Report

Title Partcitypate

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Acknowledgement

Glossary

Abbreviation	Description
EPS	European Project Semester
ISEP	Instituto Superior de Engenharia do Porto
ICT	Information and communication technology

1. Introduction

1.1 Presentation and Motivation

The European Project Semester **[European Project Semester, 2022]** offers students with engineering or other backgrounds the opportunity to carry out a project in a multidisciplinary team at a partner university under scientific supervision within one semester. The following project was realized at the "Instituto Superior de Engenharia do Porto" **[Instituto Superior de Engenharia do Porto, 2022]** by the students Carla Gomes Cardani, Carmen Couzyn, Eliott Degouilles, Julia Aleksandra Engst, and Jan Michael Benner.

Each student has their motivations for participating in the project semester:

- **Carla Gomes Cardani:***"When I was presented with EPS, I knew that I should live this experience. The possibility to meet people from different cultures and study areas is fascinating and could lead to remarkable experiences. I am very excited to explore each member's features and learn from them as a group."*
- **Carmen Couzyn:***"What made me choose the EPS was the opportunity to collaborate with students from other areas of engineering and from different cultural backgrounds."*
- **Eliott Degouilles:***"For me, this EPS is a unique opportunity to work on a multicultural and multidisciplinary team. After studying mechanical engineering for 4 years, I hope to be able to provide my knowledge to this team."*
- **Julia Aleksandra Engst:***"I see the EPS program as an ideal opportunity to get out of my fixed education schedule. Furthermore, I enjoy being pulled out of my comfort zone and being put in an environment where I am obligated to be independent and self-sufficient and at the same time get the chance to learn from others."*
- **Jan Michael Benner:***"By working in a multidisciplinary, multicultural, and multilingual project team in an unfamiliar subject area, I hope to broaden my horizon. The recognition and use of different backgrounds and talents is an interesting challenge."*

To enable productive work in the team, it makes sense to assign responsibilities to team members (see table 1). In this way, one member at a time maintains an overview of the respective area of responsibility and serves as a contact person. However, this does not mean that individual tasks in the subareas can not be taken over by each group member.

Table 1: Team members and their responsibilities

Group member	Origin	Background	Responsibility
Carla Gomes Cardani	Brazil	Design	Graphic Design and Marketing

Group member	Origin	Background	Responsibility
Carmen Couzyn	Austria	Media Technology	Software Development
Eliott Degouilles	France	Mechanical Engineering	Hardware - Materials
Julia Aleksandra Engst	Germany	Management (Building Real Estate Infrastructure)	Project Management
Jan Michael Benner	Germany	Energy Engineering	Quality Manager and Reporting

The elaborated project is briefly explained in the following video:

vecteezy_ukrainian-pigeon-flag-with-text-pray-that-you-exceed-your_6671449_370.mp4
[vecteezy, 2022]

1.2 Choosing the topic

After receiving the topic “Our City Experiences” (Smart Cities) it was essential to gather some first impressions, because of this it makes sense to first start with a trip around the city of Porto and analyze what could be improved and what comes to the mind (see Figure 1).

Figure 1: Walk around the city of porto

While brainstorming about the impressions in Porto and the experiences with our hometowns five ideas were developed. Based on basic research on each idea, it was possible to select a topic with which the group can best identify itself with and market opportunities exist.

- **City Guide**: Due to negative experiences with some city guides and individual needs for bundled information on one website, the idea of developing a modern website with information for tourists and citizens regarding all offers in the city was born. The inclusion of information regarding people with disabilities would be an add-on. Often information has to be gathered from different sources and the governmental information sources are frequently overloaded and outdated. Additionally, gamification of a city guide could make people perceive the city differently. Due to fears that a website with all the information about the city could quickly

become overloaded and due to large competitors with high market shares (**[TripAdvisor LLC, 2022]**, Google Maps **[Google LLC, 2022]**, digital city guides **[CITY GAME PORTUGAL, 2019][Secret City Trails, 2021][Team3, 2022]**, etc.), this idea was not pursued further.

- **Sharing Food**: This idea relates to the "buy one give one" principle of some existing initiatives to support populations living in poverty (e.g. "Light the world with love" **[Intellectual Reserve Inc., 2021]**). In this way, when a citizen buys a product at a vending machine its funds go directly to each participating charitable organization, making a difference for those in need. This is a very important and interesting topic, but for this project, it seemed to be difficult to differentiate from existing products and to create innovation, therefore it was decided to continue with a different idea.
- **Recycling and Sustainability**: Recycling is one of the most important challenges to achieving a circular economy. In addition to the recycling of electronic devices, clothes, and buildings, the recycling of household waste also plays an essential role. In many regions, the separation of household waste is uncommon or carried out improperly. Making it easier to separate waste and bring it together with wit minimum effort to a collection point could encourage people to dispose of it correctly. Due to the desire to deal with a topic in the digital environment, this topic will not be investigated further.
- **Redesign Traffic**: Redesigning crosswalks, traffic lights, stairs, and other traffic objects could give a city a unique look. This could strengthen the recognition value, familiarity, and identification of citizens with the city. Due to the desire for a digital theme, this idea is also not pursued further.
- **City for the people**: According to the quote "What is the city but the people" by William Shakespeare **[William Shakespeare, 1608]**, the citizens of a city are the most important building block. Digitalization and the progress towards smart cities offer the possibility to efficiently involve citizens in urban planning. This topic offers challenges in many different areas such as marketing, human-computer interaction, hardware-/software development, and many more. This forms the basis for a stimulating problem for all team members. For this reason, it was decided that the project would be continued on the topic of citizen participation in urban planning.

"What is the city but the people?"

– William Shakespeare (Coriolanus, Act 3, Scene 1)

1.3 Problem

Involving people in urban planning offers many benefits, but current methods are failing to get a large number of citizens to participate. People have a high participation barrier when it comes to public participation in urban planning, as it requires a lot of time and initiative only a small non-diverse group of citizens take part in governmental initiatives. This fact prevents the productivity of citizen participation and can lead to dissatisfaction among the population. Even the use of modern methods in a smart city has not yet succeeded in finding a comprehensive solution.

A more detailed explanation of the issue with a scientific background can be found in chapter 2.

1.4 Objective

This project is intended to contribute to the solution of the aforementioned problem. A combination of a public screen with a visual experience and an active interaction through a website (on a smartphone) will make it easier for citizens to participate. A public screen is placed at the location of a future construction project and is intended to arouse the curiosity of passers-by. The screen will display 3D models of the construction project to provide visualization at the future location, in addition the screen will display information about the project, comments and feedback of citizens. The interaction of the population with the screen should be done via smartphone with the help of a web application. Using a QR code, it is possible to access the website without having to make any prior arrangements (downloading an app). Several citizens can simultaneously call up further information on the construction project and record their opinion in the form of comments or likes. Active interaction with the public screen is only allowed to one person at a time. This citizen gets the possibility to project different models of the building project on the screen and to move them three-dimensionally, for this a limited time window is provided so that a long occupation by a citizen can be excluded. Experience from previous studies should be taken into account to ensure the success of the project. The overall aim of this system is to reduce the barriers to participation and to inspire citizens to engage in urban planning in a fun way.

1.5 Requirements

The requirements for the project can be divided into legal, social, frame conditions set by the project supervisors, and functional requirements.

The following EU directives are to be mentioned as legal requirements:

1. Electromagnetic Compatibility Directive (EMCD);
2. Low Voltage Directive (LVD);
3. Machinery Directive (MD);
4. Radio Equipment Directive (RED);
5. Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive (ROHS)

Social requirements include:

1. As environmentally friendly as possible over the product life cycle
2. The inclusion of as large a population group as possible (as far as possible)

The framework:

1. Budget of 100€ for the prototype
2. Use open-source software and technologies when possible
3. Adoption and use of the International System of Units (The NIST International Guide for the use of the International System of Units)

Functional Requirements:

1. Defying environmental influences when installed outdoors
2. Easy installation and maintenance
3. Residents must be made aware of the opportunity to participate

4. Ease of use of the application

1.6 Functional Tests

To be added

1.7 Project Planning

To be added (when chapter is finished)

1.8 Report Structure

The following table 2 provides an overview of the contents of this report and the respective chapters.

Table 2: Overview of the content

	Chapter	**Summary**
1	Introduction	Introduction of the project environment and the team members as well as a summary of the problem and the solution approach
2	State of the Art	Investigation of the theory underlying the project from the literature as well as a comparison with existing solution approaches
3	Project Management	Overview of the applied project management methods within the team
4	Marketing	Insight into the marketing strategy with identification of target groups, stakeholders, and marketing opportunities
5	Eco-efficiency Measures for Sustainability	Measures and possibilities to integrate the product into a society that is as environmentally friendly as possible
6	Ethical and Deontological Concerns	Analysis of existing Code of Ethics and specific benefits and concerns regarding the project
7	Project Development	Overview of the project process up to the completion of a prototype and test procedures
8	Conclusion	Project results, discussion and outlook for further research

2. State of the Art

2.1 Introduction

In this chapter, the terms “Smart City”, “Public Display” and “Citizen Participation” are first explained and then existing concepts and solutions of citizen participation in urban planning are explained and commented on. Based on these fundamentals, the concept for the project can then be created and developed.

2.2 Smart city

A smart city is a term that is becoming increasingly popular in scientific and political discussions, at the latest after the addition of large companies such as IBM **[Council on Foreign Relations, 2008]**. But what exactly is a smart city?

Initially, the definition was limited to information and communication technologies, such as sensors, for the efficient management of urban infrastructure and services. Today, however, it is used to refer to almost any form of technological innovation to improve the efficiency in urban management **[Sarbeswar Praharaj, Hoon Han, 2019]**.

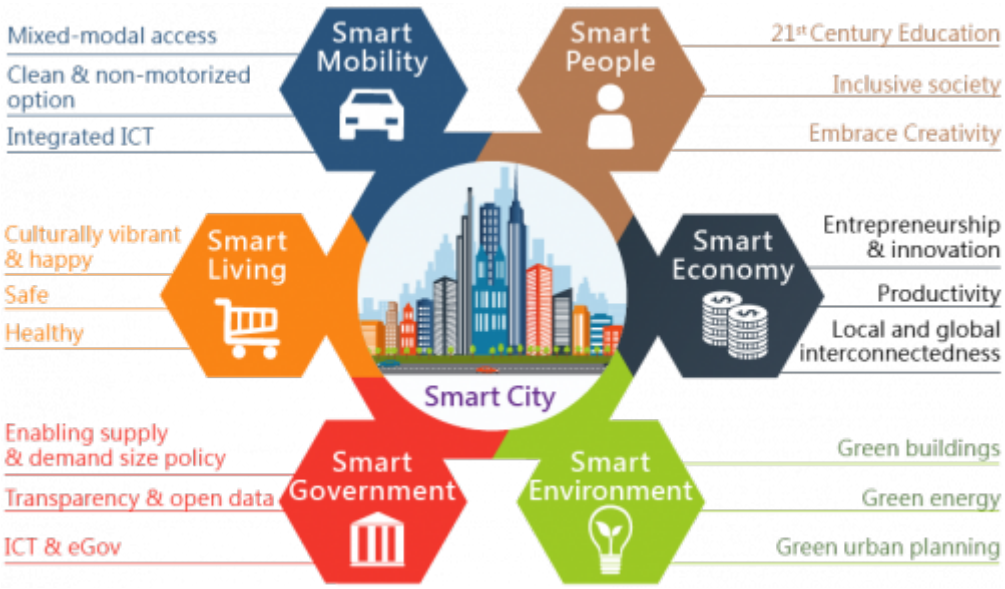


Figure 2: Characteristics of a smart city **[Dr. Winnie Tang, 2017]**

Technology has found its way into all areas of life, including buildings and urban areas. A new domain of the smart technology ecosystem has evolved as a conceptual extension of smart space, from the personal context to the broader community and the entire city **[Gregory S Yovanof, George N. Hazapis, 2009]**. Based on this, the term smart city can be extended to the areas of entrepreneurship and creative industries, Community development and social capital Learning and knowledge-based development and Sustainable development **[Sarbeswar Praharaj, Hoon Han, 2019]** (see figure 2).

2.3 Public Display

Public screens should be familiar to all of us and are present everywhere in our lives. For example, you can find them in shopping malls and streets as advertising platforms or at train stations as information displays. They are also used to display worldwide sporting events. Artists can use public screens to exhibit new creative art (see figure 3).

