Ray: Utilizing Museum Visitor Data to Add Surprise to the User Experience

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Abstract

This paper describes a M1.1 design project executed for the Eindhoven Museum. The project tries to capture the clients vision, which is focused on creating a better future by sharing insights from the past, within its design concept. As trends see a rise in museums adopting digital technologies, the proposed concept is manifested as a digital installation. The installation called Ray, provides users with a personalised profile based on their data gathered during the visit. By giving an analysis of personal non-intrusive data back to the visitors, they can learn and be surprised by what data can do.

Authors Keywords

Data enabled design; Interaction Design; Eindhoven Museum; Conversational User Interface

1. Introduction

Eindhoven Museum (EM) is driven by its mission to foster foundations for a better future by sharing the rich insights gained from the historic development of Eindhoven's identity. While EM owns close to 23.000 physical artifacts [2], the museum currently does not have a permanent space to exhibit these items. Instead, it is actively exploring models that allow for a 'pop-up' style museum exhibitions.

With the ever-increasing complexity of technology, visitors have come to demand more from museums [3]. As such, EM is looking into strategies to better serve their visitors in this regard, including in-the-moment visitor data analysis, a more prominent social media presence and highly interactive installations. The result is the concept of Museum In The City: an exhibition style that uses dynamic themes to highlight relatable parts of history, e.g. food and mobility. Installations for these exhibitions are designed to generate insightful data to be used at the closing event. Here, the data is used to provide food for thought on society's views on the exhibition's overarching theme. Especially this element serves as an inspiration to this work.

In this report we describe the iterative design process of creating an interactive installation which aids EM's pursuit of innovation in the context of museums. First, we review

developments on the intersection of museums and technology. Then, we elaborate on the process that guided the design decisions, and introduce the resulting design. Finally, we evaluate the design in-context and discuss the implications for future work.

2. Related Work

While developments in technology offer museums new opportunities, they also create an obligation to adhere to the shifting expectations [5]. Trends seen in the context of museums include a rise in adoption of (digital) technologies, data analytics in museum curation and creating participatory visitor experiences [6]. Moussouri and Roussos argue that mobile sensing and big data can play an important role in audience research by museums [9]. Analytics made possible by data collection can be used to guide the curation of museums. With Constructivist Analytics, Berland poses a framework for employing advanced data analytics in order to cause beneficial social change in museums [1].

Data is not only being used for making informed decisions, it is also used to enhance the visitor's user experience. Yoshimura et al. see a future in using visitor cellphone's bluetooth data beyond analysis: they utilise it for real-time orchestration of visitors to prevent overcrowding [12]. Guided audio tours in the museum dynamically guide visitors towards less crowded areas.

Additionally, Petrelli et al. capture museum visitor's journeys to generate an individual 'data souvenir' [10]. The souvenir is a physical postcard printed at the end of the exhibition (See Figure 1). The researchers highlight its potential for similar mechanics to be used as a means for museums to collect visitor-generated content.

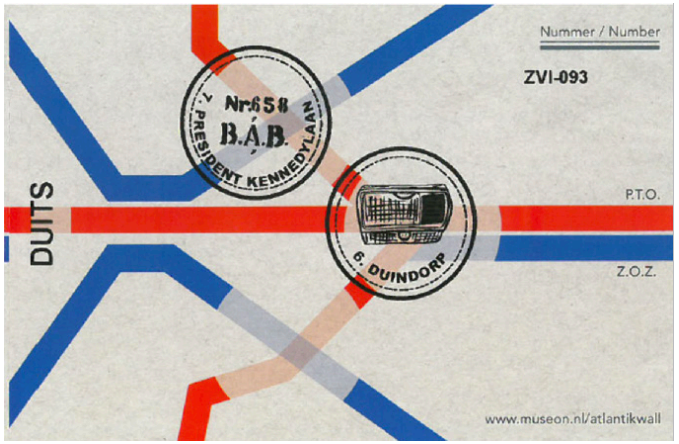

Figure 1: *One of the postcard souvenirs, dynamically generated based on a visitor's journey. Taken from [10]. Copyright 2016 by Petrelli, Marshall, O'Brien, McEntaggart and Gwilt.*

In conclusion, sensors and data are regarded to have a significant impact on the museum of the future. Sensors and data have traditionally allowed for more informed curation of exhibitions. More recently, data science technologies are being implemented to enhance and personalize the museum user experience on an individual level.

