



Museu del Ferrocarril de Catalunya
a Vilanova i la Geltrú
MNACTEC



Escola Politècnica Superior
d'Enginyeria de Vilanova i la Geltrú

UNIVERSITAT POLITÈCNICA DE CATALUNYA

BIGGING UP THE RAILWAY

Experiencing the past to understand the present

Final Report

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EPS PROJECT

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Abstract

This report is the methodology of how this EPS group of students came together to create an app for the railway museum of Catalonia. We have been asked to do this to allow their visitors to have a better experience of the museum.

The app will not only serve as a comprehensive resource for visitors, but it will also offer practical functionalities. By incorporating these features, we aim to make the museum more accessible and engaging, improving the overall visitor experience. Extensive research has been conducted on existing apps and interactive games to inform the app's layout and interactive elements.

In summary, the Railway Museum Project focused on developing a user-friendly app that enhances the Vilanova Railway Station's visitor experience. By providing comprehensive information, interactive features, and practical functionalities, we aimed to make the museum more accessible and engaging for a wider audience and believe this report shows that.



Acknowledgements

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Thanks also to the Railway Museum for letting us use their facilities whenever we needed them and above all for giving us access to all their historical information. We are grateful to have been able to work with such an important company that represents an enormous feeling and a great change in history for the citizens of Vilanova i la Geltrú.

We would also like to thank the UPC for all the knowledge provided by the different professors who taught the EPS classes in order to create a better group dynamic and thus facilitate the completion of this work.

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4. Introduction

The Railway Museum Project aims to provide visitors with an immersive and educational experience on the history and evolution of railways. Railways have played a significant role in shaping the modern world, revolutionizing transportation, and connecting people and places across the globe. The current issue is that they want to share and create a platform which allows customers more exclusivity into the images and narratives about the start of the Vilanova Railway Station which occurred over 140 years ago.

The team consists of four members; two of which study product design, one studies business administration and the other studies computer science. With the EPS bringing European students together, our team has a diverse set of nationalities consisting of Poland, Finland, Spain and England. We are being monitored and supervised by Joseph Barr and Ana Grande who respectively represent both the EPSEVG and the Catalonia Railway Museum.

The museum is located in the historic steam locomotive depot of Vilanova i la Geltrú in Plaça d'Eduard Maristany and is one of the largest and most important railway museums in Europe.

The project aims to create an easy to use and aesthetic app for the railway museum that provides information about the history of the museum and contents inside, as well as interactive features such as audio guides, virtual reality simulations, and games. The app can also offer directions to exhibits, opening hours, and ticket prices, making it easier for visitors to plan their visit and navigate the museum. Overall, the app can enhance the visitors experience and make the museum more accessible and engaging for a wider audience.

Currently other apps have been researched for layout purposes and other interactive games have been looked at for ideas. Now research needs to be complete about the overall history of Vilanova i la Geltrú's railway history and to design different interfaces and receive feedback.

Roadmap to completing the project:

Phase 1: Planning and research

- Conduct market research to identify best practice in web application design and functionality.
- Study the competition in other railway museums.
- Research the history of the company and the museum.
- Develop a project plan and timeline, with milestones and deliverables.
- Study the necessary requirements of the company.

Phase 2: Design

- Develop wireframes and high fidelity mock-ups of the web application user interface.
- Brainstorm ideas (website style, colours, sections to go inside).



Phase 3: Development

- Build the front-end of the web application using HTML, CSS and JavaScript.
- Research how the backend of the museums is designed.
- Development of the game
- Recapturing all the necessary information to be found inside.

Phase 4: Testing and development

- Conduct user testing and collect feedback to identify areas for improvement.
- Optimise the web application for different devices and browsers.
- Deploy the web application on the museum's servers and make it available to visitors.

Phase 6: Budget

- Research market prices
- Create an estimate of the cost of the product

Phase 7: Marketing

- Create a marketing campaign to promote the product.

Phase 8: Maintenance and support

- Monitor and maintain the web application to ensure that it remains up to date and functional.
- Provide ongoing assistance to users and stakeholders, addressing any issues or concerns that arise.
- Continuously improve the web application based on user feedback and analytical data.

4.1. Goals Objectives and Limitations

Goals objectives

Setting project objectives is essential to provide direction, measure progress, motivate the team, guide decision-making, facilitate communication and evaluate success. Objectives help maintain focus and maximise the chances of achieving the desired results. That is why it has been decided to establish two objectives, one as a group and the other focused on the work.

Personal objectives:

It is important to set clear objectives to ensure that all team members are on the same page and working towards a common goal.

- Effective communication: The main objective of the group is to communicate clearly and efficiently. This involves expressing oneself clearly, actively listening to other members and providing constructive feedback.

- Meeting deadlines: The team agrees to meet the deadlines set for each phase of the project. This involves dividing the work equally, setting realistic deadlines and keeping in regular contact to track progress.

- Active collaboration: All members of the group commit themselves to participate actively and equally in the project. This includes contributing ideas, taking initiatives and sharing responsibilities fairly.

- Quality of work: The aim is to produce high quality work that reflects the effort and dedication of the team.

- And finally and most importantly Mutual learning: The group is committed to using the teamwork experience to learn from each other. This involves sharing knowledge, skills and techniques and helping each other to improve in specific areas.

Objectives on the project

- Identify the purpose: Clearly define the purpose of the app, whether it is to provide information. This objective should guide all design and content decisions.

- Intuitive user experience: Create an intuitive and pleasant user experience, facilitating navigation and access to information. The goal is for visitors to easily find what they are looking for and to be able to interact efficiently with the page.

- Attractive and coherent design: Create a visually appealing and coherent design that reflects the brand's identity and values. The aim is to convey a professional and attractive image that generates confidence in visitors.

- Relevant and quality content: Provide relevant and quality content that meets the needs of users. The goal is to offer valuable information, solve problems and provide an informative and engaging experience.

- Accessibility: Ensure that the website is accessible to all users, including those with visual, hearing or motor disabilities. The goal is to ensure that all visitors can interact and enjoy the site without barriers.

- Social media integration: Integrate the website with relevant social media to extend its reach and allow users to easily share content. The goal is to increase visibility and engagement on social networks.

- Analytics and tracking. The goal is to obtain data that allows for continuous improvement of the site and to achieve the established objectives.

In the following image you can see what will be done in each department to achieve our objectives.



Figure 1: Goal map

Limitations:

Realistically the limitations we can find in this work can be summarized in different aspects.

Mainly, the **technological limitations**. To begin with, it should be noted that the team only consists of one computer scientist who has to take care of a very large part of the programming. In other words, there are limits to the ideas, and these limits are set by the computer scientist. For example, one idea that has been put forward during meetings with the company has been the incorporation of AI in the application, but this requires a lot of time in advance on the part of the computer scientist.

In addition, we have to take into account that another major constraint in this project is **time**. Creating a mobile application takes time. From design and programming to testing and troubleshooting, enough time is needed to ensure that the application is ready for launch.

The mobile application **market** is highly competitive and it can be difficult to stand out from the crowd and create many innovative ideas. It is important to conduct market research and develop an effective marketing strategy to promote the application.

On the other hand, **compatibility** with other mobile devices may not be compatible with certain mobile devices due to technical restrictions, which limits the accessibility for users with such devices. Also the requirements and the series of inspections that have to be followed before an app can be included in the app store or google play.

In terms of **accessibility**, one of the limits that we can find when creating an app for all types of users is its accessibility for disabled people. If the application is not designed to be accessible to people with visual, hearing or physical disabilities, then these people may have difficulty using it.

5. Company

We are collaborating with the Vilanova i la Geltrú Railway Museum to execute this project.

This is a powerful and innovative company with an experiential, heritage, informative, cultural and technical leisure asset at the service of citizens and the train transport sector, a museological reference centre for the railway in Catalonia. An inspiring Museum that stimulates participation, dialogue, curiosity, enjoyment and learning in the railway educational cluster created in Vilanova i la Geltrú.

The museum's mission is to be a vehicle of heritage communication at the service of people through a sample of railway culture throughout history. The stories and experiences that inspire heritage assets are the vehicle to promote knowledge, appreciation and use of rail transport. An inclusive and dialoguing facility, rooted in the territory, in which the movable, immovable and documentary elements and the intangible memory it preserves explore and expose the continuous action of men and women in the innovation of rail transport, as well as the transforming effects of its connectivity.

The company's strategy is to position the Museum as a benchmark in Catalonia for heritage conservation and the dissemination of railway culture, its values and the benefits it brings to the community. To consolidate an attractive, healthy and sustainable museum with a strategic vision.

To extend its educational function to as many people as possible, beyond those who visit the museum in person.

The Vilanova i la Geltrú Railway Museum, also known as the Museu del Ferrocarril de Catalunya, is a museum dedicated to the history of railways in Catalonia, Spain. The museum is located in the town of Vilanova i la Geltrú, approximately 40 kilometres southwest of Barcelona, and is housed in a former locomotive depot.

The museum was founded in 1981, with the aim of preserving the railway heritage of Catalonia. The collection includes over 61 railway vehicles, including steam diesel and electric locomotives, passenger and freight cars, and other railway equipment. The oldest vehicle in the collection dates back to 1854, although the museum has in its collection the only existing replica of the first train that operated in the country in 1848 between Barcelona and Mataró, which this year celebrates its 177th anniversary. The newest was built in the 1980s.

In addition to the collection of railway vehicles, the museum also has a collection of documents, photographs, and other artefacts related to the history of railways in Catalonia. There are also interactive exhibits, including a simulator that allows visitors to experience what it's like to drive a train.

The museum is open to the public all year round, and guided tours are available in Catalan, Spanish, English and French. The museum also hosts special events throughout the year, including steam train rides, model railway exhibitions, and historical reenactments.

This is why an app is being created to help the Railway Museum of Vilanova i la Geltrú to fulfill its mission and strategy. The incorporation of new technologies such as an app can help to update the museum and encourage people to learn more about the history behind it.



Figure 2: Entrance to the Railway Museum

6. History of the Railway Station

Understanding the history of the Vilanova i la Geltrú railway station is crucial to understanding the significant impact on the city and to reflecting on the importance of this project.

To begin with, the appearance of the railway in cities from the mid-19th century onwards was one of the most influential elements in the configuration of the urban layout. In the vast majority of cases, the subsequent development of cities has been caused by the incorporation of railway facilities.

Vilanova i la Geltrú is one of these cases, the layout of a railway line began in 1881. It was conveniently located near the town centre and 1 km from the coast. It was not a simple matter, as it not only consisted of the creation of a station and tracks, but was accompanied by locomotive repair shops, a roundabout and a swing bridge.

Moreover, it was difficult due to the communication of the routes as, historically, Vilanova i la Geltrú has been subjected to a marked isolation. The local roads with Sitges, Vilafranca and other urbanisations were impassable in two directions. On the one hand, due to natural factors, Vilanova is limited by a series of mountains that surround the town. On the other hand, due to the size of the road in relation to the volume of traffic. This made the products more expensive, which left Vilanova in a situation of impossible development in terms of commercialisation.

The town did not have the financial resources necessary for the construction of a coastline. Numerous projects had already been created, but the costs were unattainable for them. It was not until 1878 that Francesc Gumà de Vilanova, who had made his fortune in Cuba, with his own savings and those of the local bourgeoisie, put up the money necessary for the construction of this railway.

This is when the construction of the railway line between Barcelona and Vilanova i la Geltrú began in 1878, and the line was officially inaugurated on 29 December 1881. The railway station was built in the Art Nouveau style, a Catalan version of the Art Nouveau movement popular in Europe at the time. The station building and designed by the engineer Cels Xauradó. The railway line between Barcelona and Vilanova i la Geltrú was one of the first railway lines built in Spain.



Figure3 :Construction of the road

7. Research for External Information

7.1. Researching Previous Projects

First of all, it is not the first time that the Railway Museum works together with the Universitat Politècnica de Catalunya since 2014 the museum has collaborated and developed a wide variety of projects:

- A study of Interaction Design in the Catalonia Railway Museum.
- Developing multimedia actions for the Catalonia Railway Museum.
- Web tool Railway Museum.
- Design of new school activities aimed at primary students combined with the Catalonian Railway Museum and Universitat Politècnica de Catalunya.