Figure 3: Public Screen as a Display for sporting events **["AJJ Press", 2011]**

In summary, mankind has become accustomed to the value and use of public screens but public displays still lack an adequate definition to describe all their features and capabilities **[Guiying Du, 2018]**. The English Dictionary **["Lexico.com", 2022]** describes a pervasive public display as electronic devices for visual presentation that spread widely throughout an area or a group of people. For this project a more detailed understanding of public displays is needed. Moving forward, a public display is defined as a subsegment of public electronic signage that is “centrally managed and individually addressable for display of text, animated or video messages for advertising, information, entertainment, and merchandising to targeted audiences” **[J. Schaeffler, 2012]**.

2.4 Citizen participation

Public Participation is “the involvement of citizens in governmental decision-making processes” it ranges from “being given notice of public hearings to being actively included in decisions that affect communities” **["Oxford Univercity Press", 2022]**. According to Schoßböck et al. **[Maria Leitner, 2018]**, there are four different levels of citizen participation. The intensity of co-determination builds on each level and the degree to which they are binding increases in every stage (see figure 4).

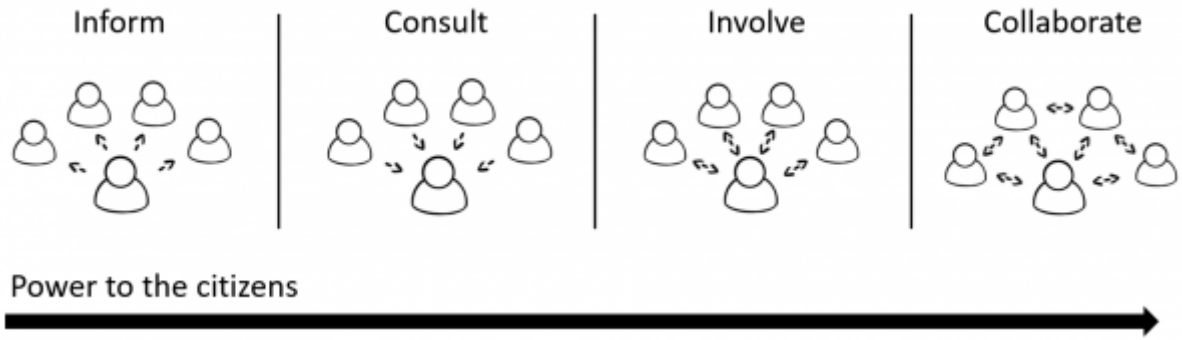


Figure 4: Levels of Citizen participation (cf. **[Maria Leitner, 2018]**)

The purpose of the information is to inform the participants about plans or decisions. Communication at this level runs in only one direction. Information reaches citizens through, for example, newsletters, databases, or meeting broadcasts.

Consultation and involvement enables two-way communication. In addition to receiving information, participants can express their opinion on a particular topic or design. The influence granted to the participants can be of varying degrees. In any case, communication in this framework is from the decision-making unit to the participants and from the participants to the decision-making unit. Feedback may also be provided to the participants. Consultation can also occur at regular intervals over a longer period. The involvement of citizens at this level is traditionally achieved, among other things, through citizen panels, chats, complaint management, and discussion forums. The difference between consultation and involvement is the inclusion of citizens in the brainstorming process and the direct feedback on the citizens' opinion.

Cooperative public participation allows stakeholders to have a “chance on decision-making” in the process. This is done, for example, through online mediation, citizen journalism, or interactive planning. Intensive communication between participants and decision-makers can turn into collaboration, which is the most intense form of participation. Citizens can actively participate in decicions via e-voting or online surveys.

In an effort to involve citizens in decision-making, more and more governments at various levels of power are implementing citizen participation initiatives. This tendency is due to a various number of reasons and implies different sources of potential problems.

“While planners bring technical skills and knowledge, citizens provide community history, local knowledge, and an understanding of cultural values.”

– Healey 1992; Innes 1996, 1998; Talen 1999

To begin with, greater participation of the citizen in urban planning would allow being closer to actual people's needs and are therefore better accepted. All voices used not to be listened to by city planners, and some voices weighted more than others. Moreover, smaller places like playgrounds for example tend to be overlooked during the design of cities which are made on a bigger scale. Thus, the involvement of citizens can fix this problem and go even further by proposing the implementation of more detailed elements (wheelchair ramps, trash cans, guidelines, etc.). In this way, cities will be able to evolve closer to users' needs and develop better its inclusiveness. Furthermore, citizen participation aims to reconnect citizens with their governments, because citizens' trust in governments has reached a particularly low level in recent years **[Antoine Clarinval, 2021]**.

Unfortunately traditional and other existing methods of citizen participation come with drawbacks, warnings, and limitations which will be discussed in the following chapter.

2.5 Review of participation methods

As shown, the participation of citizens in planning processes leads to an improvement of the overall quality and can contribute to a strengthening of a sustainable local democracy. Getting citizens to participate efficiently and in a useful way is not easy. That was the case before “smart cities” and is still a challenge **[Antoine Clarinval, 2021]**. Involvement can take place through a variety of methods, a consideration of traditional methods and modern concepts can provide the basis for finding a solution.

Vindasius classified traditional mechanisms for citizen participation in 1974 (see table 3). Various

parameters, such as specificity or workload of the methods were evaluated on a scale of 1-3, while 1 is a low score and 3 is the highest.

Table 3: Participation methods and their caracteristics (cf. **[Hend Magdy Mohamed Sameh, 2011]**)

Type of public involvement mechanism	**Focus in scope**	**Focus in specificity**	**Degree of two-way communications**	**Level of public activity required**	**Agency staff time requirements**
Informal local contacts	1	3	3	2	2
Mass media (newspapers, radio, TV)	3	1	1	1	1
Publications	3	2	1	1	2
Workshops	1	3	3	3	3
Advisory committees	1	3	3	2	3
Public hearings	2	1	1	3	2
Public meetings	2	1	2	2	2
Public inquiry	3	1	1	2	2
Special task forces	1	3	3	3	3

These methods have been used for a long time and have proven some advantages and efficiency over a long period of time. Nevertheless, they are accompanied by a list of disadvantages and difficulties (cf. **[Hend Magdy Mohamed Sameh, 2011]**,**[Ole Smørdal, Kristina Wensaas, Susana Lopez-Aparicio, Ida Pettersen, Kristian Hoelscher, 2016]**, **[Antoine Clarinval, 2021]**):

- Often traditional methods provide a confrontational atmosphere (this can lead to a small vocal minority, with often extreme views, dominating the discussion and a quieter majority being discouraged from participating).
- The restricted time period of public hearings/meetings and the physical location can limit broad participation (often in the morning hours when many citizens are working)
- People have to work and family and often have little time to participate further
- One-day events can provide a wealth of information and ideas that can easily be lost if not captured digitally
- People can participate much more effectively when information is presented simply and visually than in words. When the complexity is too high, people may find it difficult to understand the project or discourage people from learning about the subject matter.
- By the time information reaches the citizens and is up for discussion, important decisions have usually already been made by the authorities.
- Many people do not even learn about participation opportunities because they do not live in the immediate vicinity of the project but can still be affected by it.
- Due to the high effort, mostly only simple participation methods are used by the authorities

The use of digital media and tools to enable the participation of inhabitants in urban planning processes on a massive scale is a promising, but currently not comprehensively analyzed approach **[Sander Münster, Christopher Georgi, Katrina Heijne, Kevin Klamert, Jörg Noennig, Matthias Pump, Benjamin Stelzle, Han Meer, 2017]**. An overview of all traditional and modern communication channels can be found in figure 5.

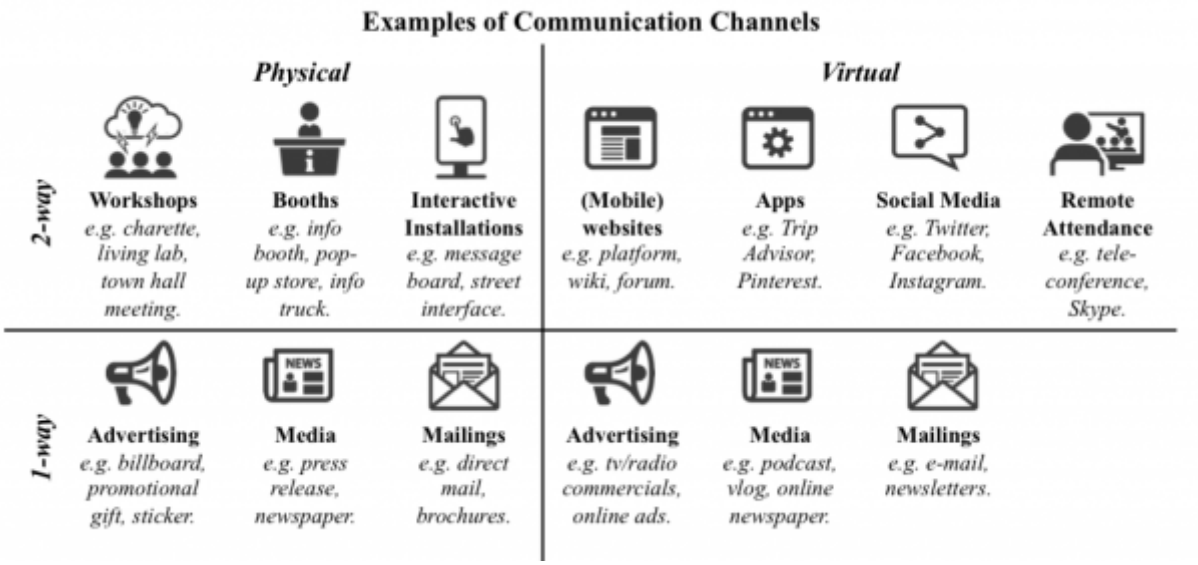


Figure 5: Overview of communication channels: physical, virtual, 1-way and 2-way **[Sander Münster, Christopher Georgi, Katrina Heijne, Kevin Klamert, Jörg Noennig, Matthias Pump, Benjamin Stelzle, Han Meer, 2017]**

The use of ICT makes it possible to reach a large number of citizens with little effort. In addition, people can participate online and anonymously at any time. Citizens can use e-planning to get involved in the planning process at an early stage and generate a new wealth of ideas. As shown some of the problems of traditional methods can be solved through the use of modern ICT resources, but modern methods of citizen participation also have their challenges, which are sometimes similar to traditional methods **[Sander Münster, Christopher Georgi, Katrina Heijne, Kevin Klamert, Jörg Noennig, Matthias Pump, Benjamin Stelzle, Han Meer, 2017]**:

- User group is too small (lack of information on participation opportunities, lack of knowledge of the software, high level of initiative is necessary)
- People who participate are rarely representative of the entire citizenry
- Information is presented in a too complex way (motivation to participate decreases)
- Participation is not possible at the location of the project
- Transparency, inclusion, and fairness (if this is not properly addressed, it can lead to a worse outcome than without any opportunity for participation).

Due to this, according to Schuler **[Douglas Schuler, 1996]**, efficient participation measures should have the following characteristics:

- As many as possible citizens in a city should be reached/involved
- The flow of information should be reciprocal
- It must be easy to reach and as inexpensive as possible for the citizen
- The participation should be with as few restrictions as possible
- Adaptation to changing legal framework conditions and evolving software should be possible
- Transparency, inclusion, and fairness

In addition, interactivity can lead to higher participation from the public. These measures are one of the bases for the development of this project.

In the following chapter, digital systems already designed to encourage more people to participate in urban planning are presented.

2.6 Similar Projects

Market analysis offers the possibility to examine the strengths and weaknesses of existing solutions and consider them in product development. Recent scientific publications reveal that there are only a few commercial competitors in the field of smart screens for citizen participation, but a lot of studies on that topic. First, Claes et al. **[Sandy Claes, Jorgos Coenen, Andrew Vande Moere, 2018]** developed a device to display environmental measurements, such as pollution data, in the vicinity of the measuring location. This public visualization is paired with a polling system, allowing citizens to respond to the data by pressing one of three buttons showing happy, sad, and neutral smileys. Each of their visualization sets consists of six wirelessly connected displays powered by batteries. Figure 6 shows the structural graph of the installation. The individual displays show different visualization types and representations of the data, such as textual quotes, infographics, or graphs. The authors propose to increase trust and introduce perceived personal ownership by having the devices hosted directly by community residents, who seek to raise awareness on a local issue.