3. Design Process

Design Requirements

EM have a strong vision to showcase the past, present and future of Eindhoven in order to create a more considerate and tolerant society [2]. This implies that they need to design their exhibitions in a way that engages their visitors. In their design brief, EM wish for an installation that helps them in connecting past-, present- and future developments in the Eindhoven region.

An important consideration within the design space is the fact that EM have no permanent exhibition space: the designed installation needs to be flexible- and adaptable in terms of size- and content. Additionally, the museum's staff has not been trained in (information) technology — the system needs to be designed to provide them with a certain ease of use.

Finally, EM wishes for the system to be something beyond a novel user experience. EM are interested in a system that is able to provide them with rich insights: a system that can make suggestive predictions to have a short- and long-term impact.

Ideation

The design process started with a foundation of (user) research. To empathize better with the design context and the envisioned user groups, the research team conducted field research at museums. The field research consisted of observations as well as interviews with museum staff members, including Philips museum's curator, Sergio Derks. An elaborate overview of the research is included in Appendix B. The research provided us with useful insights about the importance of personal meaning, creating emotions with the exhibition items and strategies to increase the engagement level among visitors.

Additionally, an interview was held with Joep van de Ven, designer of 'Back To The Future' [8], a previous project conducted within the Design for Creatives squad. This allowed us to learn about the intricacies in designing to support EM's vision. Overall, we concluded that the visitor's user experience can be substantially increased in perceived value and enjoyableness by establishing a strong connection between the museum's objects and its visitors.

The concept generation process was kick-started with Google's Crazy 8's technique [4]: a wide range of concepts were generated within a short period of time. Within these concepts, four themes arose: data visualisation- and gathering, museum crowdsourcing, customized museum experience and bridging the physical and digital. From these, three distinct concepts were selected. They are briefly described here, more can be found in Appendix D.

'Personal Stickers' (Figure 2) is based on unobtrusive data gathering. Visitors can pick up decorative stickers based on statements they relate with. The stickers can be used to personalize the information that is displayed alongside historic artifacts to better suit the visitor. This concept generates insights on the audience for EM, while also stimulating social interaction between like-minded visitors.