We believe it is important to research previous projects to get ideas or improvements, so we have focused on last year's project, which although different as it has other objectives could complement this year's project very well.

Last year's project consisted of creating a microsite (a website with a single function that works together with a main website) that allows everyone (families, school groups, people with disabilities) to plan their visit before coming to the museum.

7.2. Research of other Railway Museums

The Museo del Ferrocarril in Madrid

Location: Madrid, Spain

Exhibits: The museum showcases the history of railways in Spain, including over 30 steam locomotives, other types of locomotives and railcars, exhibits on railway signalling, maintenance, and safety.

Activities: Train rides on a historic railway line, workshops, educational activities for children, and special events.

History: Founded in 1984, the museum is operated by the Spanish railway company Renfe and is part of the National Railway Museum system.

Hours and Admission: Tuesday to Sunday from 10 am to 3 pm. Admission is 6 euros for adults, 4 euros for children aged 6-12, and free for children under 6.



Figure 4: The museum in Madrid

National Railway Museum York

Location: York, England

Exhibits: The museum has a collection of over 100 locomotives and railcars, including the famous Flying Scotsman, as well as exhibits on railway signalling, maintenance, and safety.

Activities: Train rides on a steam locomotive, workshops, educational activities for children, and special events.

History: Founded in 1975, the museum is part of the Science Museum Group and is one of the largest railway museums in the world.

Hours and Admission: Open daily from 10 am to 5 pm. Admission is free, but donations are encouraged.



figure 5: The National Railway Museum York

California State Railroad Museum

Location: Sacramento, California, USA

Exhibits: The museum has a collection of over 20 restored locomotives and railcars, as well as exhibits on the history of California railroads, including the construction of the Transcontinental Railroad.

Activities: Train rides on a historic railway line, workshops, educational activities for children, and special events.

History: Founded in 1976, the museum is part of the California State Parks system and is one of the most popular tourist attractions in Sacramento.

Hours and Admission: Open daily from 10 am to 5 pm. Admission is \$12 for adults, \$6 for youths aged 6-17, and free for children under 6.



figure 6: The California State Railroad museum

Summary:

Despite the fact that all of the museums showcase the history of railroads in their respective nations, there are significant distinctions amongst them—from entry costs to exhibitions and the variety of activities they provide.

The Locomotives they display are all different and the only one to have had an app was the National Railway Museum York, which had designed and created an app in 2012, however it is no longer in service but other museums like the railway museum of Madrid has a mobile app that offers visitors access to audio guides, virtual tours, and interactive maps of the museum's exhibitions, these existing apps can help inspire the Catalonia railway museum app.

The railway museum of Catalonia offers a wide range of ticket pricing to accommodate as many different visitors as possible, starting at a general admission ticket price of € 6.50 and offering discounts for groups, seniors, students, single parents, etc. Children and train company employees can visit the museum for free on days when it is open, and entry tickets can be purchased in combination with short-distance train tickets for €10. Almost no other railroad museum offers this service, which makes it stand out from other museums.

7.4. Research of other Railway Museum Apps

There are not many railway railway apps out on the internet, however, we have found one from Japan. [1]

Their app provides detailed information on every exhibition, and multilingual support, for over 10 languages.

The key features are:

- Special exhibition page - for limited time exhibitions.
- Experience and events page - for interactive events.
- User guide - which are the rules for the museum.
- Magazine review - The website has a page from a japanese railway magazine review.
- Audio guide - Shows how to use the in app audioguide for each exhibit.

We needed to look into other museum apps to help give us ideas of what to include into the app, as this website was good but there are not others to compare it too.

7.5. Research of other Museum Apps

There is a wide variety of applications for museums, depending on the specific needs of the institution and its visitors. Here are some examples:

Museum mobile apps: Many museums have their own mobile apps that visitors can download to their smartphones or tablets. These apps often include exhibit information, maps, schedules, and other useful information.

Audio guides: Some museums offer audio guides that visitors can rent or download to their own devices. Their guides provide detailed information about specific exhibits or collections.

Augmented reality apps: Some museums use augmented reality technology to enhance the visitors' experience. These apps may include virtual tours, interactive exhibits, and other features.

Having seen the types of apps that can exist within a museum, a search has been made for different apps that can be of help or inspiration for our own uses that allow visitors to explore exhibits in new and innovative ways.

Because there are not many apps for train museums, it has been necessary to research museum apps in general.

Rijksmuseum, Amsterdam

The Dutch are known for their rich cultural heritage. Most of the artworks by Vermeer, Rembrandt, and Van Gogh can be seen here. The Rijksmuseum app is one of the most elegantly designed museum apps available. [2]

Features:

Users can purchase e-tickets and swipe them at the entrance from the phone.

- The Rijksstudio section allows users to scroll through the extensive collection and view them from any angle.
- The artworks are accompanied by an audio clip that enables the user to better understand its history through commentary.
- Animation provides an exciting experience.
- Acts as a personal tour guide app for guided tours of the museum at the user's own pace.



Figure 7: The app

The Smithsonian’s National Museum of African American History and Culture (NMAAHC), Washington DC.

The latest addition to the extensive Smithsonian Museums, the NMAAHC, was the first museum to have a web presence even before it opened. The NMAAHC app offers an enhanced experience of American history through the eyes of African Americans.

Features:

- Filled with video clips and AR to add more interactive elements into the user’s visit.
- Built-in floor-by-floor map that allows the user to zoom in on any of the eight levels.
- Information and alerts about upcoming events that a user might be interested in.
- Users can let friends know about their experience through in-app social media integration.
- Users can share stories and suggestions with others through the app.

By focusing on letting users create and share their ideas using the app, the museum has been able to build a community of loyalists and create a mechanism of getting direct feedback from their patrons.

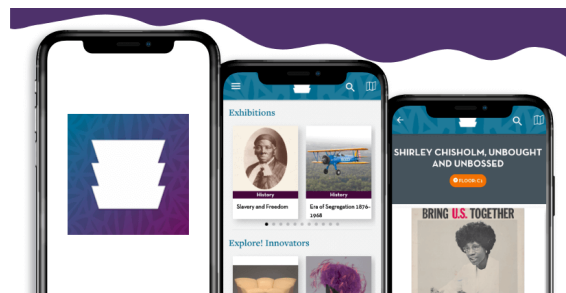


figure 8: The app in national Museum

Living museum: Botanical garden featuring augmented wildlife

The augmented reality tours occur in the tropical greenhouses and include 20 interactive and educational games for kids and visitors of all ages. During the AR tour, digitally augmented animals seamlessly appear blending in with the garden premises, as seen below:



Figure 9: The Botanical museum app

Each 3D animation is accompanied by a story and a purpose that complements the message that the botanical garden touring specialists want to tell.

Digitalized Gauguin art with a detailed 360-degree view

A comprehensive art-exposition app includes augmented reality technology to integrate detailed 3D models, allowing users to observe art pieces up close as if they were in their hands. The collaboration between Wikitude and Wezit started with the launch of an application for the RMN in Paris in 2016, entitled “Gauguin L’alchimiste”.

To gain a better understanding of Gauguin’s artistic approach, the Museum wanted to offer multiple digital tools for mediation, publishing, and communication, based in particular on a major 3D capture and modelling campaign. [3]

A total of thirty works of art were digitised with very high precision. For this task, the RMN referred to its own photography agency using an exact 3D scanning technique, allowing visitors to explore and appreciate Gauguin’s work from a different point of view, revealing many details of:

- 21 Ceramics and carved wood elements
- 11 Paintings

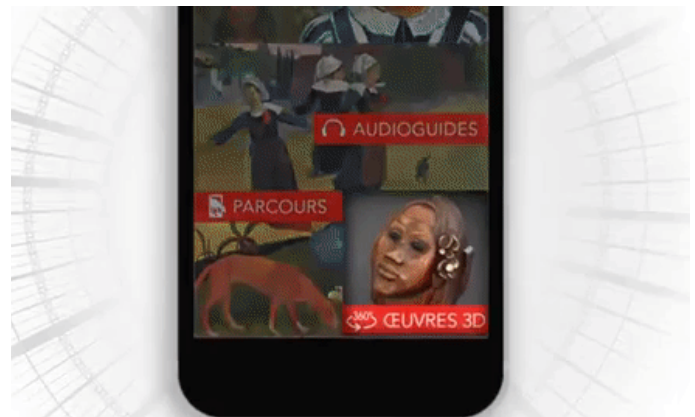
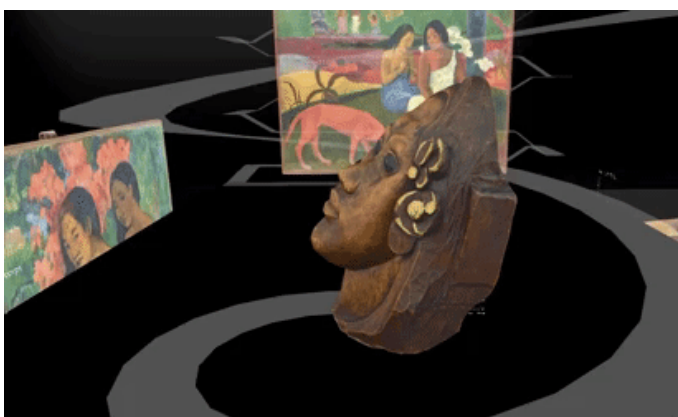


Figure 10: 360 Degree view

Tate Trumps:

This app uses a gaming interface to teach visitors about works of art in the Tate collection. Visitors compete in games that test their knowledge of the artworks and their history. [4]

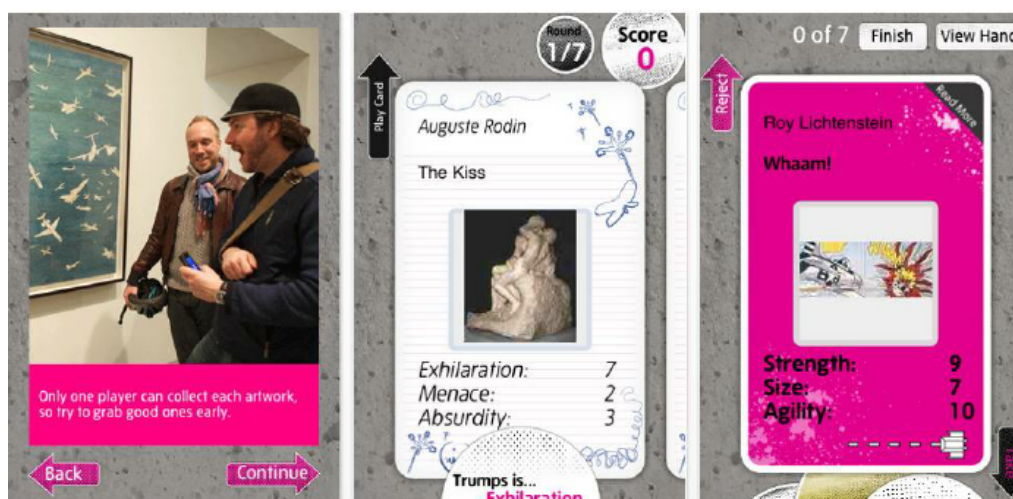


Figure 11 : The game of tate trumps

Google Arts & Culture:

This app offers a wide range of content from museums around the world, including virtual tours of exhibitions and collections, as well as high-resolution photographs of works of art.

The app also has an augmented reality feature that allows users to interact with works of art in their own spaces.

In addition, the application reserves a curious space that allows you to take a photo of yourself and look for similar characters in the paintings in its database or find paintings in which the colours of the photo you take predominate.