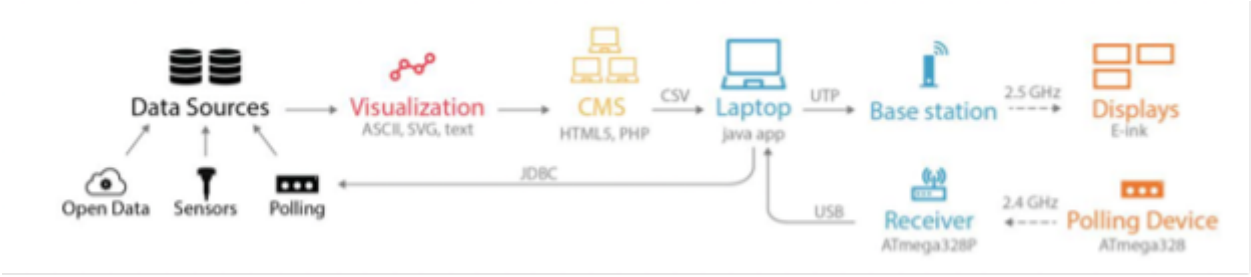


Figure 6: Claes et al. structual graph of the installation **[Sandy Claes, Jorgos Coenen, Andrew Vande Moere, 2018]**

The second competitor, 'Vote with your Feet' **[Fabius Steinberger, Marcus Foth, Florian Alt, 2014]** is a polling system that interactively allows citizen participation in polls through buttons on the ground. The system aims to increase participation by lowering the interaction barrier and drawing attention through a tangible user interface. Figure 7 shows the concept sketch of the installation. In a field study and subsequent interviews, the authors confirmed that the buttons drew considerably more attention from passers-by than the screen alone. Moreover, they proved that the participation barrier was lowered, as participants perceived their installations as inviting and easy to use and a welcome way to pass time while waiting for public transport. However, they also found that kids were eager to play with the buttons to trigger the visual and audible feedback, thus distorting the validity of the polling results.

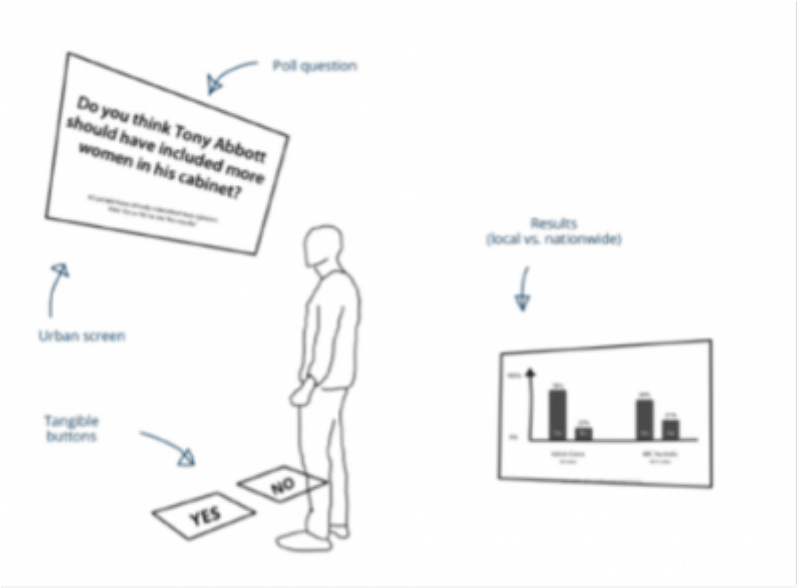


Figure 7: Vote with your feet **[Fabius Steinberger, Marcus Foth, Florian Alt, 2014]**

Ubinion **[Simo Hosio, Vassilis Kostakos, Hannu Kukka, Marko Jurmu, Jukka Riekki, Timo Ojala, 2012]** specifically targets young adults and uses social media integration to establish trust and support content creation, storing, and delivery. The installation aims to increase participation through a playful and fun interaction experience as well as by engaging the users' creativity. Through an integrated web camera, citizens can participate by taking a snapshot, which can then be edited by adding speech bubbles and protest signs with a custom text input. Afterward, the images are shared on Ubionion's Facebook page and the comments are replicated on a Twitter feed. Figure 8 shows the screen flow of the display. Similar to 'Vote with your Feet', the developers of Ubinion found that the display was often perceived and used as a playful attraction instead of a serious feedback device. Moreover, users were frequently distracted by the possibility to take and share a photo. Hence, providing feedback was not the primary purpose of their interaction.

Figure 8: Ubinion **[Simo Hosio, Vassilis Kostakos, Hannu Kukka, Marko Jurmu, Jukka Riekki, Timo Ojala, 2012]**

Furthermore, a research project named Game.Up from the Technical University of Munich **[Sarah L. Muehlhaus, Chloe Eghtebas, Nils Seifert, Gerhard Schubert, Frank Petzold, Gudrun Klinker, 2022]** developed a prototype of gamified public participation application in urban planning. People would use a tablet or a smartphone in the area of interest and within a user interface, game elements were incorporated in the interactions with and between application screens. The structure of the system is shown in figure 9. In the first layer, people can choose their avatar and edit their profile, also achievements during the participation can be shown. The second layer includes the map interface, which displays the avatar at the user's location and project icons at the location of the project. Moreover, information about the project can be accessed. With the third layer user input, Quests, and augmented reality enable participation. Thru the use of avatars, a 3DModell of the

environment and AR users could feel embodied. This enabled users to find and determine the personal relevance of the project very fast. In addition to the gathering of information about the project, users can participate through quests or surveys, developed by authorities. But the question remains unanswered as to how people are to be encouraged to use the application.

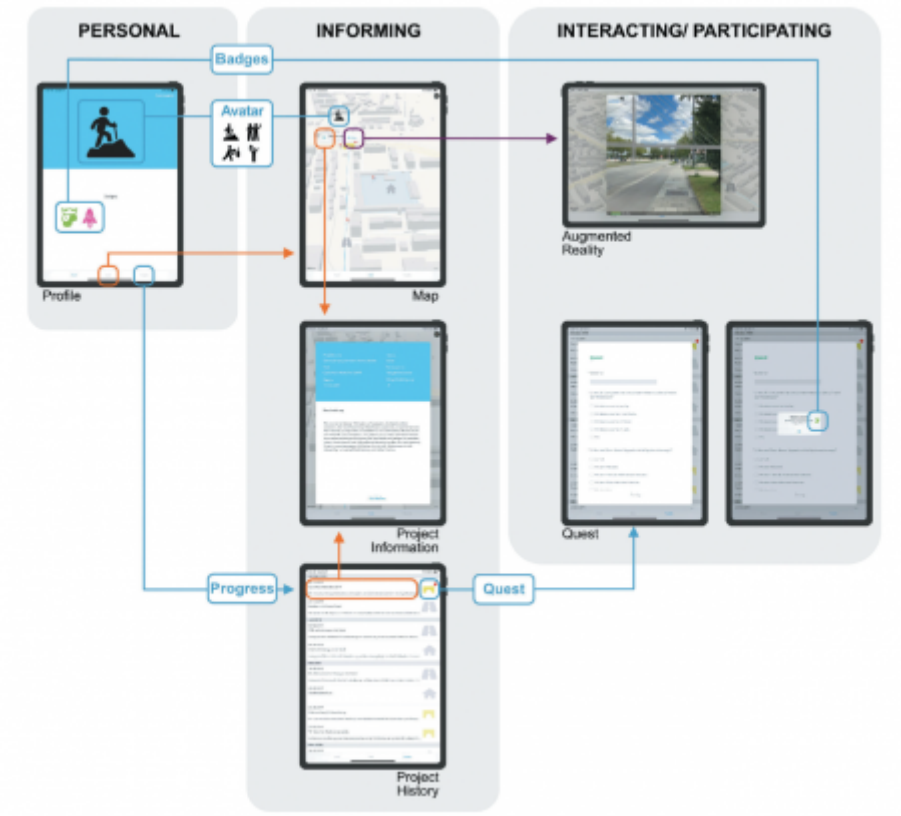


Figure 9: Application user interface layout with gemification elements **[Sarah L. Muehlhaus, Chloe Eghtebas, Nils Seifert, Gerhard Schubert, Frank Petzold, Gudrun Klinker, 2022]**

ChangeExplorer **[Alexander Wilson, Mark Tewdwr-Jones, Rob Comber, 2019]** was a smartwatch application to support citizen feedback on projects. When entering an area where a change is proposed, the smartwatch would notify the user of potential development changes in the area and allow them to give quick responses to prompt questions. They had to reflect on who they would like to improve the area for, and what improvements they would like to make. They could then also add further comments either on their app or on their phone. A summary of the process is shown in figure 10. The notes and interactions were simple and straightforward, allowing the selection of categories for quicker responses, with the option to add additional comments if the user wished to do so. Also, the user did not need to understand the structure of their local council or learn how to use a GIS system. To avoid the problem of comments being too general, ChangeExplorer used categories to guide the user to planning-related comments; this also allowed for easier sorting of comments after they were made. Finally, the user could think about a project while standing physically in the environment. Nevertheless, there were some criticisms of this principle, so it didn't allow for further information on thought or opinions like sketches. Also, there wasn't a feeling of direct feedback on an idea and the lack of further information on the exact changes that were proposed. A lot of people saw the app as a way of evidence gathering around issues and requested a possibility to submit photographs to document these problems. So the device was not able to capture the richer discussions that took place around the vote but let participants submit the first thing that was obvious.

Figure 10: Operating principle of ChangeExplorer **[Alexander Wilson, Mark Tewdwr-Jones, Rob Comber, 2019]**

Finally, in a study by the University of Münster **[Guiying Du, Christian Kray, Auriol Degbelo, 2020]**, an interactive and immersive public display as a conduit for increased involvement in urban planning was developed. It involves a three-sided immersive video environment, showing panoramic videos of the place where an urban development project is to be realized (shown in figure 11). The videos are overlayed with planning content, like static overlays of 3D drawings as well as voting and comment panes. An additionally mobile app offers the possibility for commenting and voting on the topic. The system was easy to use and overall provided easy access to participation through the use of the smartphone. Negative aspects are the physical distance to the real construction project due to the installation in buildings far away from the project and the lack of direct feedback and interaction. In addition, it was necessary to install the application on the smartphone to use it.

Figure 11: Prototyp implementation of an interactive and immersive public display **[Guiying Du, Christian Kray, Auriol Degbelo, 2020]**

A comparison and differentiation between the different comparable solutions for citizen participation are shown in the following table.

Table 4: Comparison of different aproaches

Project	Depth of Participation	Used Devices	Strengths	Weaknesses
Public visualization of pollution data with polling system **[Sandy Claes, Jorgos Coenen, Andrew Vande Moere, 2018]**	Information and feedback in form of three different smileys	Public screen, Environmental measurements, Buttons	Makes people aware of problems in public places	Limited feedback (No possibility to propose solutions), No further interaction or information
Polling system that allows citizen participation in polls through buttons on the ground **[Fabius Steinberger, Marcus Foth, Florian Alt, 2014]**	Information and voting	Public Screen, Buttons	Buttons draw attention	Limited feedback (No possibility to propose solutions), No further interaction or information, used as a playground
Ubinion (Public Screen with integrated camera) **[Simo Hosio, Vassilis Kostakos, Hannu Kukka, Marko Jurmu, Jukka Riekki, Timo Ojala, 2012]**	Commenting	Public Screen, Camera, Touchscreen	Camera draws attention, Possibility to comment in an online environment	No further Information on the project, Playful attraction instead of a serious feedback device
Game.Up (Gamified public participation application) **[Sarah L. Muehlhaus, Chloe Eghtebas, Nils Seifert, Gerhard Schubert, Frank Petzold, Gudrun Klinker, 2022]**	3D-Feedback, Comments	Application for smartphone/tablet	People could feel embodied through AR, A lot of information and feedback is possible	Hurdle to make people aware of the application, High need for adaptation to different projects
ChangeExplorer (Smartwatch application) **[Alexander Wilson, Mark Tewdwr-Jones, Rob Comber, 2019]**	Comments and further feedback	Application for smartwatch/smartphone	Easy and fast feedback, Notifications	No further information on the project, Hurdle to make people aware of the application, Limited Feedback
Interactive and immersive public display **[Guiying Du, Christian Kray, Auriol Degbelo, 2020]**	Comments and voting	Public Screen, Smartphone	Easy and fast feedback, Information	Need to install an application, Physical distance to the real construction project

2.7 Conclusion

As described in chapter 2.4, citizen participation in urban design can have many positive effects. The combination of a public screen with a visual experience and an active interaction through a website

(on a smartphone) to make it easier for citizens to participate in urban planning can be used for all 4 levels of citizens' participation. They can use the display to find out about current projects and to understand them better with all the advantages and disadvantages. But a smart display can also encourage citizens to cooperate or even collaborate **[Maria Leitner, 2018]**. In the further course of the project, however, the findings from chapter 2.5 regarding the problems of existing participation opportunities and the conclusions from chapter 2.6 must provide the basis.