Figure 2: *Physical model of concept 'Personal Stickers'.*

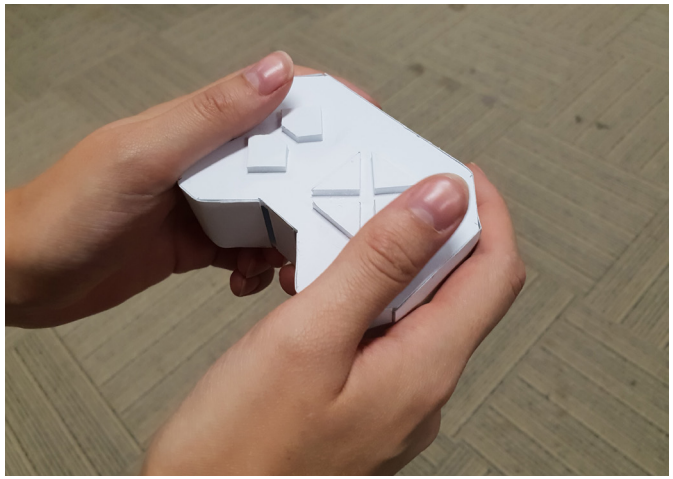

Figure 3: *Physical model of concept 'Individual Connection'.*

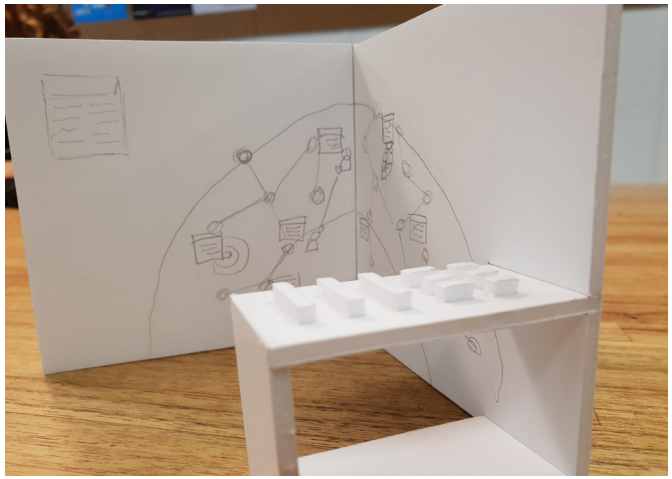

Figure 4: *Physical model of concept 'Interactive Data'.*

'Individual Connection' (Figure 3) is based on creating 'richer' interactions with exhibition items. Tokens resembling game controllers can be used mimic movements related to historic artifacts, engaging visitors motor skills. The tokens can be adaptive, allowing them to be used to participate in quiz-like games. This concept generates data on the popularity of exhibition items, and also on how well the audience knows the history of eindhoven.

'Interactive Data' (Figure 4) is based on gathering- and showcasing visitor data within the theme of the exhibitions. A variety of interfaces allows visitors to answer questions posted by EM staff. A projector showcases a dynamic data visualisation of the answers compared with historical data, available for all visitors to see.

Customer Journey Mapping [7] was used to analyse the users' needs and emotions throughout the proposed concepts. For each concept, touch points were mapped across the different stages of the journey. Through this journey mapping study we found key design principles that were present in all concepts: 'engaging visitors with a better interaction', and 'potential of multisensory interactions'. To meet these principles, a hybrid concept based on 'Personal Stickers' and 'Individual Connection' was chosen as a first full concept iteration.

Early Prototype

For our first concept iteration we designed a modular quiz-style game system that discloses EM's knowledge in a playful, interactive way (See Figure 5 on the next page). Visitors of the exhibitions can use multiple stations to test their knowledge, and compete in teams. The system is modular to provide flexibility and portability: school visits can include two to three installations while longer expositions can include multitudes of that.