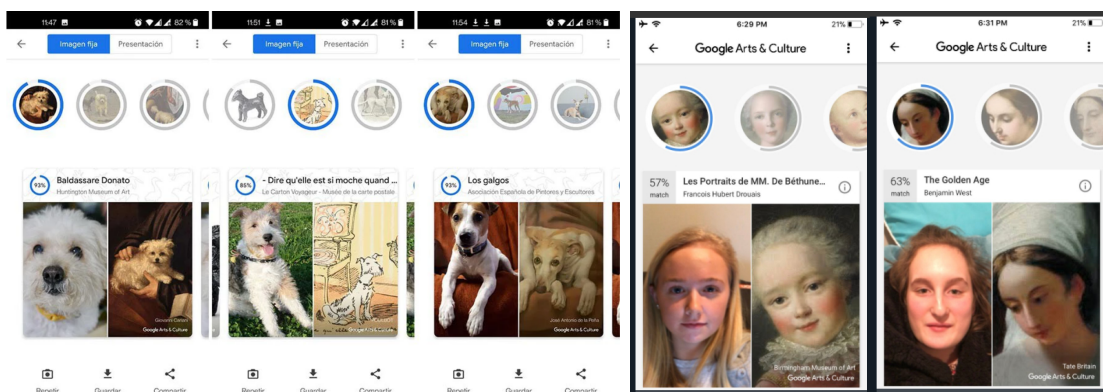


Figure 12: Google Arts

The MoMA app

The MoMA app is also an official app, in this case of the MoMA in New York, the museum with the most important collection of modern art in the world. Through the app you can be informed of all the temporary exhibitions that are going to be held, as well as visit its extensive permanent collection.

It has extra functions such as MoMA Snaps, which allows you to take a snapshot of your favorite work and share it with your friends, or choose a playlist that will accompany you in the background during your visit to the museum. It's a pity that many of the explanations are only in English, but at least this museum app is free. [5]

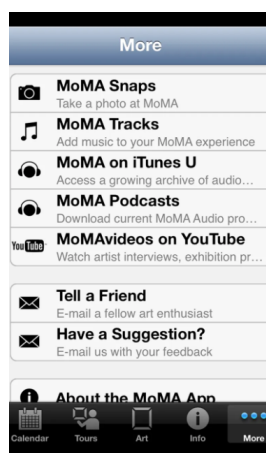


Figure 13: Google Arts

Project AMUSE: the App for all people in smart museums

Beeacons are smart indoor guidance beacons that make it easier for blind and visually impaired people to identify places and locate nearby objects.

They are placed at points of interest and connect to mobile devices via Bluetooth, making it easier for blind people to find their way around an unfamiliar space. When a user approaches the area where they are located, the beacons notify their presence with an audible alert, verbal message or vibration. Once users connect to the beacons, they can obtain information about objects in the environment and data such as the distance or size of the room or area they are in, as well as extended information about the identified objects.



Figure 14 : Project AMUSE

Kohl's Art Generation app at Milwaukee Art Museum, Milwaukee

Why you need it: The whole family can learn about art through games, videos and scavenger hunts with this app that was created specifically with little ones in mind. Kids will especially enjoy "A is for Art," an alphabetical guide to the institution's most popular pieces and the "selfie art" filter, where they can add their photo to a picture of 18th and 19th century art. [6]

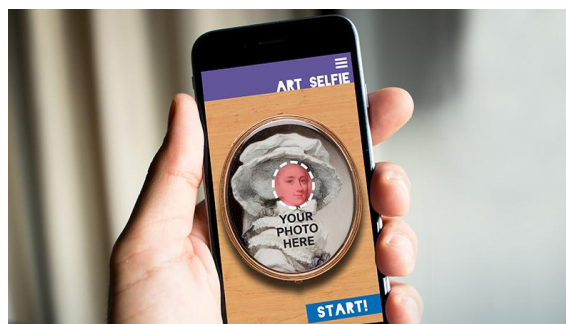


Figure 15 : Milwaukee Art museum

Tate Kids

In the UK, Tate Kids is a 360° programme with both online and offline activities at the different museums in London, Liverpool and St. Ives. It includes family events, such as drawing stations in the galleries themselves. The Tate Kids Draw & Play app is accompanied by a website with games and quizzes, art history lessons specially designed for children and downloadable instructions for DIY art projects, the results of which can be shared in the Tate Kids online gallery.

Figure 16 : Tate kids



7.6 Web Apps over Native Apps

For native apps:

Increased functionality: Native iOS and Android apps can offer increased functionality, such as utilizing native device features like the camera, microphone, and GPS. This can allow for a more personalized and immersive experience for visitors, enhancing the overall museum experience.

Improved performance: Native apps can be optimized for specific devices, resulting in faster load times, smoother transitions, and better overall performance compared to web apps. This can enhance the user experience and improve visitor satisfaction.

Offline access: Native apps can be designed to work offline, allowing visitors to access museum content even if they don't have internet access. This can be particularly useful in museum settings where Wi-Fi or cellular connectivity may be limited.

For web app:

Cross-platform compatibility: A web app can be accessed from any device with an internet connection, regardless of the operating system or platform. This can help to ensure that all visitors can access the museum content, regardless of their device preferences.

No need to download: With a web app, visitors do not need to download and install an app, which can be a barrier to entry for some visitors. This can also help to save storage space on visitors' devices.



Easier updates: Web apps can be updated more easily compared to native apps, as updates can be pushed automatically to all users without requiring them to download a new version of the app. This can help to ensure that all visitors have access to the most up-to-date museum content and features.

Lower development costs: Developing a web app can be more cost-effective compared to developing separate iOS and Android apps, as the code can be reused for multiple platforms.

Flexibility: With a web app, there is greater flexibility in terms of design and functionality, as the app is not limited by the features and restrictions of specific devices or operating systems. This can allow for greater creativity and customization in the app's design and features.

Summary:

Overall, while developing a web app may have some limitations compared to native iOS and Android apps, such as limited access to device features and reduced performance, it offers cross-platform compatibility, easier updates, lower development costs, and greater flexibility in design and functionality.

7.7 Coding Language

As developers, we thoroughly examined a wide array of both front-end and back-end technologies before making our final decision. On the front-end side, we considered AngularJS, ReactJS, VueJS, and even the prospect of developing a Native App. Each technology presented its strengths: AngularJS with its robustness and two-way data binding, ReactJS with its vast community and flexibility, VueJS with its simplicity and quick learning curve, and Native Apps with their top-notch performance and access to device features.

Similarly, we explored various backend options such as Firebase, AWS, Azure, and Heroku. Firebase attracted us with its scalability, real-time database, and strong integration with Google services. AWS presented a comprehensive suite of tools and services but at a more complex cost structure. Azure, with its seamless integration with other Microsoft products, was also considered. Heroku, on the other hand, is known for its developer-friendly setup and automatic platform updates.

In our evaluation, we weighed the merits of each technology against our project requirements, budget, and timeline constraints. AngularJS emerged as a clear choice for front-end development, and Firebase was selected for the backend, given its features and cost-efficiency perfectly aligning with our needs. This thoughtful exploration and selection process played a pivotal role in successfully delivering our project on time and within budget.

In conclusion, AngularJS and Firebase were chosen not only because they aligned with our developer's experience but also because they offer features perfectly suited to our project's needs and constraints. We have also prepared tables with characteristics of each technology to present our decision process.



Frontend Technologies Comparison:

Front end, in the context of web development, refers to the user interface and user experience aspects of a website or web application. It encompasses everything that a user directly interacts with when using a web platform. This includes all visual and interactive elements, such as buttons, navigation menus, forms, text, images, videos, and overall layout and design.

Front end development is primarily concerned with the user's experience and interface functionality. It aims to present information in a visually coherent and user-friendly way, ensure the platform is responsive to different screen sizes and device types, and facilitate smooth user interaction with the system.

Our decision-making process was supported by a thorough analysis of various front-end technologies. The table presents a comparative assessment of these technologies across several critical dimensions.

Technology	Angular JS	React JS	Vue JS	Native Apps
Learning Curve	Moderate	Steep	Easy	Steep
Popularity	High	Very High	Rising	High
Community Support	High	Very High	Rising	High
Compatibility with Firebase	High	Moderate	Moderate	Moderate
Development Speed	High	High	High	Low



Developer Familiarity	High	Moderate	None	Moderate
-----------------------	------	----------	------	----------

Table 1: Fronted technologies Comparison

Backend Technologies Comparison:

The back end, in the context of web development, refers to the server-side components of a website or web application that handle data management and business logic. It's the part of a web platform that users do not directly interact with, yet it's critical for the platform's functioning.

Back end development is responsible for managing and orchestrating tasks like database interactions, server configuration, logic implementation, and data processing. The goal of the back end is to support the front-end experience with reliable data handling, efficient computation, and robust security measures.

In summary, the back end of a web platform is the server-side part that operates behind the scenes to make the front-end user interaction possible. It's an essential part of a web application, working in tandem with the front end to create a cohesive and functional user experience.

Our decision-making process was underpinned by an extensive evaluation of a range of back-end technologies. The table provides a comparative study of these technologies across several crucial aspects

Technology	Firebase	AWS	Azure	Heroku
Scalability	High	Very High	Very High	Moderate
Cost Efficiency	High	Moderate	Moderate	High



Real-time Database	Yes	No	No	No
Integration with Google Services	High	Low	Moderate	Low
Authentication Services	Yes	Yes	Yes	Yes
Developer Familiarity	High	Low	Low	High
Development Speed	High	Moderate	Moderate	High

Table 2: Baceknd technologies Comparison

8. Design of the App

8.1. Initial Designs

In order to create the design of the app we first created three prototypes designed at the midterm before making a decision with the company on which prototype to choose.

First prototype

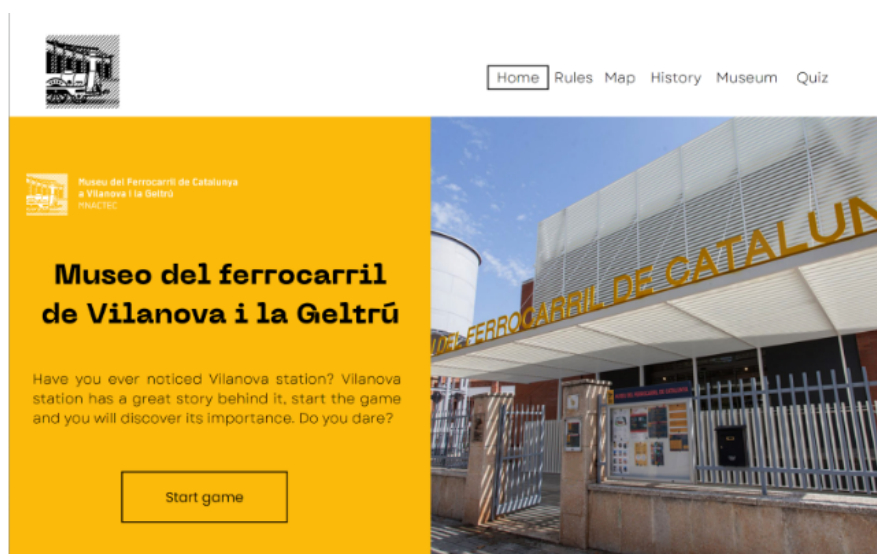
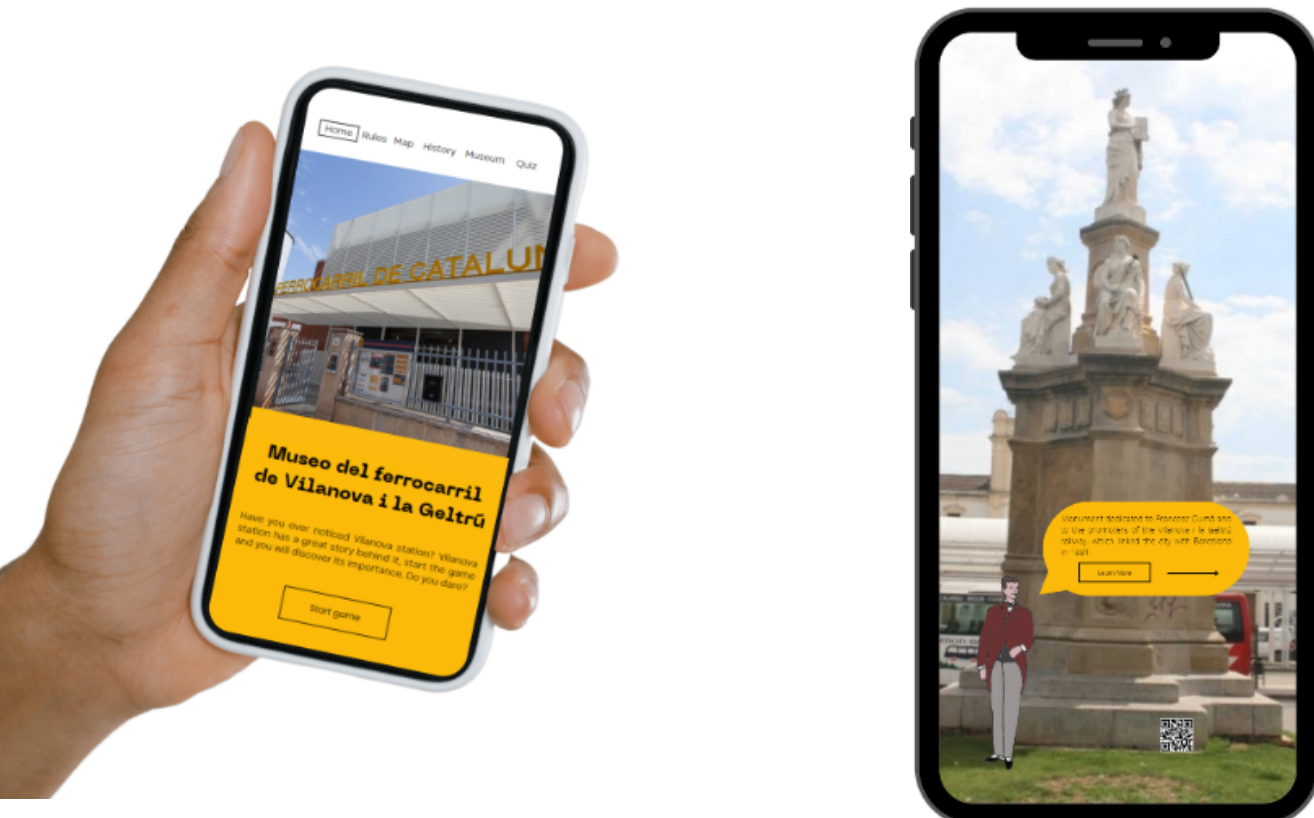