For this reason, the following ten goals should be achieved:

1. As many as possible citizens in a city should be reached/involved
2. The flow of information should be reciprocal
3. It must be easy to reach and as inexpensive as possible for the citizen (inviting and easy to use)
4. The participation should be with as few restrictions as possible
5. Transparency, inclusion, and fairness
6. Interactivity should be possible
7. Participation should be possible at the location of the project
8. Anonymous participation
9. Be taken seriously as a participation opportunity (not as a toy)
10. Possibility of participation of several persons at the same time

3. Project Management

3.1 Scope

The project scope represents the work that will be performed to deliver the requirements (functions and features) we have established for our product. To get an overview of our tasks, we have decided to create a work breakdown structure (see figure 12).

The work breakdown structure of this project is process-oriented and hierarchically structured. In order to efficient documentation control, an alphanumeric coding "SDXXX" was chosen, where "SD" stands for "Smart Display". The project is subdivided into six sub-projects "initial", "design", "interim", "executive", "testing" and "final". These sub-projects are broken down into further work packages. Each work package, which represents the smallest unit, is to be assigned to a responsible person. If necessary, further sub-projects or work packages can be added.

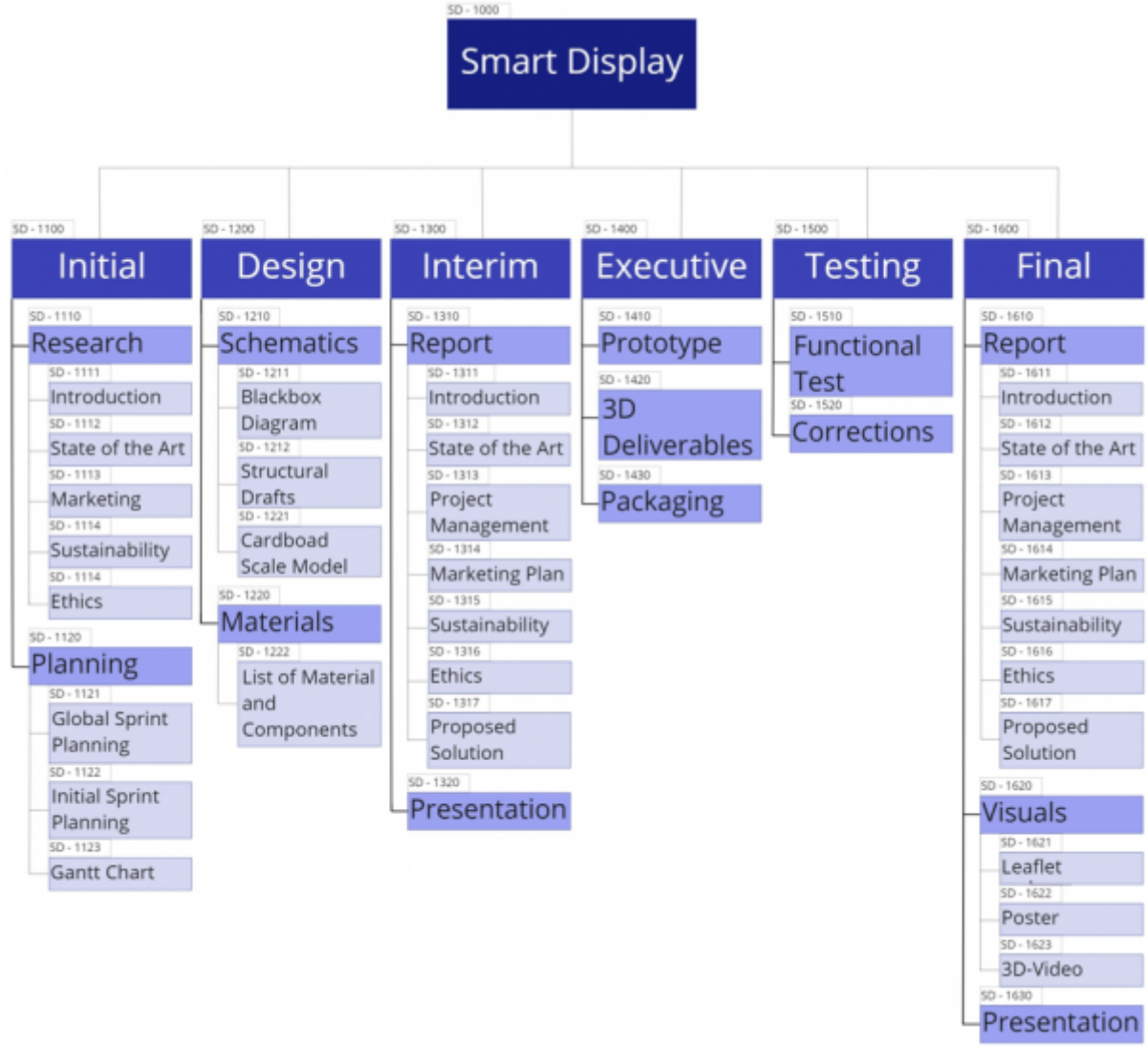


Figure 12: Work Breakdown Structure

3.2 Time

Scheduling is an important management tool for project control. It is broken down into individual activities that are coordinated in terms of time and defines the individual project milestones. It also serves as an instrument for efficient project monitoring in accordance with the work breakdown structure.

In order to obtain a detailed schedule overview, we have used the Gantt chart (see figure 13)).

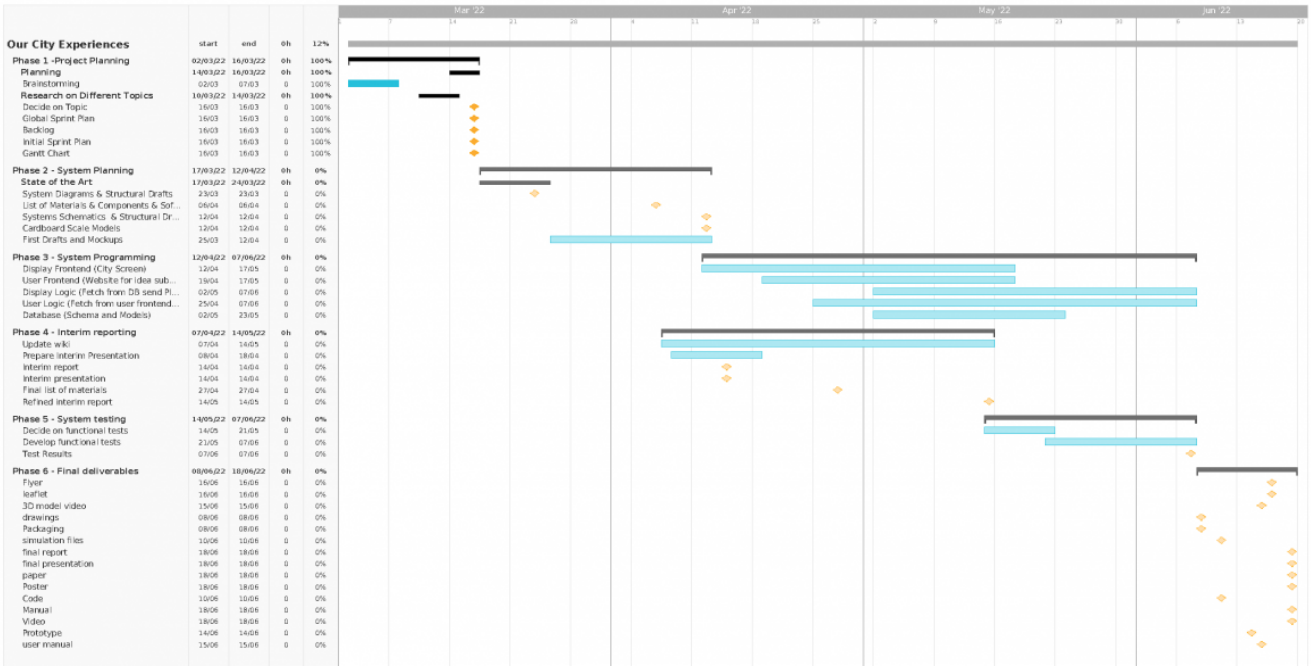


Figure 13: Gant Chart

3.3 Cost

To be added. Document the planned vs. effective costs of your project.

3.4 Quality

To be added. Document quality metrics that will apply to your project deliverables, associated thresholds and how they should be reviewed.

3.5 People

In the team, we first identified all stakeholders who are directly or indirectly involved in the project. These were divided into external and internal stakeholders.

The internal stakeholders are:

- Project team: Eliott, Carla, Carmen, Jan and Julia

Multidisciplinary group that is in charge for the creation and achievement of the project’s purpose

- Supervisors

ISEP teachers responsible for giving feedback and help with the develop of the group and its project

- Teachers

ISEP teachers responsible for classes that add value to the project

The external stakeholders are:

- Government

For Parcitypate to exist, the government need to invest on our project to achieve the citizen participation

- Public

The population is the main target on this project. It is responsible for the success of Parcitypate

- Suppliers

3.6 Communications

Our collaboration is characterized on the one hand by weekly meetings and on the other hand via a cloud-based storage.

The meetings within the project management team always took place on thursdays at around 2:00 p.m. We have chosen this day because we have a jour fixe with our supervisors in the morning. During our meetings we presented our work results from the previous week, discussing about the critique of our supervisors and create a task plan with corresponding responsible persons for the coming week. In addition, we prepared an internal minutes to keep all members up to date.

Furthermore, we have chosen a cloud-based solution - provided by the university ISEP - “OneDrive”, as this allows collaborative work in the team.

3.7 Risk

The biggest challenge of a project is that due to existing risks a project success can be achieved completely, partially or not at all. With a well-developed risk management, the chance of achieving the project goal is increased and risks can be minimized through early and effective identification. Furthermore, minimizing the risk potential also means avoiding post-processing costs. The tasks of a risk manager include: risk identification, risk evaluation, risk handling, risk controlling.

In the following our group identified key risk regarding to our product and our project:

3.7.1 Product Level

Table 5: Risks in the product level

Risk Event	Probability	Impact Rating	Risk Handling
technical issues (failure of parts)	unlikely	severe	creating stress-simulation
delivery delay	possible	significant	guaranteed delivery on time
too costly	possible	moderate	make or buy decision, finding a cheaper alternative, finding sponsors

Risk Event	Probability	Impact Rating	Risk Handling
public has hurdles to participate	unlikely	severe	strong study of the state of the art

3.7.2 Project Level

Table 6: Risks on the project level

Risk Event	Probability	Impact Rating	Risk Handling
Deadlines are not kept	possible	significant	creating sprint plant to keep all members updated with the current tasks, finding out the origin of the delay, weekly meetings
Lack of appropriate prior knowledge to gather expertise promptly	very likely	significant	assign different expert roles to each Person, who informs their group members about their research and transfers learned skills
Coordination problems between the team members	possible	moderate	weekly meetings incl. write minutes that are published in the shared cloud

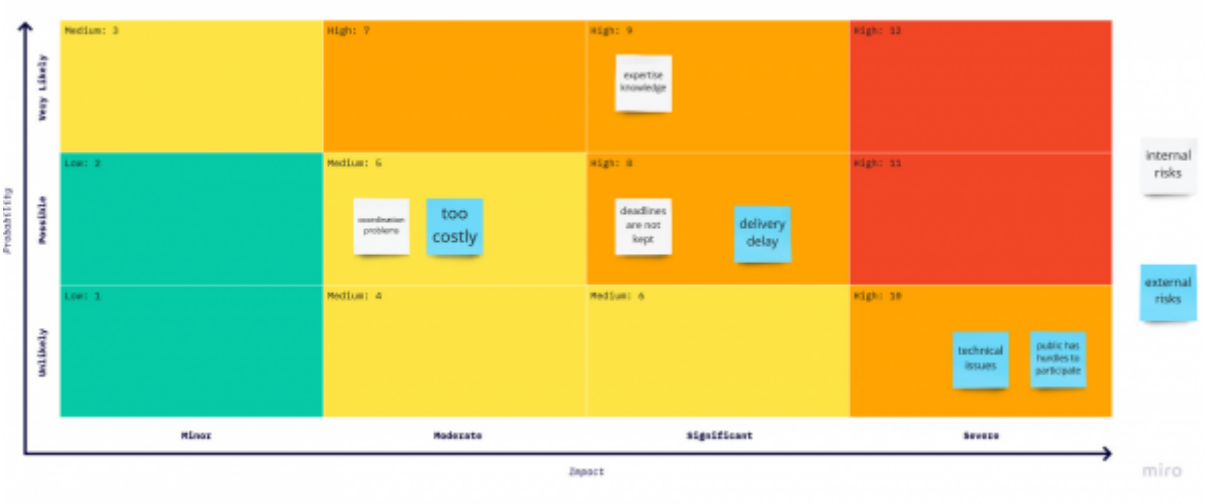


Figure 14: Risk assessment

3.8 Procurement

To be added. Document your procurement management strategy including make vs buy decisions, materials/services to be acquired, sources, costs, timings, etc.