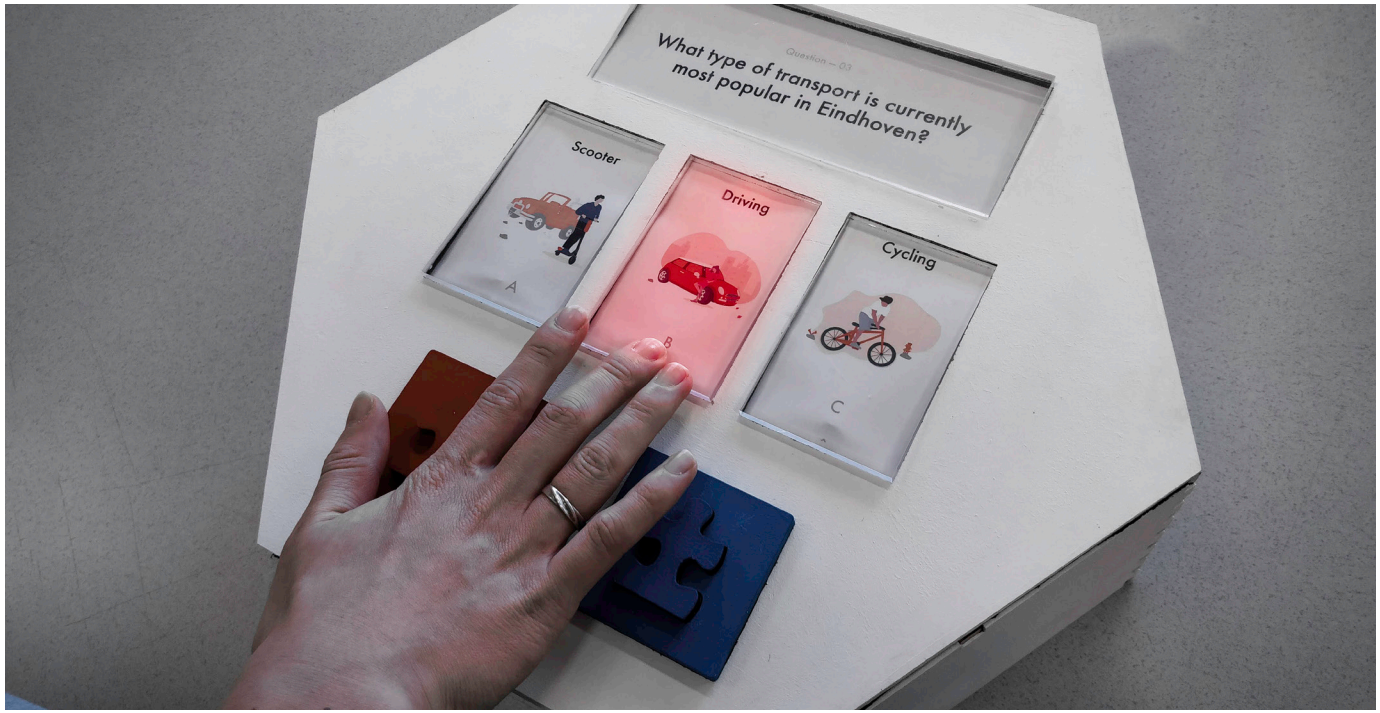

Figure 5: *One of the modular quiz-game system prototypes. In this photograph, the visitor is answering a question by pressing the button. However, they answered wrong — luminous feedback communicate this game state.*

The prototype has a hexagonal shape, allowing multiple displays to be chained together. The system allows EM staff to create their own quizzes using the supplied digital assets. The prototypes were designed inspired by the honeypot effect as studied by [11]. They explore the common social effect that attracts people to an item, simply because other people are standing in its vicinity.

Visitors can pick up a token which assigns them to a team. They use the token to unlock an interaction at one of the installations. A question related to mobility is presented alongside three answers that can be pressed. Embedded lights provide functional feedback: a red glow indicates a wrong answer and a green glow indicates a correct answer. Right- and wrong answers affect the team score, displayed centrally.

The tokens can be handed in at the end of the game. The final stand has a speculative question about the future: visitors can share their opinions by putting their tokens back on the answer stack they relate to, or create a new answer.

This concept was presented at the mid-term demo day. When

reflecting on this first design iteration, we realised that the prototype lacked in attraction. Some of the visitors found it hard to see the value of the system, and it was lacking a surprising unveiling of the collected data.

Guided by mentor advice, we put the development of the quiz-game concept on hold, and took the key insights from the prototype to a next iteration.

Ray – Final Concept

The element of surprise that was lacking in the previous concept guided the adjustment of the design vision. After consulting our mentor, we found that we could create value for EM and their visitors by focusing on data integration and visualisation. Previous installations showcased in Museum In The City exhibitions have had the ability to capture various types of visitor data. However, the museum had limited means to create value from the collected data, both in curating exhibitions and in the design of installations.

We perceived the latend need for a system that creates value from data collected by other installations. Data produced by other distributed installations are captured in a central database, where it is processed. This creates two main opportunities, the data can:

> *Be used to create user profiles of visitors that can be revealed at the end of the exhibition;*
>
> *Help the EM board with the decision-making in the curation of exhibitions.*

The user profiles composed of data generated during their visit is divided in three categories: *Personality*, *Physicality* and *Culture*. As a visitor progresses through the exhibition, the system learns more about them within these categories.