Figure 17 : Prototype

Second prototype



Figure 18 : Prototype

Third prototype

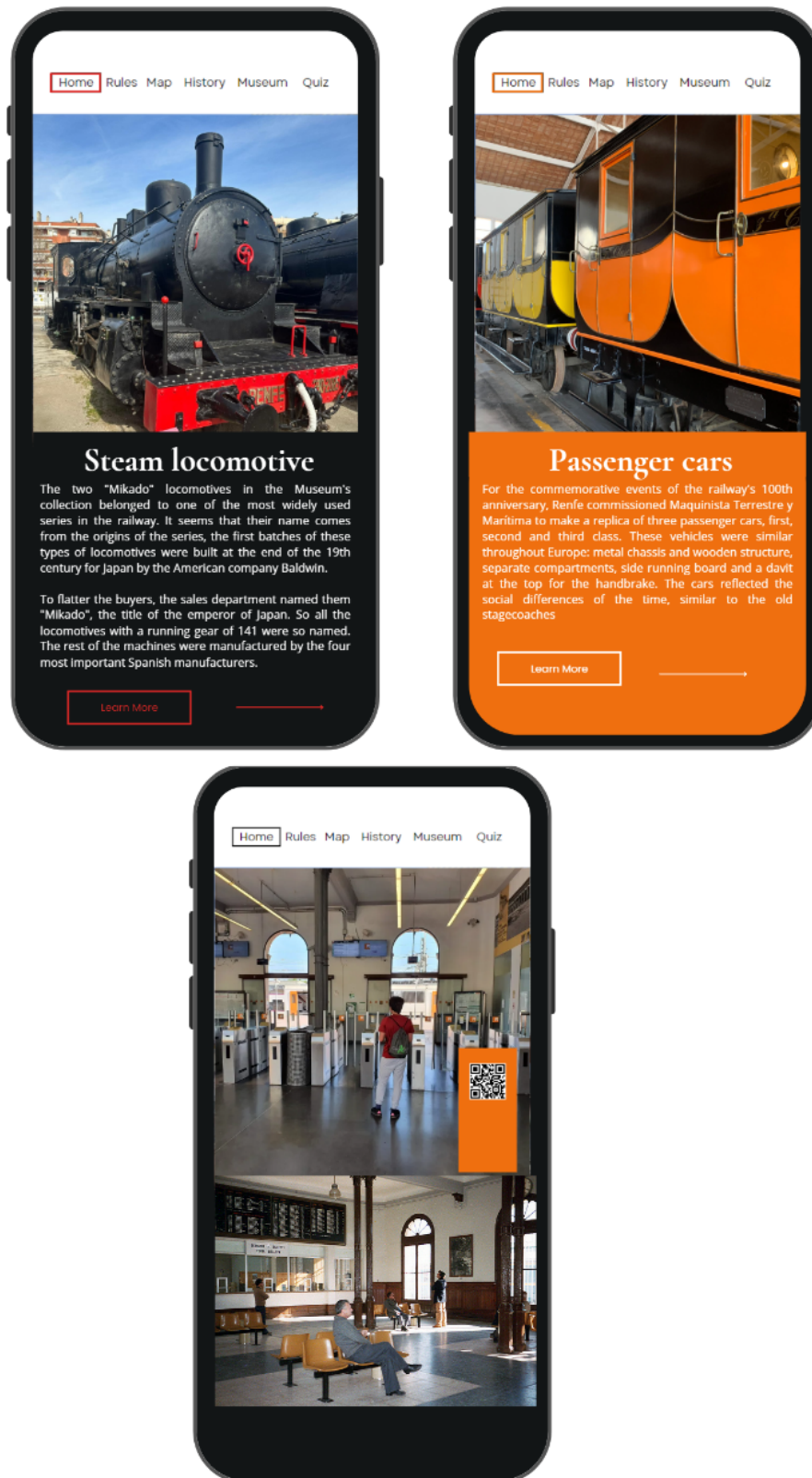


Figure 19 : Prototype

8.2. Design Development

When you have to develop an application for such a generic audience, i.e. an app for all age groups, there are several important aspects to take into account.

To begin with, the first point that we must face as designers of an app is the wireframes (the diagrams or plans of the different screens), this is the most complicated point. Here is where the most creative part has to be extracted, several things have to be taken into account such as: the different icons that will be used, where they will be located, how to distribute them within a screen so that they are easier to find and use. In other words, in this part, the most important things are: usability, coherence, simplicity and that the information is located in the easiest way for everyone.

In the following, we will explain the procedure and the aspects we have taken into account to arrive at the final design:

First of all, we have investigated the interface of apps that are very popular for this, as these apps have a reputation for being very easy to use. [7]

Evernote, this is the most complete notes application for android, its interface is very simple and easy to use, the menus are very well placed so that everything is very intuitive.

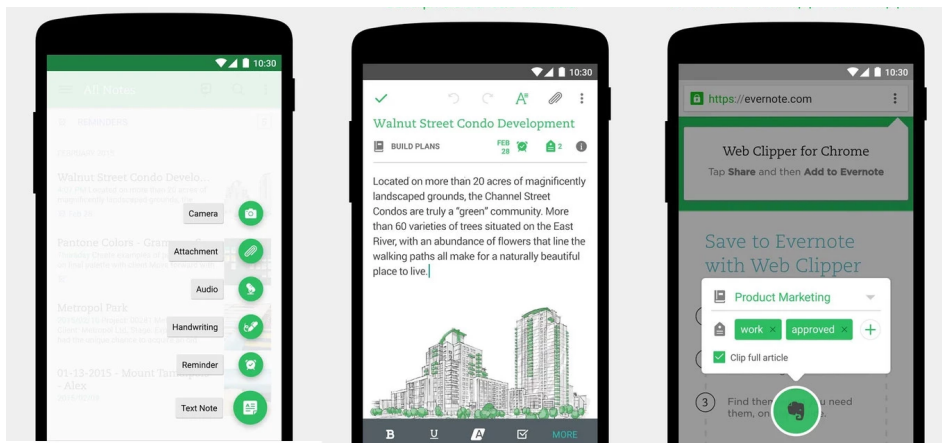


Figure 20: Evernote

We can also see solid explorer where the icons represent each element very well.

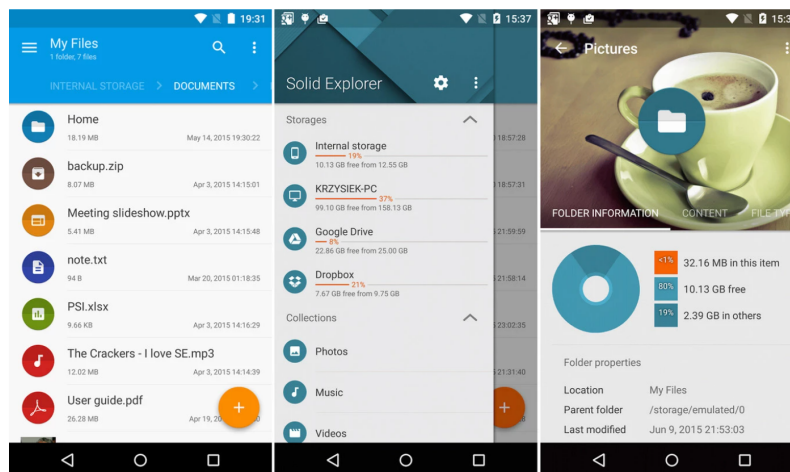


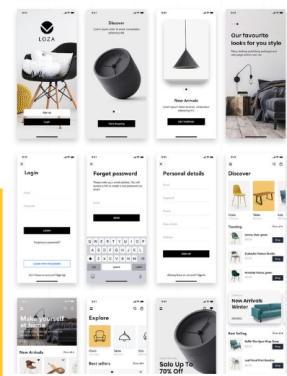
Figure 21: solid explorer



Secondly, you will use a tool called moodboard. This is basically a collection of different visual elements. A personal collection of ideas and concepts. Thanks to them, we build a board like a collage, trying to find our own look & feel. This moodboard will help us to define the visual style that our project will have later on.

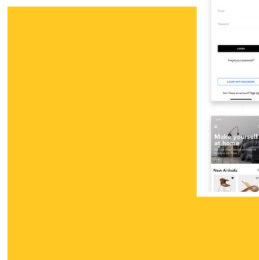
Its main role is to provide inspiration and focus. The moodboard is the step before the visual identity design process, where the logo will be developed, a corporate colour palette, typography, etc. will be chosen. The moodboard will set the guidelines for the subsequent design phase.