3.9 Stakeholders Management

To be added. Define how you will manage stakeholders to keep them engaged.

3.10 Sprint Outcomes

To be added. Include the outcomes of all sprint reviews (what was the sprint backlog, completion

status, planned capacity vs. achieved velocity).

Table 7: Sprint 1 - week 9

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
Weekly Classes		74	74	all	done
PROJE	Choosing our Topic	2.5	2.5	all	done
PRMTW	Preparation of a Team Building Game	2.5	2.5	all	done

Table 8: Sprint 2 - week 10

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
Weekly Classes		80	80	all	done
PROJE	City Walk	20	20	all	done
	Research of our Preferences	30	30	all	done
	Project Backlog	2	2	Carmen	done
	First Global Sprint Plan	3	3	Carmen	done
	Gantt Chart	4	4	Julia	done
	Report + Agenda	2	2	Carmen	done
ETHDO	Code of Conduct (Engineering)	10	10	all	done

Table 9: Sprint 3 - week 11

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
Weekly Classes		98	98	all	done
PROJE	State of the Art	20	32	all	doing
	Blackbox	3	4	Carmen	done
	Structual Drafts	5	5	Carla	done
	Report + Agenda	2	2	Jan	done
ESUSD	Research about Energy (Flow and Reserves)	2	?	Eliott, Jan	done
MACOM	Our Group Target	5	7	Carla, Carmen, Julia	done

Table 10: Sprint 4 - week 12

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
Weekly Classes		118	118	all	done
PROJE	State of the Art	4	9	Jan	doing
	Blackbox	3	2	Carmen	done
	Report + Agenda	2	2	Julia	done
MACOM	Finding our Team-ID	14	16	all, Carla	done
MACOM	Leaflet	8	8	all, Carla	doing
PRMTW	WBS	6	6	Julia	done

Table 11: Sprint 5 - week 13

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
Weekly Classes		129	129	all	doing

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
PROJE	State of the Art	5	8	Jan	doing
	Continuing with Team ID	20	20	all	doing
	Report + Agenda	2	2	Carla	done

Table 12: Sprint 6 - week 14

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
Weekly Classes		56	42	all	done
PROJE	Leaflet	5	5	Carla	done
	List of Materials	8	9	Eliott	done
	Sprintplan and Backlog	6	8	Julia	doing
	Report + Agenda	2	2	Eliott	done

Table 13: Sprint 7 - week 15

Subject	Task	Estimated Duration (h)	Real Duration (h)	Members Involved	Status
Weekly Classes		33	33	all	done
PROJE	Upload Intirim Report	40	50	all	doing
	Cardboard scale model	10	10	all	done
	Report + Agenda	2	2	Carla	doing

3.11 Sprint Evaluations

To be added. Include the summary of all the sprint retrospectives, including any actions implemented as part of the team’s continuous improvement strategy.

3.12 Conclusion

To be added. Provide here the conclusions of this chapter and introduce the next chapter.

4. Marketing

4.1 Introduction

The marketing decision making on a company shouldn’t be made without planning. Part of a company’s success come from a marketing plan, specifying its objetives and strategies to help achieve the main goal - it’s more than promoting a product. This plan should be elaborated to help identify, anticipate and integrate the purpose of the product and its brand.

A Marketing Plan is a document that clarifies our marketing objectives, strategies, budget and action plan to accomplish the target. It is a tool that can be considered a manual to be used and updated every year.

It allows the improvement of the company by the relation with the client, internal organization, and in your relation with the market. It allows to gather information about our target group , decide how to behave based on real data, market analysis, helps defining and reach the goal, besides controlling investment and anticipating crisis (know how to deal with it). In that way, it makes the company prepared to act and respond to whatever adversities there is.

4.2 Market Analysis

A Market Analysis is essential to understand and direct resources to aim the desired target. There are a lot of studies on smart screens for citizen participation, but only a few commercial competitors (as we can see at section 2.6 Similar Projects)

Our device is made for all governments that wants to include the citizen participation on the urban planning. In Portugal, there are 8 cities with between 100,000 and 1 million people, and 210 cities with between 10,000 and 100,000 people. The start point of Parcitiypate is Porto - the second-largest city in Portugal **["World Population Review", 2022]**. According to the website of Porto **["porto.pt", 2021]**, Porto had a total of 231.962 habitants in 2021.

- 66.6% of Portugal’s population lives in urban centres

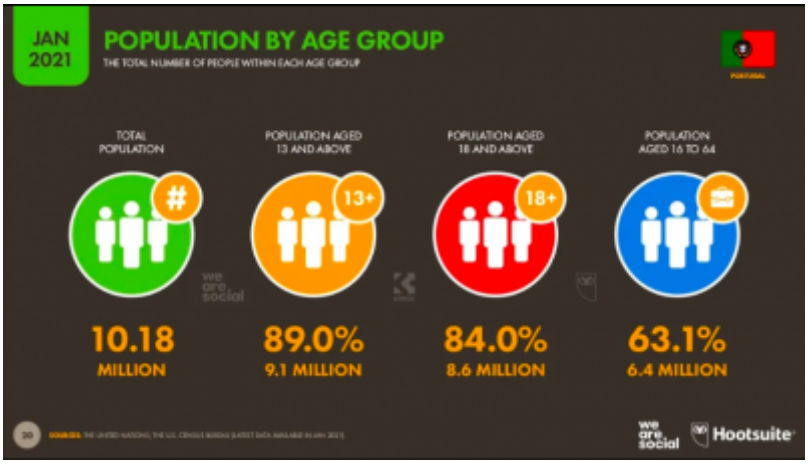


Figure 15: Population by age group

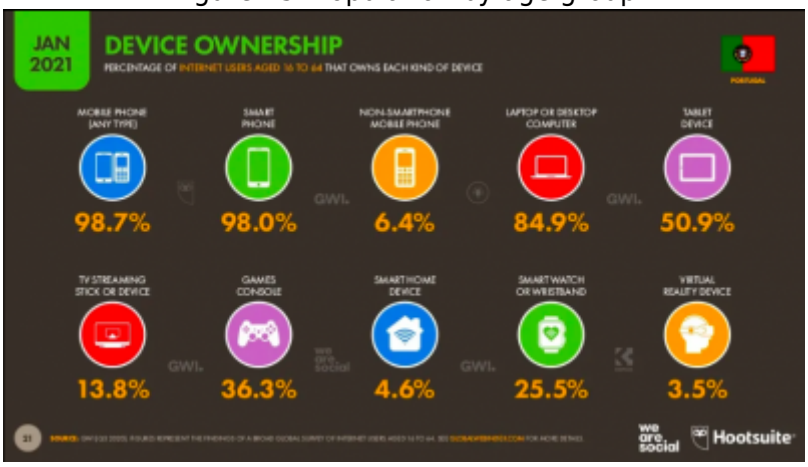


Figure 16: Device ownership

4.3 SWOT Analysis

The SWOT Analysis is a strategic marketing tool which combines the company analysis (internal perspective) and environmental analysis (external perspective).

Each letter is related to the following word:

S → Strengths

W → Weaknesses

O → Opportunities

T → Threats

Figure 17: Parcitypate SWOT analysis

4.4 Strategic Objectives

4.5 Segmentation

Target Market, Profiles

4.6 Strategy/Positioning

4.7 Adapted Marketing-Mix

4.8 Budget

4.9 Strategy Control

4.10 Conclusion

Provide here the conclusions of this chapter and introduce the next chapter.

Based on this market/economic analysis, the team decided to create <*specify the type of product*> intended for <*specify the market niche*> because … Consequently, the team decided to create a product with <*specify the features*>.

5. Eco-efficiency Measures for Sustainability

5.1 Introduction

The concept of sustainable development as we understand it today was born at the end of the 20th century. As originally defined in 1987 at united nations, it is “a development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Sustainability can be achieved by taking into consideration these three pillars: environmental, economic and social. The consequences can easily be observed when these principles have not been applied. As an example, it is possible to cite the global warming for the environment, subprime crisis for the economy or child labor for the social.

Smart cities are a direct enforcement of these principles. In this context, our product, ParCITYpate, should respect all of the three pillars from the sustainable development. Therefor, in the following sections, we are going present its impact on the environment at first, and on the economic aspect. Then we explain the social value of our product before ending with a life-cycle analysis.

5.2 Environmental

ParCITYpate impacts the environment at three diverse levels.

Firstly, manufacturing needs resources for making every component inside. These same components might also be transported which impact the environment as well. As an example, manufacturing a screen (especially if it is a large one) is extremely polluting. But once all these components are coming together, we still need a structure to hold and protect them. This structure needs materials which are probably going to be transported, transformed, and shaped. All these operations will have some impact on the environment either directly or by the usage of energy. We will try to avoid or minimize environmental consequences as much as possible. This is going to be a defining criterion for many of the choices we are making (material used, manufacturing methods, etc.).

In a second time, ParCITYpate will be impacting the environment through all the energy it will consume during its time in service. To save as much energy as possible, we tried to choose components which consume less and implement some functions to adjust the energy consumption depending on the situation (adaptative brightness, sleep mode, etc.).
Low energy consumption is one thing but energy source matters even more. Our two main options to power our system were to connect it to the electricity grid or to power it with a built-in solar panel. We came to the conclusion that the best option was to connect directly to the grid. There are several reasons for that. In addition to the fact that a solar panel would certainly not provide enough power, its inconsistency would force us to add a battery to our system to store energy when the weather is not good enough. As we know, manufacturing solar panels and batteries aren't the cleanest thing on earth and the benefit would not compensate for their environmental cost. So, we decided to connect our device to the electricity but, depending on the country, this electricity can be very clean or not at all. As an example, producing electricity in Sweden emits almost no CO^2 unlike Poland which emit 60 times more for a similar amount.

Finaly, our product will impact the environment after its lifetime. Therefore, we need to design it in a way that would generate no waste. To begin with, it must be possible for our system to completely take it to pieces. This allows unique parts to be changed if they stop working and to be reused after the product lifetime. The structure of the product must be easily 100% recyclable which limits usable materials but also prevent the use of multi-materials parts.

5.3 Economical

5.4 Social

5.5 Life Cycle Analysis

5.6 Conclusion

Provide here the conclusions of this chapter and introduce the next chapter.

Based on this sustainability analysis, the team chose *<specify here the design, technique(s) material(s), component(s)>* for the following environmental reasons…

6. Ethical and Deontological Concerns

6.1 Introduction

The word deontology derives from the Greek words for duty (deon) and science/study of (logos).

According the Stanford Encyclopedia of Philosophy **[Stanford Encyclopedia of Philosophy, 2021]**, deontology is a “normative theory regarding which choices are morally required, forbidden, or permitted”. It does not assess what kind of person you should be nor the consequences of your actions. Instead, it focuses on guiding and assessing our choices of what we ought to do by using a set of rules.

Ethical and deontological concerns are extremely important in a society, firstly by proposing rules which goes even beyond the laws. Companies has a lot to lose from ethical scandals especially companies which relies on their brand image. Indeed, we have seen many companies loosing clients, loosing markets, or even collapsing after ethical troubles. This effect could be even more important in recent years with the development of social medias in our society.

We are caring about making our project ethically blameless. To do so, we focused on different angles which make the following sections. First of all, the engineering ethic, where we focus on engineer’s duties. Then, sales and marketing ethics, where we try to delimitated the frame in which these activities can be done. But also, environmental ethic which is related to the sustainability section and finally liability.