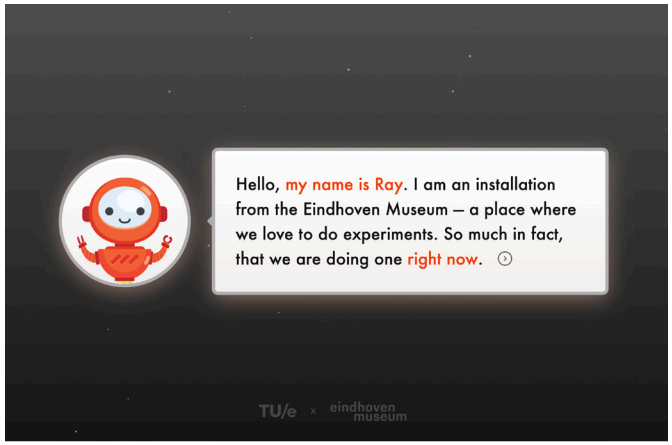

Figure 6: *A first look at the 'Ray' conversational user interface. In this still, Ray introduces himself to the visitor.*

Ideally, a fully correct user profile is generated once they are close to the end of their visit. There, they are able to get insights in what the system has learned about them.

The installation (Figure 6) that is to be placed near the exit of an exhibition is a screen that contains a robot character: Ray. Ray is part of a conversational user interface (CUI), and is a digital manifestation of the artificial intelligence that powers the system. Through a playful, interactive dialogue, Ray shares what he knows about the visitor. For example, he could have learned that the visitor is an American female in the age range of 25-30. Ray discusses what he knows, and shows data visualisations in animated forms to add substance to his claims.

4. Implementation

In order to integrate the collected data into our system and

produce convincible personal analysis, we needed a good collaboration with the other exhibiting designers. We have held multiple meetings with other design groups of the upcoming Museum In The City exposition. In these, we explored how we can make sense of the collected data to create a playful and dynamic conversation.

Based on the other design groups' envisioned installations, it made the most sense to evaluate visitors in the three aforementioned categories: *personality*, *physicality* and *culture*. However, for future themes a different split can be made.

In optimal conditions, data generated by the installations is easily communicated to a central database (Figure 7), and personal identification of data is no problem. However, due to technical limitations a physical token was introduced to store data across devices. This token, realised by the Pre-Master design team, can be scanned at installations to store data.

When the token is scanned at our installation, we have access to the data. All data that enters our installation is stored as a JavaScript object using the JavaScript Object Notation (JSON) format. This format means the data is easily stored, and can be accessed- and edited at any time.

One Museum In The City installation envisioned by a fellow design team is the 'Bike To The Future' Installation. In this installation, visitors take part in a biking race, taking on the challenge to finish as fast as possible. Within their journey, they are shown imagery of Eindhoven in the past, present and future. Data generated during this installation includes time series data on cycling speed and heart rate. Additionally, data such as the person's weight and the time to finish can be recorded. When the finish is reached, a photo is taken of the visitors. All these data points are highly valuable for our installation: they can be used deduce gender, fitness level, ethnicity and age.