Icon typology



Types of images

Colours



Typologies of letters



brand logo

Figure 22: Moodboard

Thirdly, sketches have been created to begin to give shape to the app and distribute where everything will go, some of the sketches are the following that you can see in the figure (figure23). During the sketches we start to take into account the interaction, in this case we are talking about a web that is going to be seen on a mobile phone, therefore we will not use a mouse but the hand. Here we have taken into account the maximum use of space so that the displacement, gestures made with the fingers is the least possible. It should also be designed for left-handed people as well as for right-handed people. [8]

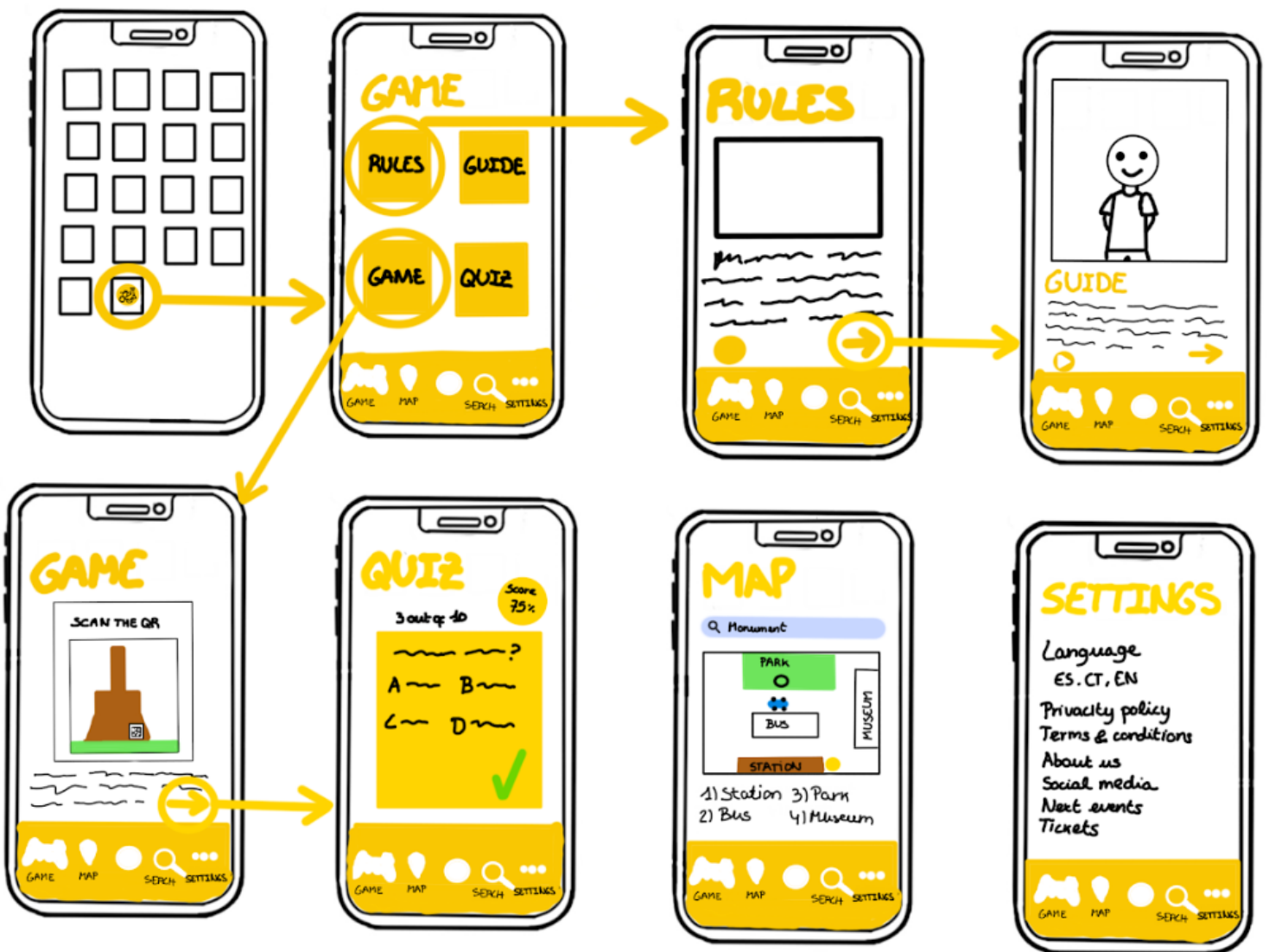


Figure 23: Design prototype

The fourth step was to choose the range of colours we wanted for our app. This step depended on the client, the client was proposed 3 colours: blue, multicolour (colours related to the trains that are in the museum) and finally yellow, these colours were chosen taking into account the issue of accessibility and the representation that it could mean for the museum. The client chose yellow, we looked at the pantheon range to see which yellow would be the most representative. [9]

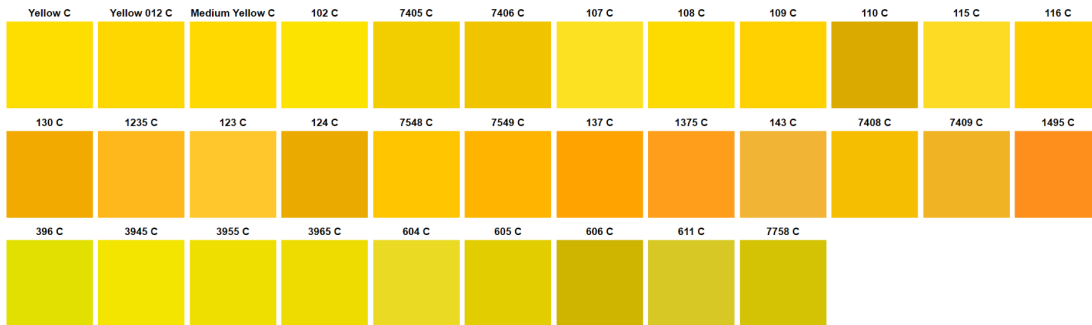


Figure 24: Pantone game

Finally the chosen colour was:



In the fifth step: The interface had to be chosen. The interface are those small icons where the user interacts with them. These are made up of many elements (graphics, buttons, backgrounds, ...). In this case we have opted to create a simple interface, easy to use, minimalist and not saturated with icons that may confuse the user.

On the other hand, when designing the app you have to take into account whether you are going to use native or custom interfaces. The difference between the two is that: The native interfaces the vast majority of design elements are given by a platform, while custom interfaces are created under their own criteria. In our case, the vast majority of interfaces are native to make it easier for the computer scientist, these are taken from the Figma and Canva platforms, apart from being icons with which users are more familiar. But it should be noted that the home interface is customised using the railway museum logo as a reference. [10]

Figma native interfaces



Figure 25 : Native interfaces



This is the play icon used to activate the audio that reads the text.



If you click on this icon you will be directed to the page where the game is located.



With this you will be able to locate yourself on the map, because during the game you will need to locate yourself on the map many times, that's why it's in the control panel.



This icon will take you to a page where you can see the QRs you have acquired and the ones you still need to collect to finish the game.



The three dots mean settings here are where the player can change the language of the game, view the privacy policy and others.



The scanning of the QR will be constant during the game so it will always appear on the screen.



The arrows will help users to turn the page or to go back.

Customised interface

This icon will be clicked when the user wants to return to the main page.



Figure 26: Home icon



Figure 27: Railway museum icon

Sixth: As in any design, it is very important to make good use of typography, but it is in applications where it is even more important. This is due to the fact that on a small screen the light conditions may vary depending on how you use it, as well as the readability and contrast being as good as possible, especially for older users who tend to have more difficulty reading on their mobile.

For the app we have chosen different typographies, the criterion has been that they should be easy to read and also that they should be in line with the application, which in this case is an application where the vast majority of the content is games, as well as having a lot of informative/historical content.

For the titles of each section we have used:
The **Anton** typeface with a letter spacing of 3%.

For subtitles is used:
The **Hind Guntur** typeface

For the informative texts, the following has been used:
The **Lustria** typeface

The lettering colours are yellow for titles and black for subtitles and normal text.

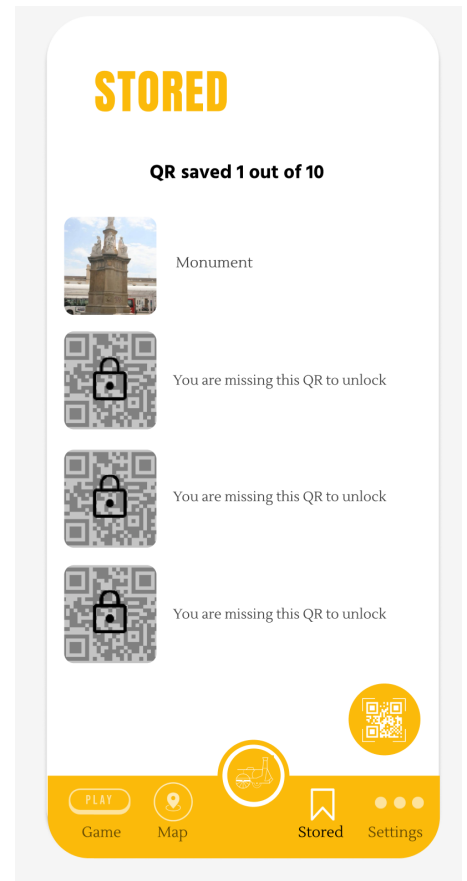


Figure 28 : One app page

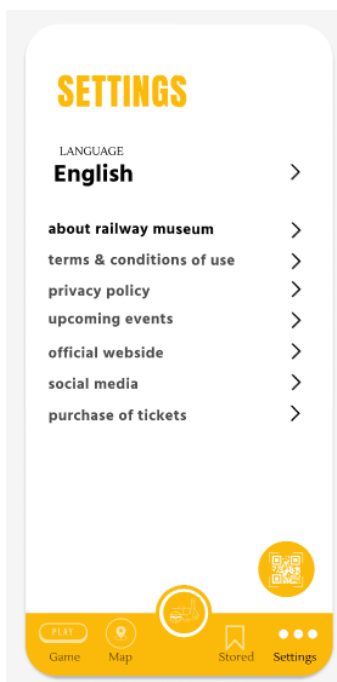
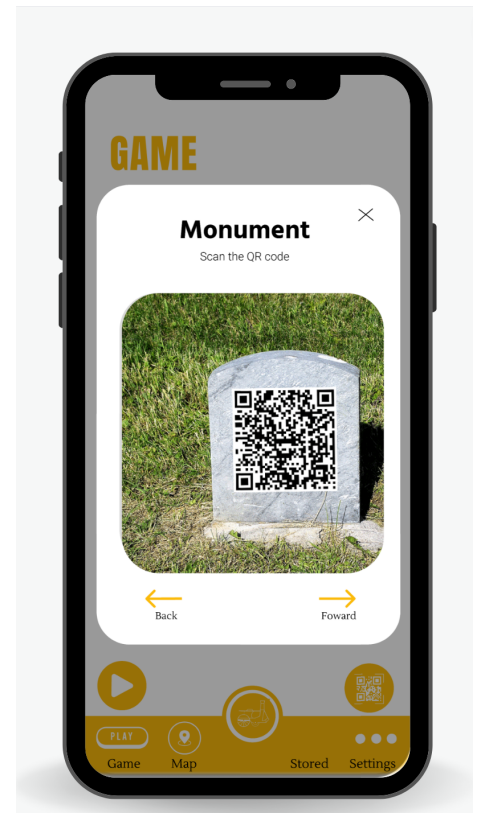
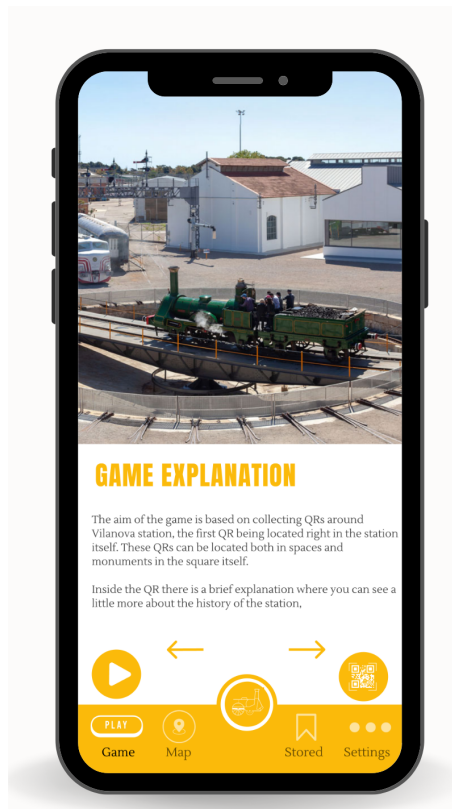
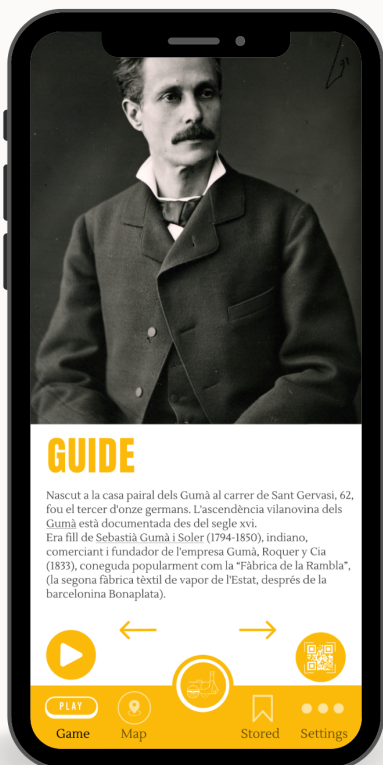