6.2 Engineering Ethics

Deontological rules for engineering can vary from one country to another and some countries do not even have a written code of ethics. We decided to comply to the Portuguese code of ethics **[55]** by engineer’s order. The first section of the document reminds engineer’s goals and justify the importance and necessity of having ethic rules. In a second time are listed all ethical rules engineers working in Portugal should comply to. They are divided into 3 main sections: Responsibility, Orientation, Implementation. For each one of these, we identified which one does apply to our project :

- Be responsible for our acts
- Assume solid principles of economic, social and environmental sustainability
- Take into account the implications that result from our performance
- Use caution and take responsibility
- Cover information to customer
- Be aware of the implications of integrating technical systems in the social, economic and environmental context
- Avoid situations that could expose them to external pressures and immediate, abusive and arbitrary constraints
- Don’t create unethical product
- Contribute to the development and continuous adaptation of the fundamentals of ethics in engineering
- Update our skills and refrain to carry works for which we are not competent
- Analize and ponder controversial views

6.3 Sales and Marketing Ethics

Because we want our project to be ethically blameless, marketing ethics should not be left aside. In order to achieve this, we followed the Principles of Ethical Marketing :

- All marketing communications share the common standard of truth.
- Marketing professionals abide by the highest standard of personal ethics.
- Advertising is clearly distinguished from news and entertainment content.
- Marketers should be transparent about who they pay to endorse their products.
- Consumers should be treated fairly based on the nature of the product and the nature of the consumer.
- The privacy of the consumer should never be compromised.
- Marketers must comply with regulations and standards established by governmental and professional organizations.
- Ethics should be discussed openly and honestly during all marketing decisions.

6.4 Environmental Ethics

6.5 Liability

6.6 Conclusion

Provide here the conclusions of this chapter and introduce the next chapter.

Based on this ethical and deontological analysis, the team chose <*specify here the design, technique(s) material(s), component(s)*> for the following ethical reasons...

7. Project Development

7.1 Introduction

As a starting point for this project, a state-of-the-art analysis was carried out. The findings of this analysis show that all existing projects face one common problem when aiming to increase citizen interaction with public screens, namely, overcoming the participation barrier. If the participation barrier is too low, e.g. allowing interaction simply by stepping on buttons, the installation is used for amusement rather than serious participation. On the other hand, if the barrier is too high, e.g. by having to publicly share your personal opinion or by using very extravagant movements for the interaction, people's motivation to participate will be too low. Consequently, the aim of our project is to create a method for citizen participation that combines public attention and private interaction.

7.2 Ideation

To address the problem outlined in the previous chapter, an idea was created that combines the advantages of public displays with the privacy of smartphone interaction. More specifically, a

combination of a public display for immediate visual feedback and web application for user input will be developed. The primary aim of the public display is to increase awareness of the participation opportunity. Moreover, citizens are confronted with the urban planning choices in the place that they are relevant for. Further, the immediate visual feedback on the screen reacting to the interaction with the smartphone, creates a sense of novelty, which improves the hedonistic user experience. Finally, it serves as a metaphor for the public influence of small choices made by citizens.

After identifying this solution, the engineering team moved to the ideation phase and created several structural sketches for different screen models. Figure 18 shows the initial structural sketches.

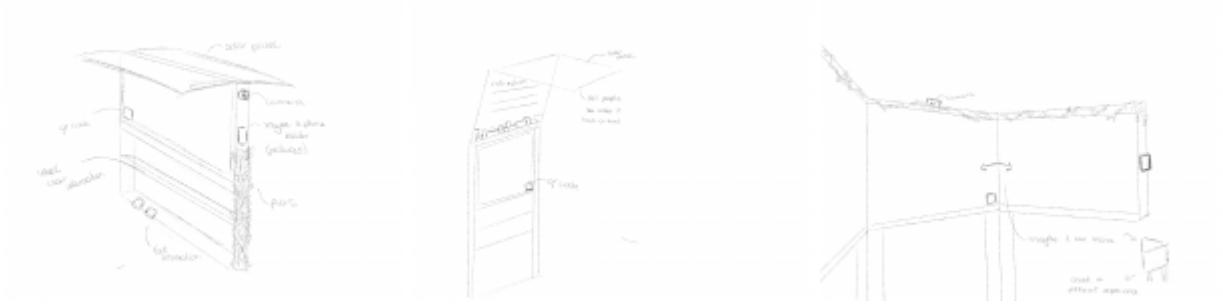


Figure 18: Initial brainstorming sketches

The ideas were thoroughly discussed and the conclusion was drawn, that the participants' focus should be clearly guided to notice the content of the display and understand the purpose of the interaction, instead of using additional gimmicks on the installation for their pure amusement. Therefore, to avoid distracting participants and to keep their focus on the mission of citizen participation in urban planning, the team decided to keep the hardware design of the display simple and minimalistic (cf. Figure 19).

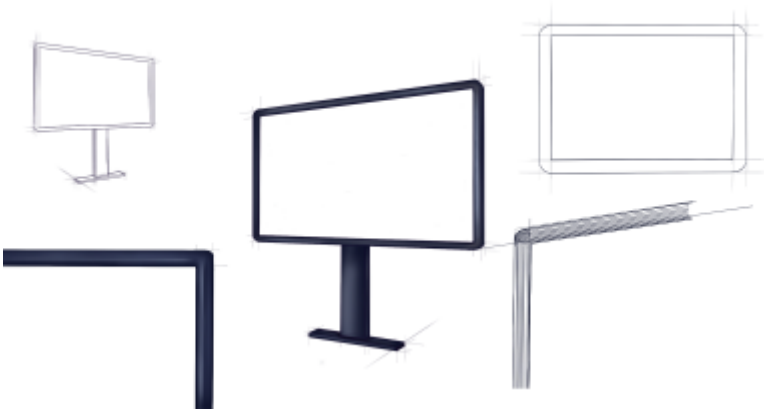


Figure 19: Structural drafts minimal display

To further specify the hardware and software components required to develop the project, a blackbox diagram was created (cf. Figure 20). The blackbox shows that the user interacts with both the smartphone app and the display at the same time. The user provides input on their phone and receives visual feedback on the display. The components required for the display are the screen, a raspberry pi connected to the internet, and a light and movement sensor. Additionally, for the web application, a website frontend must be developed and a shared server and an API must be developed that handle the communication flows and facilitate the application logic. Finally, a database will be created for data persistency. (blackbox diagram, structural sketches and cardboard model)

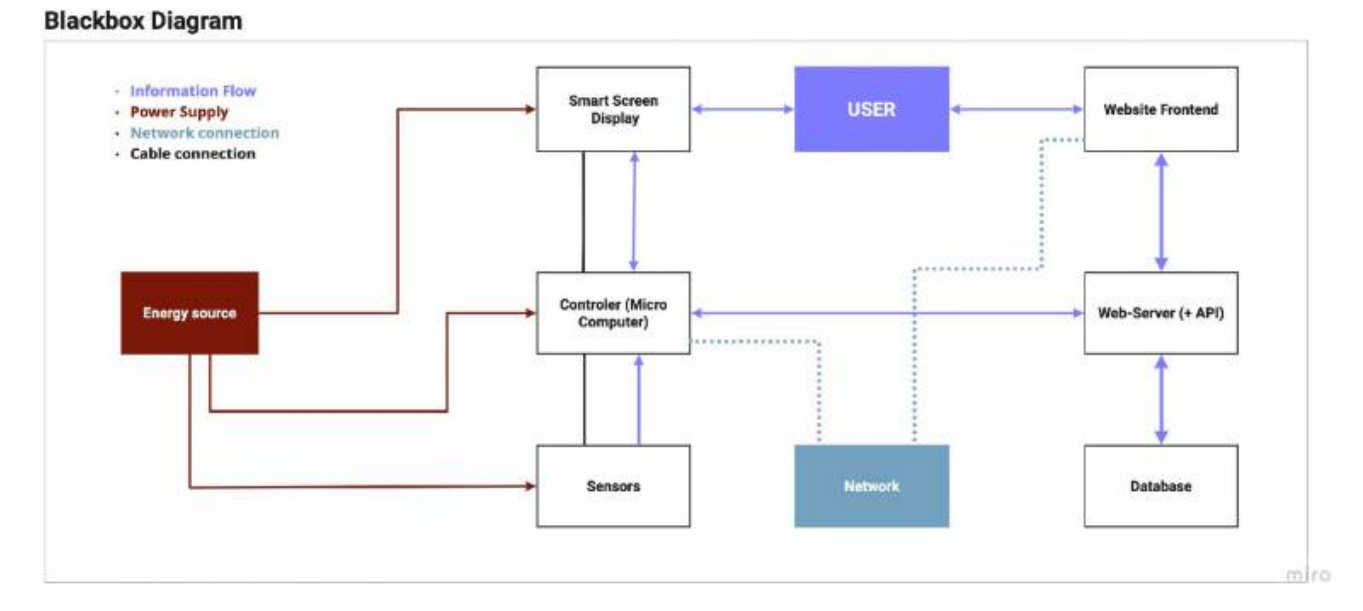


Figure 20: Blackbox diagram

7.3 Concept

This chapter includes the logo design and concerns and requirements for the project

7.3.1 Logo and Designlanguage

The Parcitypate logo was based on the city this project is being originated: Porto. It is the combination of geometric forms that can be seen from Porto's famous buildings.

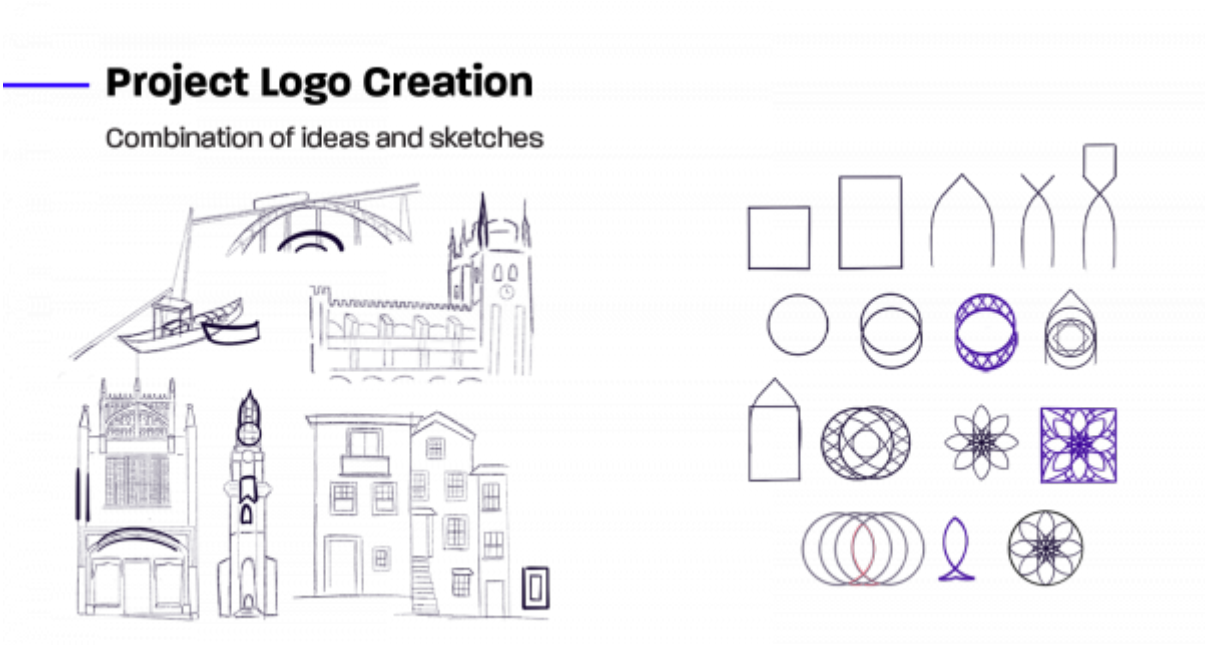


Figure 21: Inspirations for logo design

Parcitypate is the junction of City and Participate, and it was created to represent the idea of

interactiveness of the citizens in the city planning. Adopting a strong and modern typography attached to a representative geometric symbol show the power and importance of our city.

Figure 22: Logo design

There are two variants of the logo. The horizontal is the main application.