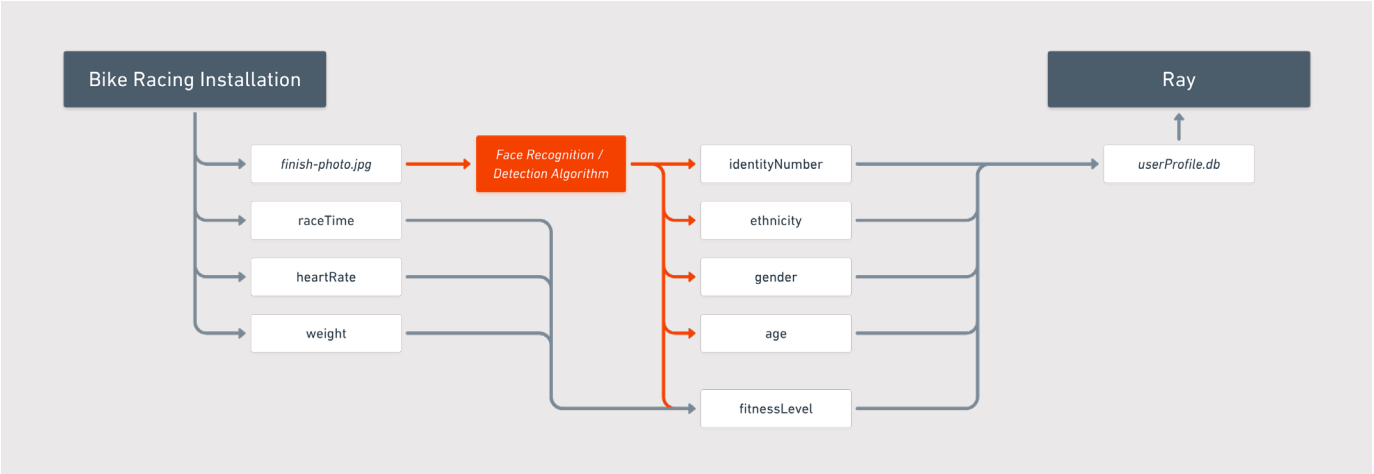

Figure 7: *Flowchart of the imagined data streams from an external installation.*

Figure 8: *Final Demo Day impression.*

Similarly, in the 'Cube / World Map' installation, from our other fellow students B2 group, valuable data is generated on the whereabouts of EM's visitors. In their installation, visitors are invited to draw their journey to Eindhoven, on a regional, national and international scale. By parsing photographs of the journeys drawn using a general computer vision feature detection algorithm, a rich list of countries of origin can be deduced. These can be shared with Ray's database to shed a light on EM visitors' Culture.

All the personal analysis information will be visualized and presented on the screen in this last stage of experience. This serves to provide a full image of a visitor's personal analysis and additional barcode allowing the visitors to take their personal profile home on their phones. It could be used as a memento for the visitors.

5. Evaluation

Final Demo Day Setup

Ray was exhibited alongside other student projects on the Final Demo Day at the University of Technology Eindhoven (See Figure 8 on the previous page). All design groups participated in building the visitors route to simulate a pop-up exhibition style and mimic a museum environment. This was done to create a moderately realistic museum experience.

The journey starts with the tokens that were designed by the premaster group. The token is used for activating different installations and collecting data from them. After visitors have completed their journey, they are invited to come interact with our installation. Our final setup contains two parts, an announcing poster at the entrance of the visiting route, aimed to attract visitors attention. The main part of installation is placed at the end of the journey, where visitors could get their personalised analysis based on the data they generated at other installations that they have used.

Client and Mentor Feedback

The CUI approach of our installation offers visitors a certain guideline when experiencing the installation. This was proven to be a clear and directive way to keep visitors engaged, so they would participate in the entire experience. The experience of our installation, whether the predictions were correct or incorrect, received positive reactions, especially the results of Ray's predictions inspired discussions amongst the visitors.

The final installation was to be a showcase of different user profiles rather than an actual interactive installation. It would be more engaging in the future to implement different types of interaction to increase the level of enjoyment and engagement for the visitor.

On the other hand, the final design can also be considered as a good example of combining the academic principles of tangible design with an intelligent system. However, some visitors still perceived the experience to be a bit conceptual and were concerned with the difficulties for further development for both museum staff and different age groups.

6. Discussion

Observations

During the project we discovered that when creating a museum experience with an interactive installation, the main focus should lay on how the information is received rather than how it is delivered. In the first concept, the main focus was put on offering visitors rich physical interactions and

delivering knowledge about EM's historical background related to mobility. However, it was perceived to be too unclear for the users to follow the interactions, because the interaction was not attractive and engaging enough. Additionally they were being observed, which resulted in limited patience from them to read through all the text.

When working on the final concept, we were confronted with some issues in realisation. Considering our prototype needed steady data input from other installations, but most installations were only a mockup of the real concept, they did not generate or store real data. Furthermore, on the Final Demo Day, we presented a setup that provided visitors the opportunity to leave feedback by means of post-its. However, it would be more effective to change this feedback into a digital interaction. This would be more in line with the overall aesthetic of interaction. This interaction could be used as a means to check whether the predictions made by the system are valid. This input can be used to further train an embedded machine learning algorithm.