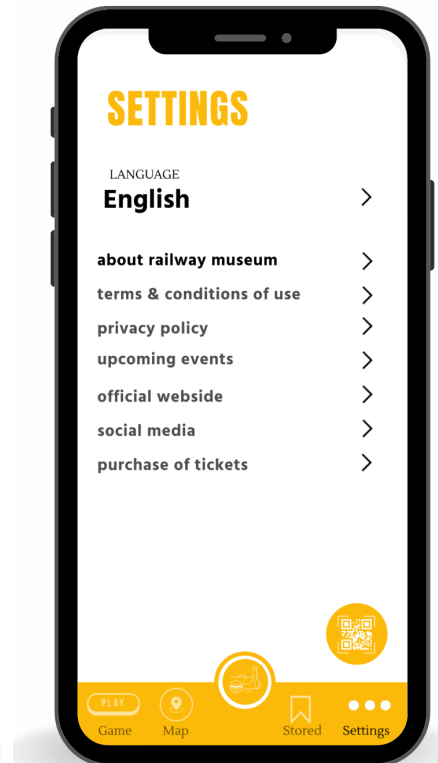
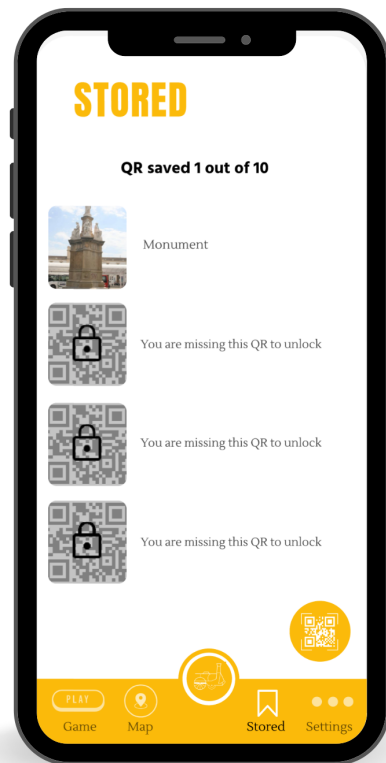
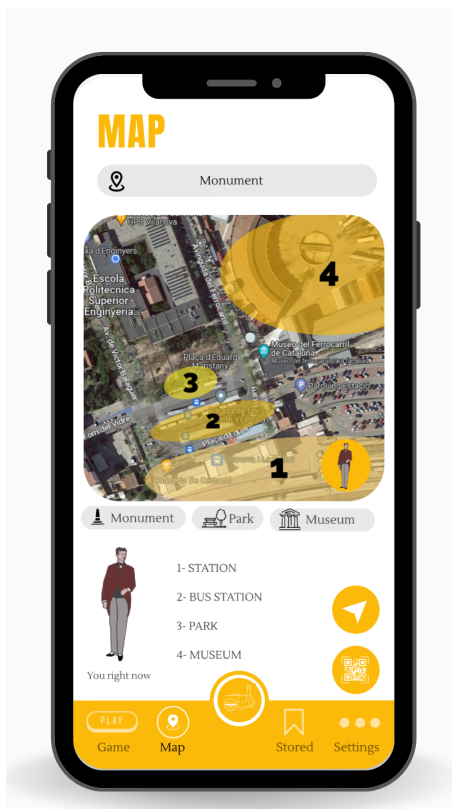
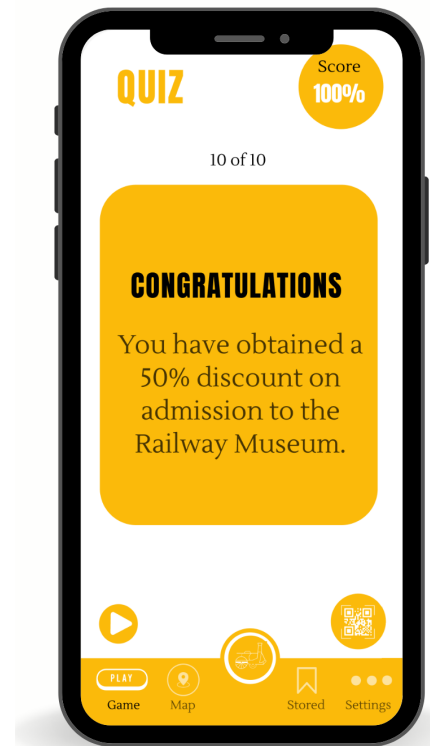
Figure 29: Setting page

Seven: The language, the platform consists of three languages which you can change. The main language will be in Catalan, although it is also available in Spanish and English.

8.3. Final Design

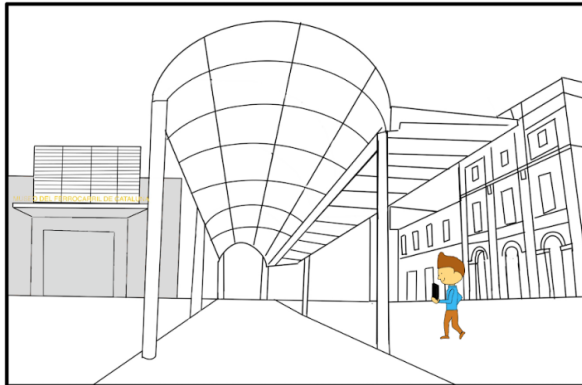
This is how the final design of each page will look like



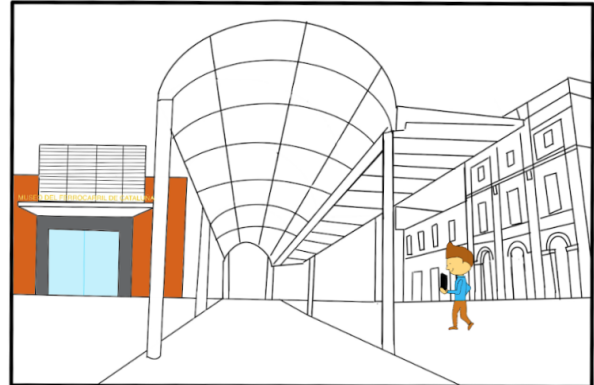


9. The App

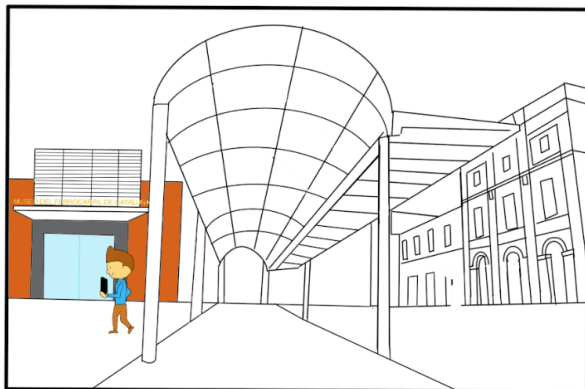
9.1. Storyboard



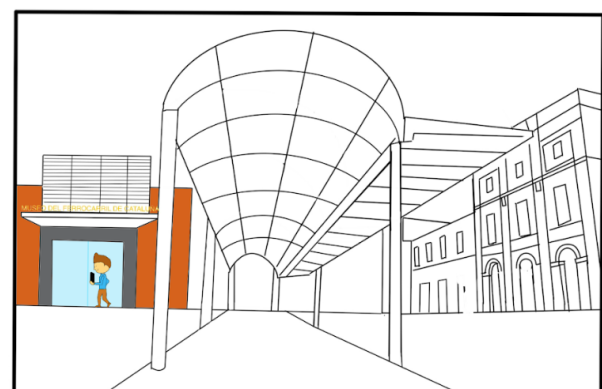
People leave the station and do not realize that there is a museum



The person leaving the station performing the game



The person playing the game by the station



The person finishing the game and entering the museum

Normally people come out of the train station and walk left towards the town centre, they do not appreciate the train station around them, even very few people have noticed the existence of the railway museum just to the right of the train station.

The solution to this problem is to create an app with a game that will start right when you leave the station to appreciate your surroundings and learn a little more about the history of the past. It is also an opportunity to visit the museum afterwards and live a complete experience of leisure and culture

9.2. Brainstorming

Before creating the app, brainstorming was carried out, which is a technique used to generate ideas in a creative and collaborative way. It is based on the premise that by fostering an open and uncritical environment, participants can freely express their ideas, which can lead to the generation of innovative and creative solutions.

This tool was very useful to start steering the app towards an idea.

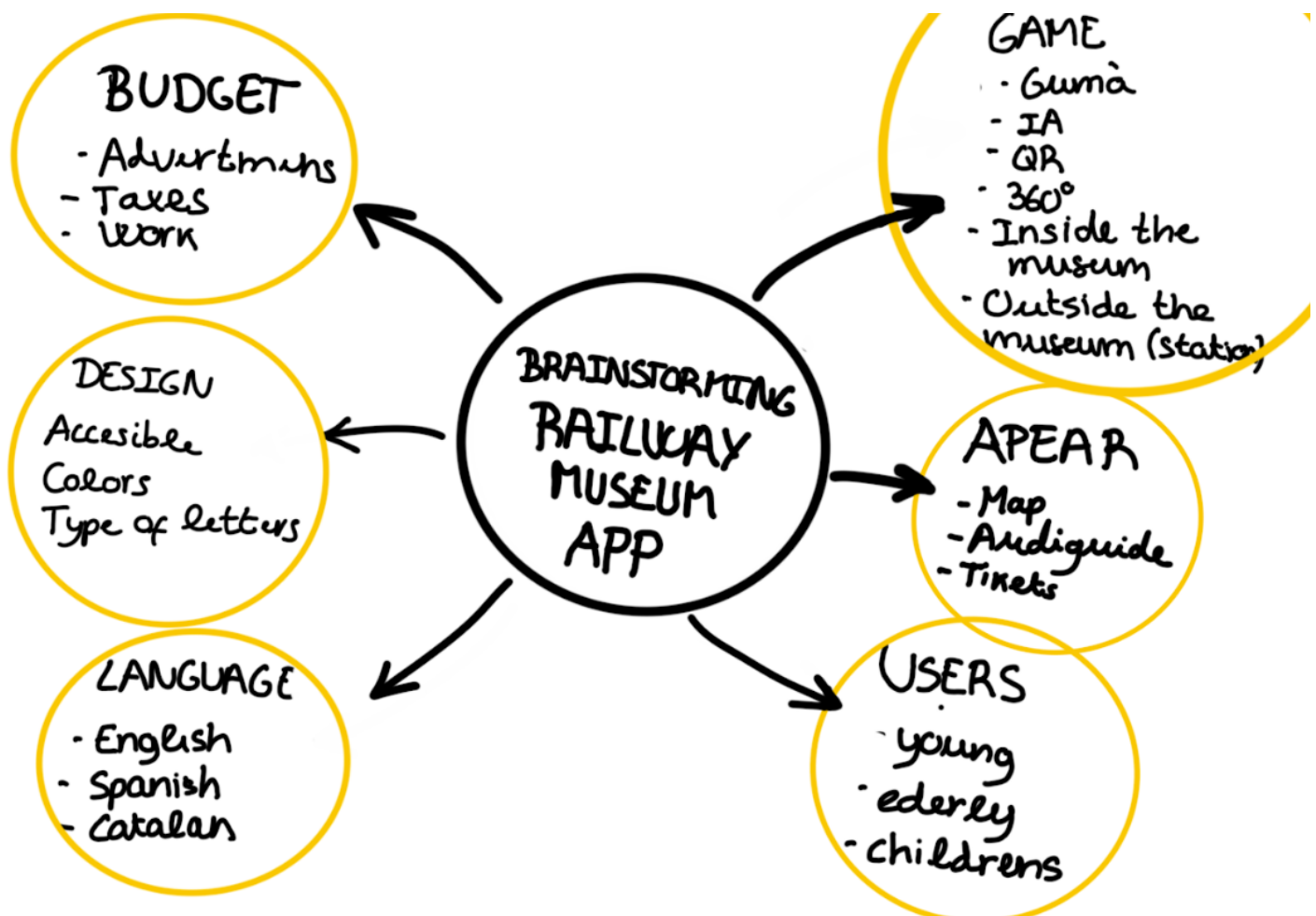


Figure 30: Brainstorm board

9.3. Explanation of the Game

The main idea of the game is to enhance the experience to as many people as possible who pass through the Vilanova i la Geltrú train station in a fun and playful way.