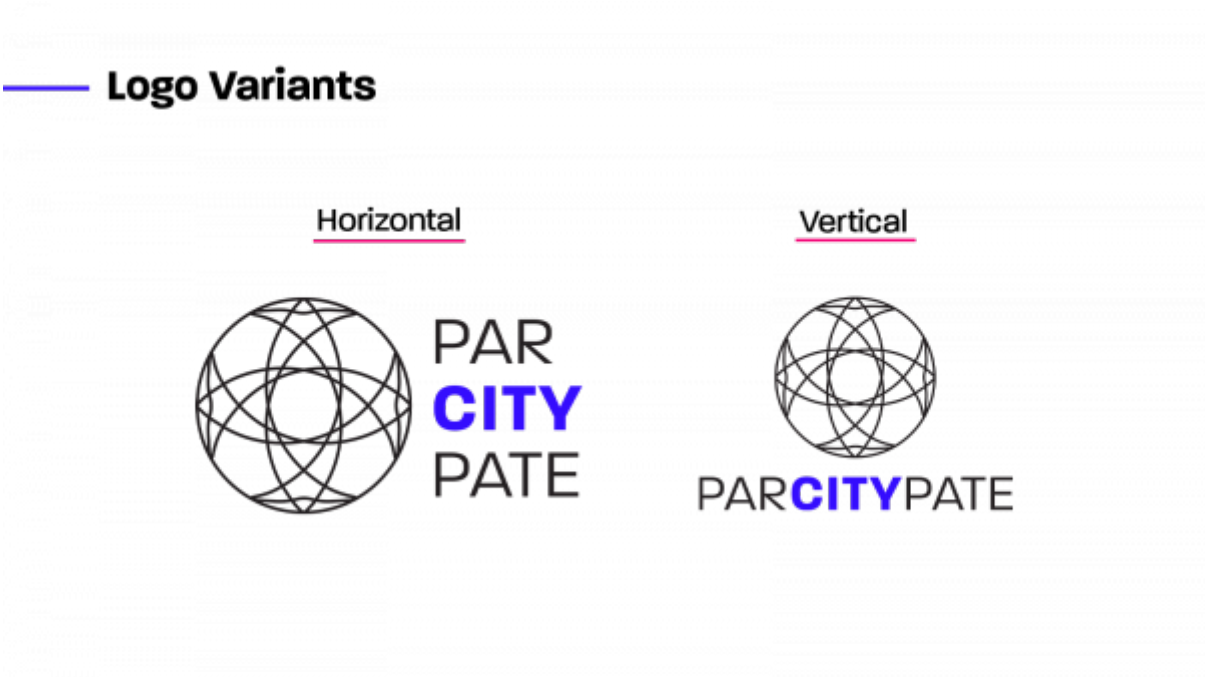


Figure 23: Variants of the logo

The monogram of the logo is the symbol of our project. It can be used as a minor feature to harmonize in the design applications.

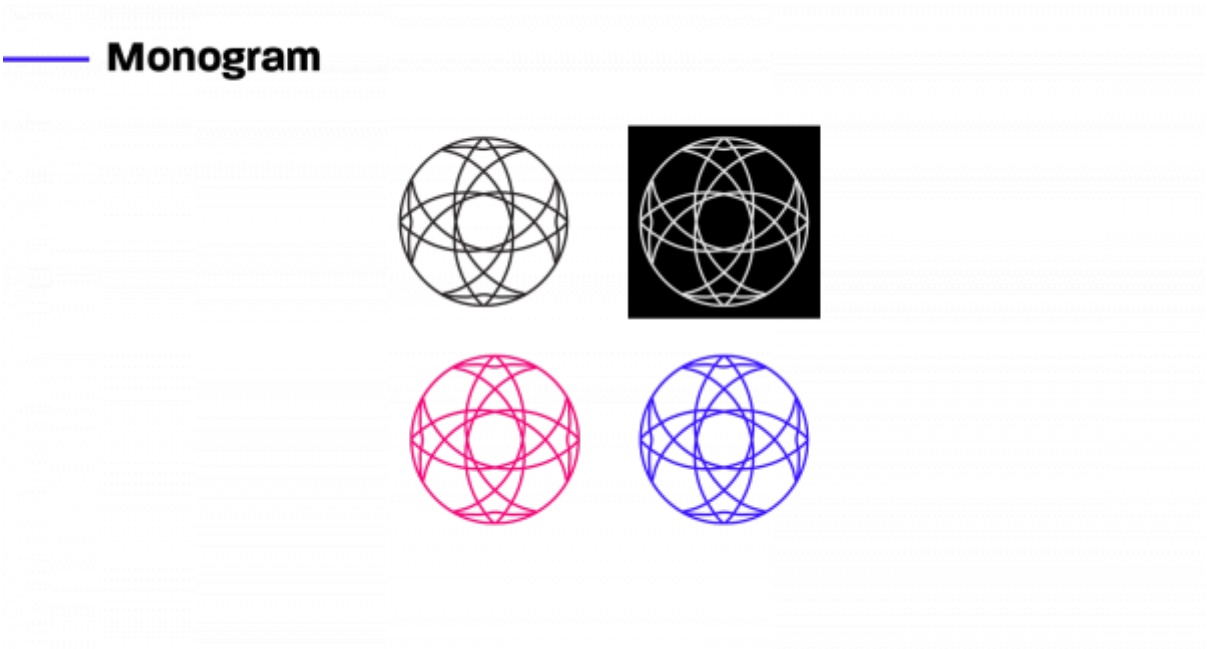


Figure 24: Monogram of the logo

Paralucent and its variants are the choice to embrace the design.

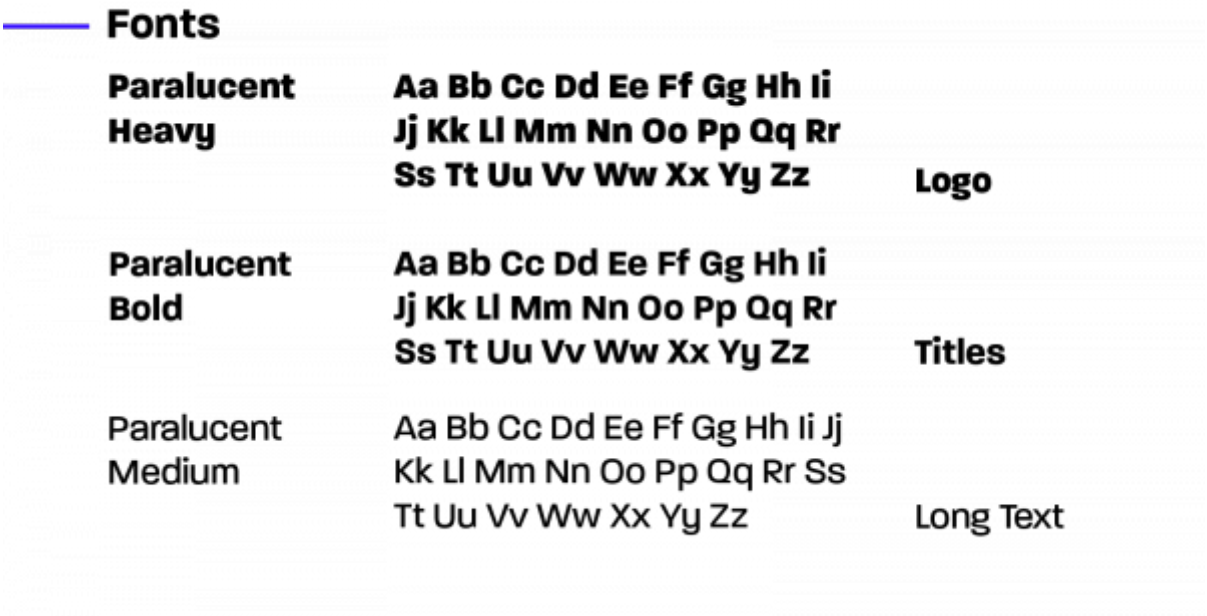


Figure 25: Paralucent font

7.3.2 Requirements and Concerns

As the display will be outside, the key requirement is sturdiness and resistance to environmental influences. Moreover, the screen must detect if there is no audience available and automatically shut off to save energy. Due to the varying light conditions, the screen must have a high maximum brightness and automatically adjust the brightness level. To facilitate the communication, the raspberry pi must have a fast and reliable internet connection.

The content displayed on the screen must take into consideration the location of the installation. For

instance, if there is street traffic nearby, no flashy images or videos should be shown.

Due to the limited budget, the key requirement concerning the software technologies is that they must me open-source and free to use.

7.4 Structural Design

7.4.1 Choice of components

Parcitypate includes a physical aspect which needs several components in order to make it work. These must be defined and selected with precaution to have the best product possible in the end. The main components are the following: a large outdoor screen, a controller, a light sensor and a motion sensor.

The first component to choose is obviously the screen itself. It is the one with the most constraint on it and represents the most expensive part as well as the most energy-consuming part. First, the screen must be quite large (about 1.5 m or so) and the resolution good enough to display the information we need (3D models, etc.).
This screen is going to work in public places and mostly outside, which imposes many properties our screen should have. It must resist cold (-10°C) as well as warm (+40°C). It must also resist chocs (20 or 30 J). Standing outside also means resistance to rain/dust and a good adjustable brightness. But all these constraints force us to choose among screens dedicated for outside usage.
Which brings us to our second criterion: these types of screens are very expensive! At this point, it is becoming very clear that the final price of our product will mostly depend on the price of the screen we choose. For that reason, we must choose the cheapest screen among those with essential features.
In addition, we wanted to make energy consumption weight on the choice process. As I said earlier, almost all the energy used by the system will be used to power the screen. This means that we need to choose a low power consumption screen to have a low power consumption product in the end.

Based on these constraints, we selected this model from LG. Its strongest point is also its biggest flaw. Because it is designed for outside usage, it features every essential feature we need and even more. But this comes with a huge drawback in the price and the power consumption. But these are problems inherent to what we are trying to do and appear even worst on other models from competitors. As screens are not conceived for our specific use, we will have unnecessary features which definitely count in the price.

Once we select our screen, we need to find how to control it. For that, we choose the Raspberry Pi 4 . It provides everything we need: HDMI ports to connect to the screen; an ethernet port to connect to the network; and up to 8Gb of RAM. Although it is a bit more expensive than others Raspberry Pi, the difference in price is negligible compared to the screen cost.

Then we can focus on choosing sensors. There are much less constraints on these than on other components. So, we are trying to find the most reliable ones since the sensor’s prices will not impact the price of our final product. We selected this sensor for light detection, and we chose this one for the motion detection since he provide a 6m range that feat our needs.

Component	picture	quantity	price/unit
light sensor		1	11.60€
motion sensor (6m)		1	9.20 €
Raspberry Pi		1	88 €
Screen		1	6,830.00 €

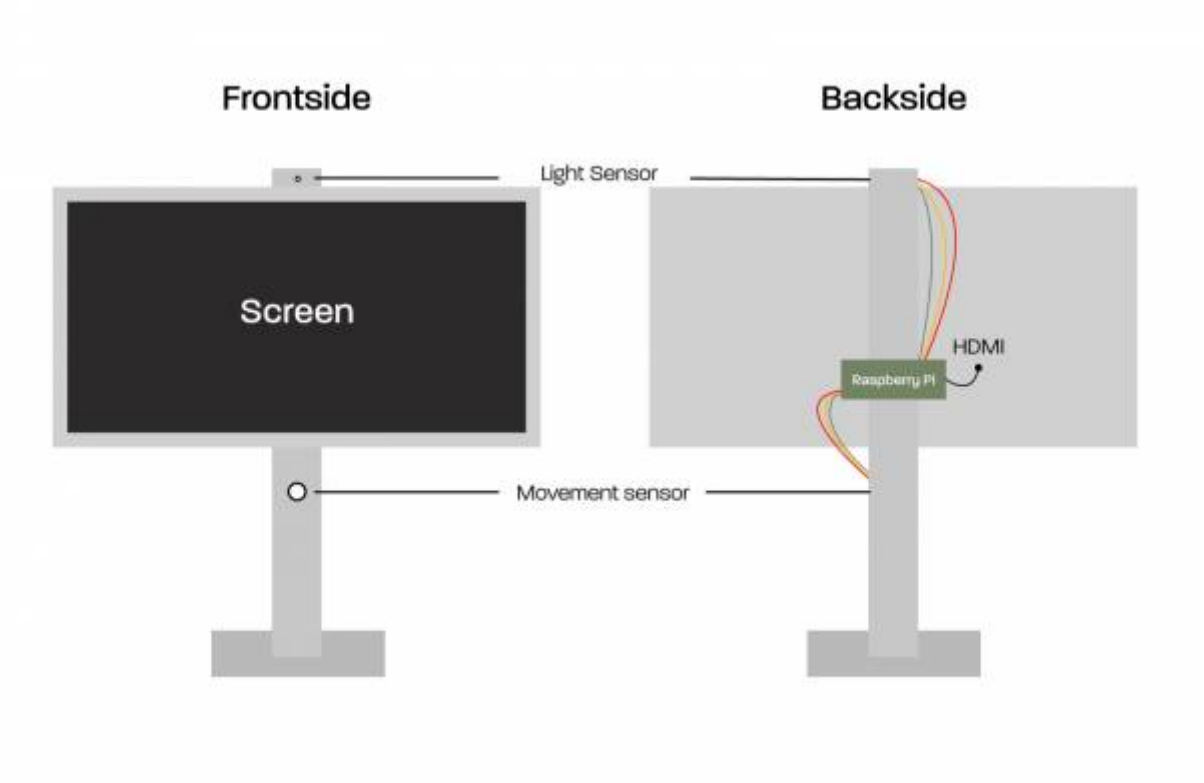


Figure 26: Structural drafts

(selection of materials, detailed drawings, load and stress simulation tests)

7.5 System Design

Detailed Schematics

The software aspect of the project consists of four components, a server, a client for the display, a client for the mobile web application and a database. The server is connected to both clients through WebSockets. When a user interacts with the website on their smartphone, the information is sent to the server. The server then forwards the interaction to the client controlling the public screen. Finally, when a user likes or comments on a model, the information is stored in a database. Figure 27 shows the schematic of the system.