Future Steps

As shown in the discussion, there are ways in which the prototype can be improved. One of the key opportunities is to re-design the interaction. As discussed, this was one of the main concerns for the visitors. Instead of only engaging the visitor's cognitive skills, their motor skills can be engaged by the use of tangible interactions including gesture detection, physical movement and emotion detection.

Additional functionalities like a camera can be implemented in order to more accurately track the movements of the visitors. Metadata can be logged, such as the duration of the experience, favourite installations and overall behaviour. Additionally, more sophisticated facial recognition tools such as the Kairos API can be used to analyse the gender, age and emotions of the visitors.

Something else to keep in mind is the security of the stored data. For this demonstrator, this was not a priority. However, organisations such as EM are bound by strict laws on data protection.

Finally, an interesting opportunity is the implementation of a chatbot intelligence. In its current state, the branching dialogue is personalized, however it always follows the same stages. We believe a truly interesting experience can take place once the conversations are more dynamic: visitors would really be stunned by the potential of integrating high technology in museums.

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Design for Creatives

Personal Reflection

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Contribution

Here I would like to reflect on my contributions within the project. I have performed different roles and took tasks on different responsibilities. In the early stage of this project, my responsibilities involved exploration of background research, conducting user studies and concept ideation. Through the entire project, I also performed actively in designing & building prototypes and creatings visual contents for the final installations.

Reflection

Through the entire project, I believe that my academic skills including research skills, presentation skills and teamwork skills were developed. Especially on the research skills, this will certainly help me in the future to choose appropriate methods and technologies for my B1.2 research project. As for the presentation skills, it was a bit difficult for me especially when I needed to make a pitch presentation. In order to improve this part, I tried to perform actively when preparing and giving presentation or pitch to my fellow students. Special thanks to Penny Qiong for her insightful guidances on preparing a pitch and supports after the midterm.

I enjoyed a lot working in this project and have learned a lot from each other. I clearly recognize my role characteristics and learn to develop my strength in the team. What I learned most working in team is to have a positive working spirit, this was crucial in fulfilling and achieving goals faster and better in a team project. We have received negative feedbacks from the midterm demo and needed to change almost entire concept within a limited timeframe. It was very stressful for us to continue the project. however, we have quickly adopted the situation and worked intensively to evaluate our concept. As results, we achieved to complete the installation with certain quality.

Here I would reflect on the expertise areas that were developed during the project.

User & Sociality

In the earlier stage of teamworks, I invested time on developing analysis skills on user study and background research. Several museum visitings and interviews were performed together with my teammates. After that I also spent time on conducting insights and user analysis for the ideations of the concept. Customer journey mapping were used in this project during the ideation phase. This technique was proven to be an effective tool when address user's needs and emotions in different stage of the experience. Extra attention was given to the implementation of gamification into our concept in this stage, I did several theoretical research and generate useful insights.

Technology & Realization

I also invested time on learning several 3D programs such as Solidworks and Rhino. I have some experience with 3D modelling programs like Maya and 3DS MAX, however, these programs are made for producing architectural visualization or animation, not for fabrications. The workflows are different as I expected, especially working in Solidworks, this program has a procedural workflow that requires a modeller well-consider the exact dimensions and scale. As results, I am able to make high quality models which meet the requirements of the industrial standards.

Creativity & Aesthetics

Graphics skills were also developed during the project, I produced all the video animations for the final design. I have learned some advanced level of video compositing techniques that allows me to quickly adjust the design and structures of the animation. I followed the stylesheet that Arthur made in order to produce all the animations which fit to the brand identity of EM.

Conclusion

This entire project help me to formalized sequences of performing a design & research project. It also raise the awareness of using appropriate methods and planning can contribute to a research project, I have learned a lot from this project, not only the academic skills of being a master student, but also gain practical experience to quickly apply these skills to future research project.