Many people leave the Renfe station and do not realise the existence of the railway museum located right next to the station. That's why the game's mission is to draw attention to those people leaving the station so that they end up going to the museum.

The game begins by introducing one of the most characteristic characters of the Francesc Gumà Station. He will be the guide during the game and will explain the rules.

The aim of the game is based on collecting QRs around Vilanova station, the first QR being located right in the station itself. These QRs can be located both in spaces and monuments in the square itself. On the website you will find a map that will show you the location of each QR you have to scan, the last one will take you to the Museum. Inside the QR there is a brief explanation where you can see a little more about the history of the station, it will be a comparison between the past and the future as the work is called "Experiencing the past to understand the present" in this explanation you can find from old posters, to images of the station a few years ago, a set of information given by Gumà which will be of great importance if you want to win the game.

The game doesn't end with just collecting all the QRs, at the end of the game you'll have to test yourself with a quiz full of questions about the things you've learned along the way. The goal is to get 90% correct in order to get a 50% discount on museum admission. Be careful because this quiz will be timed, so it won't be easy to find the information on the internet. For the younger audience, a PDF of an origami train will unlock for them to create.

9.4. In-webapp content

9.4.2. Game information

One of the advantages of the creation of this game is that: The museum at any time can create more QR and enter more information from the station and can add more questions in the quiz. The same game could be implemented inside the museum by adding QR on the trains. The following information has been sought to add to the QRs so that users can start playing, but it should be noted that this information can be expanded, the information below is basic and serves as an example to understand what kind of content the app will contain.

The **first QR** will appear inside the station on the poster, this QR will take you to the webapp where you will start reading the rules of the game.

The second QR is located at the bicycle station



Figure 31: QR code location

The information:

Vilanova Railway station, located in Barcelona, Spain, is a prominent transportation hub that played a vital role in the city's railway network for many years. The station, officially known as Vilanova i la Geltru Railway station, has a rich history that dates back to its opening in the 1881.

Vilanova construction was part of the ambitious project to connect Barcelona with Tarragona and Valencia, facilitating trade, tourism, and transportation between these major cities. The architectural style of Vilanova Railway Station is predominantly Modernista style, a Catalan variant of Art Nouveau that emerged in the late 19th and early 20th centuries. The architectural movement, characterized by its ornate and decorative features, aimed to blend traditional Catalan elements with innovative designs.

Questions:

1. **When was the Vilanova station first opened?** = 1881
2. **What style was the railway station built?** = It was built in modernista style, a Catalan version of the Art Nouveau movement that was popular in Europe at the time.

The third QR is located at the bus station:



Figure 32 : QR code location

The information:

The construction of the railway line between Vilanova and Barcelona was primarily motivated by the need to facilitate the transportation of goods and people. The railway connection played a crucial role during the Spanish Civil War, enabling the efficient movement of troops and supplies. It served as a vital lifeline for the war efforts during that tumultuous period.

The electrification of the railway line took place in the 1950s, marking a significant advancement in the technology and efficiency of the rail network. The transition from steam-powered locomotives to electric trains brought about improved performance, reduced environmental impact, and enhanced passenger comfort.

The Spanish Civil War, a significant and tragic chapter in Spain's history, occurred between 1936 and 1939. It was a complex conflict that arose from political and ideological divisions within the country. The war pitted the Nationalist forces, led by General Francisco Franco, against the Republican government and its supporters. The conflict had profound consequences for Spain, leaving a lasting impact on its society, politics, and infrastructure. The railway line between Vilanova and Barcelona played a role in the transportation of troops and supplies during this turbulent period.

Questions:

3. **What was the main reason for building the line between Vilanova and Barcelona?** = The reason was to transport goods and people. This line had a significant role during the spanish war of transportation of troops and supplies.
4. **What year was the railway line electrified?** = 1950s
5. **When was the Spanish civil war?** = 1936-1939

The fourth QR The Guma monumentThe information:

The author of the guma monument was Ramón Padró.

The magnificence of the monument gives an idea of the importance that Vilanova i la Geltru gave to being connected by rail to Barcelona and Tarragona, after drilling the Garraf tunnels.

In the monument there are four statues. The first one does not have a crown, on the right hand it holds a caduceus that represents commerce and on the left a cogwheel.

The second statue wears a wreath of flowers, in her right hand is an oar, symbolising maritime life.

The third statue carries a crown of gleanings, in her right hand she holds a shovel symbolising agriculture and in her left hand she holds a roll of cloth.

Finally, the fourth statue wears a tiara of stars and in his right hand there is a branch that shows the speed of steam and in his left hand there is a locomotive.



Figure 33 : The monument

Questions:

6. **Who was the sculptor of this monument?** = Llotja de Barcelona Joan Roig i Solé
7. **What is the meaning of the monument?** = The magnificence of the monument gives an idea of the importance that Vilanova i la Geltru gave to being connected by rail to Barcelona and Tarragona, after drilling the Garraf tunnels.
8. **The statue wearing a diadem of stars on its head that was in its hands?**
In his right hand he held a fire to show the speed of steam and in his left hand a locomotive.

The fifth QR is located at the museum:

Figure 34: The entrance of the museum

The information:

The Railway Museum, a fascinating institution dedicated to preserving the rich heritage of rail transportation, opened its doors to the public on the 5th of August 1990. This significant date marked the beginning of a journey to showcase the evolution and importance of railways in shaping the world we live in.

Located in a historic setting, the Railway Museum offers visitors a captivating experience, taking them on a nostalgic trip through time. Its extensive collection of locomotives, carriages, and railway artifacts provides a glimpse into the bygone era of steam engines, intricate railway systems, and the pioneering spirit of innovation that revolutionized transportation.

Since its inauguration, the Railway Museum has become a popular destination for railway enthusiasts, history buffs, and families seeking an educational and immersive experience. Visitors can explore the meticulously restored exhibits, learn about the technological advancements in rail travel, and gain a deeper appreciation for the human endeavor that has connected communities and nations throughout history.

The opening of the Railway Museum marked a milestone in preserving and celebrating the legacy of railways. It stands as a testament to the enduring fascination with trains and the vital role they have played in shaping our world. Whether it's the allure of vintage locomotives or the engineering marvels of modern high-speed trains, the museum offers a captivating journey into the history and future of rail transportation.

Questions:

9. **When was the Railway Museum opened?** = 5th August 1990



9.4.4. Game Prizes

As mentioned above, the winner who gets 90% of the questions correct will get a 50% discount on the museum entrance fee. For the little ones, once the game has been completed the user will be rewarded with a PDF document for a guide on how to make an origami train.



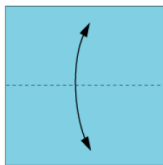
Make an Origami Train



Origami is the Japanese craft of making objects by folding pieces of paper.

Have fun making an origami train. All you need is:

1. A square piece of paper or card
2. Some colouring pens.

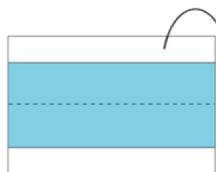
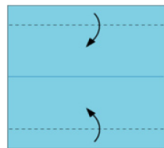


Step 1

Fold your paper in half to make a crease, and then flatten out again.

Step 2

Fold in along the dotted lines so you can see the white underside of the paper.



Step 3

Fold your paper in half along the crease in the middle.

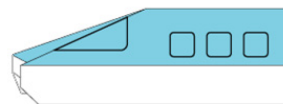


Step 4

Fold inwards along the dotted line to form a pocket.

Fold the bottom corners inwards along the dotted lines.

Step 5

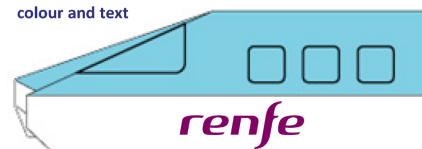


Step 6

Draw on cab and passenger windows to complete your origami Train.

Why not decorate your origami Train with some colour and text

Step 7



continued on next page...

Figure 35: Prize example

9.4.6. Terms and Conditions and Privacy Policy

Within the app we need to have terms and conditions and a privacy policy, so we have created a generic policy and if the app were to be in full use then a professional would need to create it. [11]

Terms and Conditions:

Acceptance of Terms

By accessing and using the Museo del Ferrocarril de Catalunya ("the App"), you agree to be bound by these Terms and Conditions, as well as any additional guidelines, rules, or regulations provided within the App.

Intellectual Property

All content, including but not limited to text, images, videos, and logos, displayed in the App are the intellectual property of the Museo del Ferrocarril de Catalunya or its licensors and are protected by applicable copyright and intellectual property laws.

User Conduct

- a. You must use the App in compliance with all applicable laws and regulations.
- b. You must not engage in any activity that may disrupt or interfere with the functionality of the App or compromise its security.
- c. You must not attempt to gain unauthorised access to any portion of the App or its related systems.

Disclaimer of Liability

- a. The App is provided on an "as is" basis, and the Museo del Ferrocarril de Catalunya does not guarantee its accuracy, availability, or reliability.
- b. Museo del Ferrocarril de Catalunya shall not be held liable for any direct or indirect damages resulting from the use of the App or any content within it.

Modification and Termination

- a. The Museo del Ferrocarril de Catalunya reserves the right to modify, suspend, or terminate the App or any part of it at any time without prior notice.
- b. The Museo del Ferrocarril de Catalunya may also modify these Terms and Conditions periodically, and continued use of the App constitutes acceptance of the modified terms.

Privacy Policy:

Information Collection

- a. The App may collect personal information, such as names, email addresses, and location data, to provide better services and improve user experience.
- b. The App may also collect non-personal information, such as device information and user preferences, to analyse usage patterns and enhance functionality.

Information Usage and Sharing

- a. Personal information collected through the App will only be used for the purposes specified at the time of collection.
- b. The Museo del Ferrocarril de Catalunya will not disclose or share personal information with third parties except as required by law or with explicit user consent.

Data Security

- a. The Museo del Ferrocarril de Catalunya takes reasonable measures to protect the personal information collected through the App from unauthorised access, loss, or misuse.
- b. However, no data transmission over the internet or electronic storage method is completely secure, and the Museo del Ferrocarril de Catalunya cannot guarantee absolute data security.

Cookies and Tracking Technologies

- a. The App may use cookies or similar tracking technologies to enhance user experience and gather information about usage patterns.
- b. Users can manage their preferences regarding cookies through their device settings.

Third-Party Links

The App may contain links to third-party websites or services. The Museo del Ferrocarril de Catalunya is not responsible for the privacy practices or content of such third parties.

Changes to the Privacy Policy

The Museo del Ferrocarril de Catalunya may update the Privacy Policy from time to time. Users will be notified of any significant changes, and continued use of the App after the changes indicates acceptance of the revised policy.



9.4.7. Content management

The newly developed web app for the railway museum has some exciting features, like a quiz and a game where you find QR codes in your surroundings. The great thing is that the clients can easily manage and update the app's content without any hassle.

For example, they can change the quiz questions and answers whenever they want. This means they can keep things fresh and up-to-date. They can also decide which monuments will have QR codes, so they can add or remove them as needed. This is fantastic because it allows them to keep the app in sync with the museum's exhibits and events.

But that's not all! The clients can also add more content to the app in the future without needing outside help. So if they want to add new questions, make the game more fun, or include additional monuments, they can do it all on their own. This ensures that the app remains exciting and constantly evolving.

And guess what? They can even handle translations in the app! This means they can easily change the language of the quiz questions, game instructions, and monument descriptions to cater to different languages. This way, people who speak different languages can enjoy the app too.

In summary, the clients have complete control over the app's content. They can change quiz questions and answers, choose which monuments get QR codes, add more content in the future, and manage translations. The best part is, they can do all of this without needing any extra assistance or taking up their employees' time.

10. Accessibility

A crucial component of user experience is creating apps that are accessible to all users, including those who have disabilities. Here are some suggestions for how to make an app usable by those with disabilities: [12]

Clear language: Ensure that the language used in the app is clear, concise, and simple to understand. Avoid using complex jargon or terminology that may be challenging for some users, such as those who have cognitive limitations.

Assistive Audio: Including audio explanations will help users with vision impairments grasp the content of the photos, videos, and other multimedia pieces that make up the app.