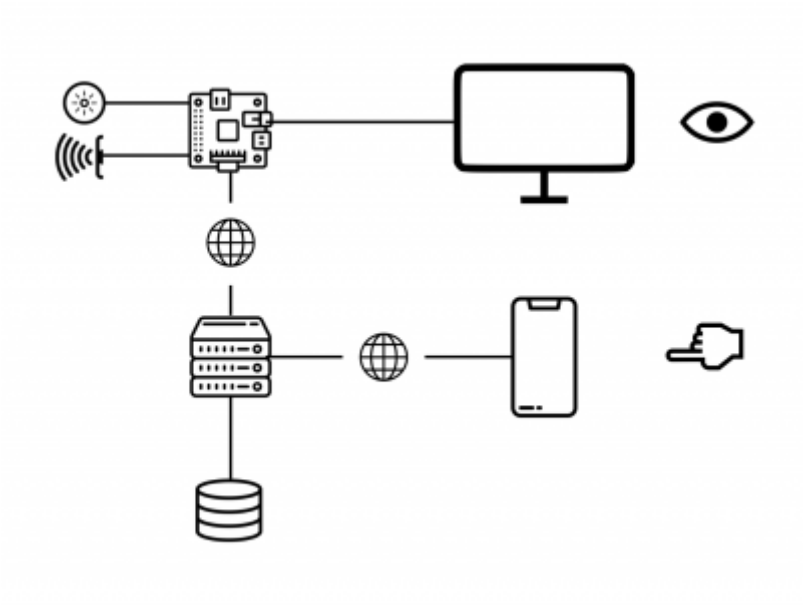


Figure 27: System schematic

Choice of components

To develop the software for the project, the following open-source technologies were selected:

- Server: Node.js - Javascript runtime
- Web-application Frontend: Vue.js - JavaScript Framework
- Screen Frontend: Vue.js - JavaScript Framework
- Database: MongoDB - noSQL database program

Mockups and simulations

After the system requirements were defined and the technologies for the components were selected, the user interface design was created. In order to identify the required views and pages the possible user interaction flows were analysed. The following diagram shows the user interaction flows and outlines the communication between the components (cf. Figure 28).

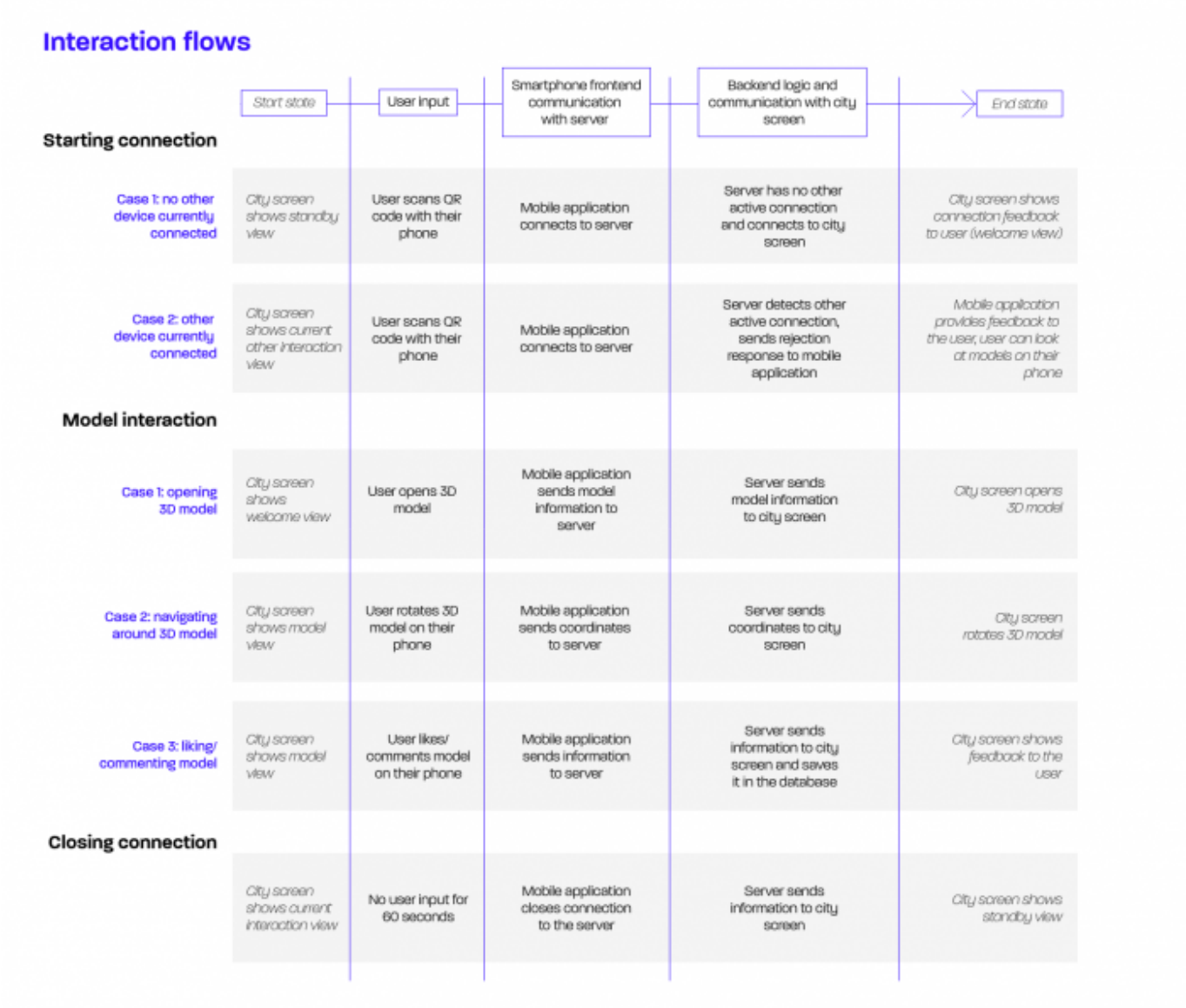
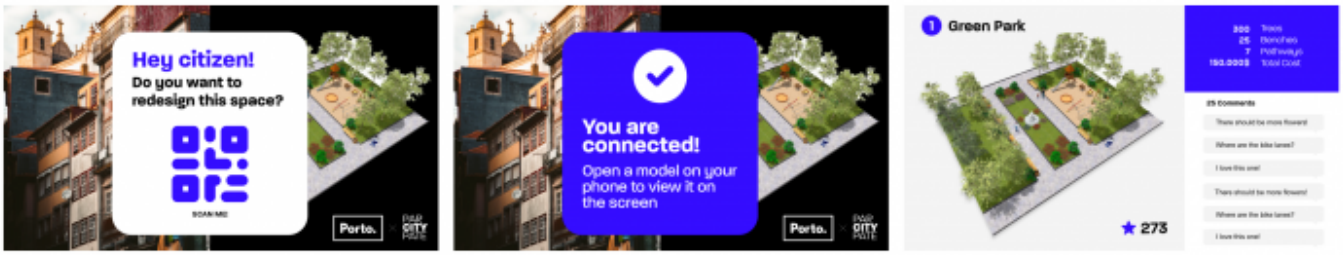


Figure 28: User interaction flows and component communication

Finally, mockups were created for all interface views on the display and the mobile web-application (cf. Figure 29). A simulation of the interaction flow can be found here.



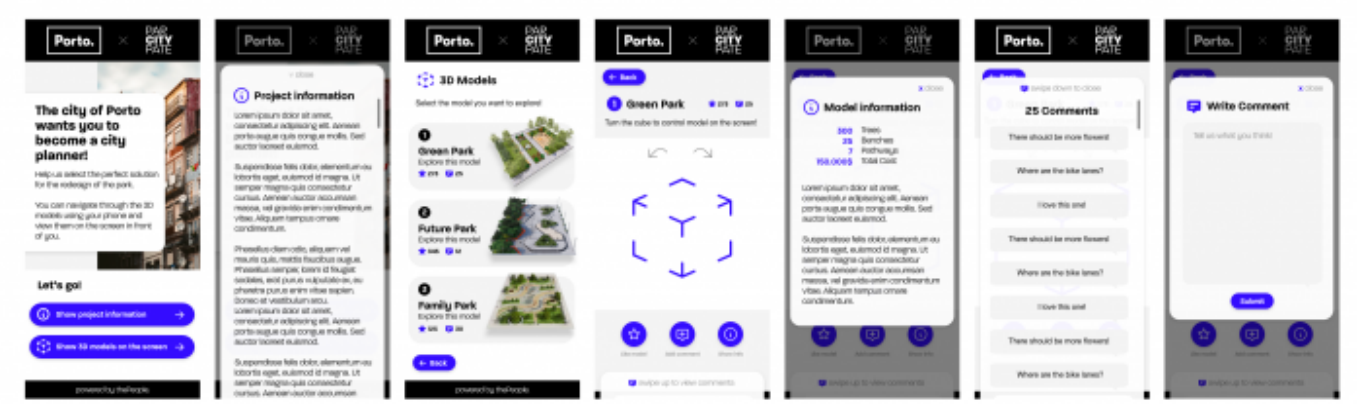


Figure 29: User interfaces

Cardboard model

To be able to imagine the physical appearance of the screen, a model was made from cardboard (see figure 30). In this way, the proportions and physical properties can be easily illustrated.

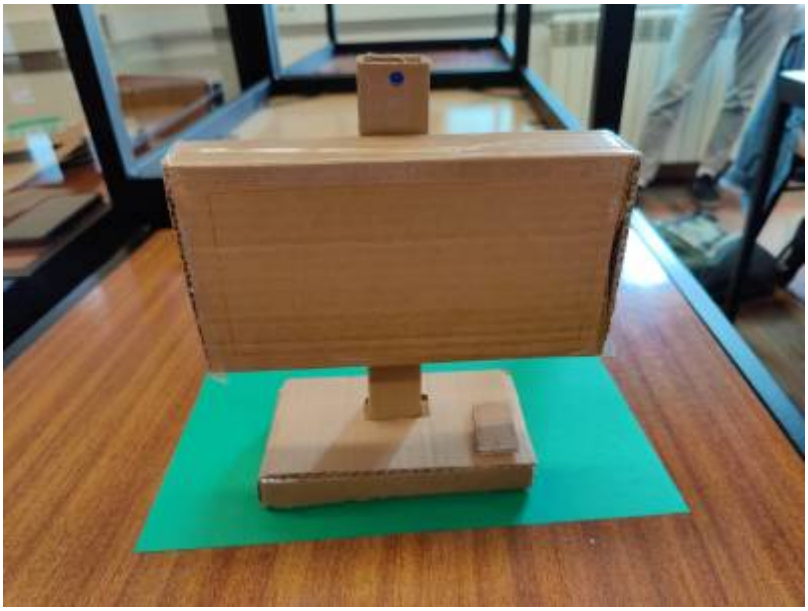


Figure 30: Cardboard model

7.6 Prototype

(in case it is a downsized version of the designed product)

7.7 Tests and Results

7.8 Conclusion

Provide here the conclusions of this chapter and introduce the next chapter.

8. Conclusions

8.1 Discussion

Provide here what was achieved (related with the initial objectives) and what is missing (related with the initial objectives) of the project.

8.2 Future Development

Provide here your recommendations for future work.

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