availability and affordability. The required dimensions are 40x40x5 mm with an average weight of 3.00 KG/MTR.

The sub frame is structured out of two possible metals respectively to their placement and role within the sub frame. The first to be discussed is the Tee section, this metal is used as a vertical foundation structure involved in the curvature of the design. The Tee section is constructed out of carbon steel. The second material used for the sub-frame is the round steel. Those straight, round pieces will be used as a connection surface for fixing the hexagons to the outer section of the machine. Thus, the aim is to keep then as straight as possible. Therefore, the curvature will be constructed out of the angled iron and Tee section steel.

The plastic that will be used in the final device need to meet the following requirements: Transparency, Weather conditions, Heat resistance, Scratch resistance, Outdoors/indoors, Transmission.

The ideal plastic for the outcome is named Polycarbonate. The thickness of this material will be 3mm, this mean that the material is able to handle some external forces but still being able to transmit the desired light effect through the material.

The frame is constructed out of four pieces, starting around the centre of the front viewpoint. The parts are divided through a + shape making each part able to connect to others, through jointing the pieces in both the horizontal and vertical axis. Thus, improving the frame in both stability and countering the load acting on the structure. The advantage that angled iron gives us will play a major part in this stage of the construction, by placing the back of the 90-degree angles together. The two pieces can be bolt together yet keeping the bolts well-hidden on the inside on both the horizontal and vertical axis. As mentioned above the Tee section will take on the role of creating the curvature between the horizontal and vertical axis of angled iron. Therefore, the round steel can be kept straight. Thus, keeping the ability of the connection between the metals and plastic. The metals will be welded together, this means all the metals will be placed within one of the four section of the outer portion of the design.

Those fixed parts will be easily assembled and thus creating an overall section of the device without the need for extra/smaller components, therefore eliminating some of the onsite assembly time. Not to mention that all connection will be standard meaning that the people assembling the device can use any bolt for the connections around the frame.

C. Effects design

The team wanted to create a very flexible and dynamic lighting arrangement in the brain, to light up the plastic hexagons, the inside in general, and visualize the data coming in. After some research, the team ended up with moving heads, wash-lights and LED-strips. The moving head is a lamp with multiple rotational axis. This head can be moved using the pan and tilt direction of rotation. As a result, the moving head can reach a large area of the outer skin and the position where the light appears, the color and the projection-form are able to change. Wash-lights are the most suitable lamps to illuminate the general inside of the brain. The team ended up with LED Wash lamps for this general illumination feature. These lamps illuminate a large area at once. The wash lamps are commonly used lamps to illuminate facades and rooms, for example.

The third part of the light effects consist of sixteen neon LED-strips. These strips will represent the connections to the different parts of the brain. In six groups of three, each group will have the same data and thus the same effect. The dataflow from the filters to the brain could be represented with a neon LED-strip as well, but then the filter needs to be located near

the machine. The neon LED-strips are entering the brain from the bottom of the stem going upwards. At the center of the brain the neon strips will spread-out and connect individually to the outer frame of the brain. The LED-strips are covered and diffused by a non-transparent silicone sleeve. These sleeves will make the LED-strips waterproof.

The moving heads and wash-lights will be controlled by a DMX-controller. DMX is a standard for digital communication networks that are commonly used to control stage lighting and effects. It was originally intended as a standardized method for controlling light dimmers, which, prior to DMX, had employed various incompatible proprietary protocols. It soon became the primary method for linking controllers (such as a lighting console) to dimmers and special effects devices such as fog machines and intelligent lights. The DMX-controller will be controlled by a Raspberry Pi through a python script. This python script also sends out serial data to the LED-strip controller. This controller is a TeensyV3.2 with an OctoWS2811-shield. This shield provides the data connection to the actual LED-strips through an ethernet-cable. The Teensy will be programmed through the Arduino IDE. The LED-strip effects and the serial read functions are located on the Teensy. The moving head and wash-lights are powered by mains. The LED-strips are powered by a 12V power-supply.

D. Data connection

For the controller it was needed to choose one that was compatible with the different light systems and could easily connect to an IoT network. There was already some experience with the Raspberry Pi from one of our team members. The Raspberry Pi uses Python and is very easy to use for multipurpose implementations. Price is also a big factor because of sponsoring and the RPi was therefore the best contender in comparison to comparable boards.

The purpose of the data connection is to send over the data from the filters to the machine. The machine will be the brain because it will show the information that came from the filters using light effects and/or sound effects. In another BeCreative project, the Vena Lumen made a bench which is a filter in the overall system. For this data connection there is chosen for an extern MQTT broker. The use for this project is very basic so the broker needs to be basic as well. After the research, the choice for the broker is Mosquitto.org. Mosquitto is very applicable for this project. The biggest benefit is that it is free to use. Another benefit is that it is easy compatible with the Raspberry Pi. It uses the paho-mqtt library which can be downloaded in the python terminal. both the Raspberry Pi of the filter and the machine are connected to the internet.

It makes use of a Pub/Sub pattern. This is a pattern where senders of messages, called publishers, do not program the messages to be sent directly to specific receivers, called subscribers, but instead categorize published messages into classes without knowledge of which subscribers, if any, there may be. Similarly, subscribers' express interest in one or more classes and only receive messages that are of interest, without knowledge of which publishers, if any, there are. In case of this project that information that is send over is the heartbeat of the bench. The brain is the machine so it will be the only subscriber of the topics the filters will generate.

IV. Results

The team managed to realize a couple goals. The biggest result is the complete design of the Art installation. A lot of brainstorming and concepts have went by before the team had a clear idea of what the final design would look like. After more research had been done for specific parts of the design like the mechanical construction and the light effects, a detailed 3D model had been created to visualize the design. Besides the design the team also created a prototype for the art installation.

This prototype consists of two parts: the mechanical part and the electronic part. For the mechanical part, it was decided to make one fourth of the design. The metals for the part have been cut to length and welded together. Due to time limits the metal frame is not finished and put together. For the electronic part (Figure 2) there is worked on a show. For the show one third of the total amount lights is being used. The lights consist of 6 LED strips, 3 LED washes and 1 moving-head. With these lights a test setup is made. After testing each light individually, a time code show with music has been made with all the effects.

Figure 2: Electronic prototype