Use contrasting fonts and colours: To make the app easier to read for those with visual impairments, make sure that the text and background colours have a noticeable difference. Additionally, persons with dyslexia or other reading problems can benefit from selecting different fonts.

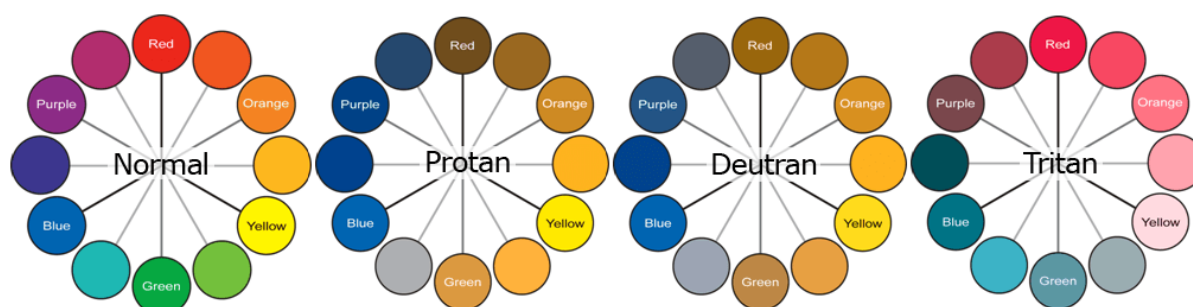


Figure 36: Accessibility for colour blindness

99% of all colour blind people suffer from red/green colorblindness (Protan and Deutran), which is why the colours Blue and Yellow are most commonly used because they stay consistent for the majority of people who have some form of visual impairment. [13]

IOS/Android compatibility: Make sure your app is compatible with assistive technology, such as screen readers, magnifiers, and switch controls. This will make it easier for users with disabilities to utilise the software.

Include speech recognition: By allowing users with mobility difficulties to communicate with the app through voice commands, voice recognition makes it simpler for them to utilise the app without their hands.

Give users alternate navigation options: For users who might struggle with touchscreens, think about giving them alternative navigation alternatives like keyboard shortcuts or gestures.

Allow for customization: Give consumers the ability to alter the app to suit their specific needs, such as by changing the font size, colour scheme, or language.

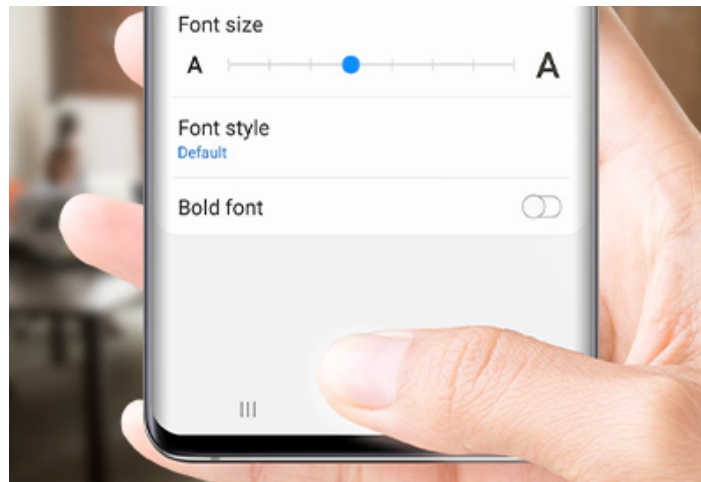


Figure 37: Accessibility functionality example

Tests involving people with disabilities: To find any accessibility issues and make the necessary app adjustments, conduct user testing with individuals with impairments.

10.1. Museums Accessibility

The museum is already fully equipped for accessibility features: [14]

Wheelchair Access:

The museum has full step free access from the use of ramps to a lift. Every part of the museum is reachable for people in wheelchairs.



Figure 38: Accessibility in museum

Walkways:

Indicated on the map in pink are the walkways that allow access for people with mobility difficulties or families with children with strollers.

Language Barriers:

Every plaque has three different languages on it, Catalan, Spanish and English, this is to help maximise the visitors that can enter the museum.

Braille:

Multi sensory module with description in Braille of the space, buildings and collection of the Museum.

Audioguide/visuals

The museum provides audio devices for an audio tour guide, as well as having a special video room next to the reception, where a video about the history of the museum plays out.

10.2. EU Accessibility Act

The Web Accessibility Directive (Directive (EU) 2016/2102) has been in force since 22 December 2016 and provides people with disabilities with better access to websites and mobile apps of public services. [15]

A summary of what is included

- an accessibility statement for each website and mobile app, stating non-accessible content and alternatives as well as contacts;
- a feedback mechanism so users can flag accessibility problems or request information published in non-accessible content.

Conclusion:

From looking over the EU Web Accessibility Directive we have discovered that we need to state all the museum's accessibility features both for the app and museum.

We can and will add a feedback page where users can write to us with ideas and potential updates on how to make the app better.



11. Testing Phase

To ensure the quality and readiness of the railway museum web app for the production environment, a testing approach was implemented despite the limited resources and time constraints. While comprehensive automated testing could not be conducted, manual testing played a vital role in verifying the basic functionalities of the application. Other team members were actively involved in performing manual tests, meticulously exploring different features and scenarios to identify any potential issues. This manual testing process aimed to ensure that the web app's core functionalities were working as intended and ready for deployment.

11.1 Users survey

Furthermore, to gather constructive feedback and insights from users, a survey will be designed and made available to the app's early adopters. The survey sought to capture users' experiences, impressions, and suggestions for improvement. By actively seeking user feedback, the team will aim to identify areas where the web app could be enhanced, address any usability issues, and gather valuable insights for future iterations.

Although the testing approach was adapted to the project's limitations, the combination of manual testing by team members and user feedback surveys will help validate the readiness of the web app for production. The collaborative effort of the team, coupled with user insights, contributed to refining the application and ensuring its functionality met the intended goals.

12. Marketing plan

Marketing plan for the website fame of Vilanova i la Geltru Railway museum.

Introduction

The purpose of this marketing plan is to outline strategies to promote the website game. The game aims to engage visitors, educate them about the museum's exhibits, and enhance their overall experience. By implementing effective marketing tactics, we will attract a wider audience and increase visitor engagement with the museum.

Target audience

Identify the target audience for the website game, which may include:

- Railway enthusiast and hobbyists
- Families and children interested in trains and history
- Students and educators seeking educational resources
- Tourists and locals looking for engaging activities in Vilanova i la Geltrú

Objectives

- Increase awareness of the website game among the target audience
- Drive website traffic and user engagement
- Promote the Vilanova i la Geltru Railway museum as a must-visit destination
- Enhance the overall visitor experience by providing a fun and educational game

Marketing strategies

1. Online Advertising:
 - Utilize ads on search engines and relevant websites
 - Run targeted social media ads on platforms such as facebook, instagram, and youtube to reach the desired audience
 - Collaborate with relevant railway and history-themed websites and blogs for banner ads
2. Social Media Marketing:
 - Maintain active social media profiles for the museum on platforms like Facebook and Instagram
 - Share engaging content related to the website game, including screenshots, gameplay videos, and teasers.
 - Encourage user-generated content by running contests or challenges related to the game
 - Collaborate with railway enthusiast to promote the website game and the museum
3. Email Marketing:
 - Develop an email list by encouraging website visitors to sign up for a newsletter
 - Send regular newsletters with updates about the museum, special events, and highlights of the website game
 - Provide exclusive promotions, discounts, or bonuses to subscribers to encourage engagement

4. Content Marketing:
 - Create compelling posts and videos related to the history of the museum, its exhibits, and the website game
 - Optimize content for search engines to improve visibility and attract relevant traffic
 - Collaborate with experts for guest posts or interviews

5. Measurement and Evaluation:
 - Monitor social media metrics such as follower growth
 - Collect feedback and reviews from website game users to assess their experience and make necessary improvements
 - Regular review and analyze the effectiveness of marketing strategies adjusting them as needed

By implementing these marketing strategies, the website game will gain visibility, attract a larger audience, and enhance visitor engagement. The game will become a valuable and enjoyable component of the museum's offerings, encouraging visitors to explore and appreciate the rich history of railways in Vilanova I la Geltru.

12.1. Social Media Publishing

In today's digital age, social media platforms have become powerful tools for business and organisations to reach a wide audience. The railway museum app holds immense potential in providing an engaging and educational experience for visitors. By strategically leveraging social media, the railway museum can effectively promote its app, attract more visitors, and enhance the overall visitors experience.

Before crafting social media content, it is crucial to identify the target audience for the railway museum app. Consider demographics, interests, and preferences of potential users. This understanding will help tailor content to resonate with the intended audience, ensuring maximum engagement and conversion rates.

When selecting an appropriate social media platform, the target audience is essential. We used platforms such as Instagram, Facebook and Tiktok that are commonly used for content distribution. For example, Instagram is ideal for visually showcasing exhibits and historical artefacts, while Tiktok can be used to share news, updates, and behind-the-scenes content. Understanding the strengths and user demographics of each platform will allow the railway museum to reach the right audience effectively.

A well-defined content strategy is crucial for successful social media publishing. It involves planning the type of content, posting frequency, and overall messaging. A variety of content formats, including images, videos, infographics and interactive elements. Content has to be informative, engaging and shareable, providing value to the audience. The railway museum app shares historical facts, stories, event updates, interactive quizzes, and exclusive app features to generate interest.

Below you can see the post for the railway museum to upload on their instagram to sponsor the app. In the following image you can see how it would be inside the instagram

Museu del ferrocarril 

Railway museum app

The new app of the railway museum that will show you the history behind the station of Vilanova i la Geltrú.

<https://www.museudelferrocarril.org/>

Download Now!

0:14

mferrocarrilcat

559 4430 1325
Publicacions Seguidores Siguiendo

Museu Ferrocarril Catalunya
Lugar destacado e histórico
Benjngut a la "Casa dels Trens"!
Visita'ns, al costat de l'estació de Vilanova i la Geltrú
(Accés als continguts)

Ver traducción

linktr.ee/mferrocarrilcat

domnegster, neakotilainen y 7 personas más le siguen

Seguir Mensaje

Activitats Interactius Col·lecció Informació Docum

Figure 39 : Instagram post



12.2. Advertising Poster

The museum has requested that we create a poster to advertise the app, that will go inside the Vilanova railway station.



Museo del ferrocarril de catalunya

Consigue hasta un 50% de descuento en la entrada del museo

Descárgate nuestra App



Download on the App Store

DESCARGAR EN Google Play

 mferrocarrilcat

 938 15 84 91

Figure 40 : Instagram post

13. Budget

13.1. How Much Does an App Cost

In order to know the budget of an app, we will first do a market research to get a relative idea of how much it costs to create an app. The price of the apps varies according to the difficulty and functional specifications.

In the market we can find different types of apps depending on the purpose, the following are the prices of the apps that most closely resemble our target. [16]

- Game app: the answer to how much it costs to make a mobile app, in this case, is between **30.000 € and 50.000 €**. In these apps, the design drives the price up. Elements related to the dynamics of the game also play a role, such as whether it is a single-player game or whether it supports a multiplayer option.
- Marketing app: between **2.000€ and 5.000€**. This app could be, for example, to promote events and, in many cases, is only used at a specific point in time.
- Social network app: between **15.000€ and 25.000€**. The price depends on the design, functionalities, privacy and security software.

13.2 Budget of our App

The following is a price estimate for the railway museum company. First of all, the app to be developed is a game app. Several factors have to be taken into account for the realization of the budget:

Internal costs

The internal costs will be based on the hours spent by the app development team. In the development team there is the budget of the engineers and the marketing part. On the one hand we have the computer engineer, who will create the software. On the other hand we have the product design engineers who are in charge of making the aesthetic part of the app. We also have to take into account the propagation of the app through the media, this part is dedicated to the marketing department.

This figure may vary depending on criteria such as the profile of the provider (freelance or company), its location, the training it has, or the technologies it handles. [17] [18]

By type of professional

- Development company for **41.25 €/hour**. If you prefer this option, the cost increases. You can also benefit from having more hands working on your project and a faster turnaround time.
- Freelance developer for **€28.75/hour**. Freelancers have lower structural costs than a company. For example, they don't have to work in an office.

Estimated costs are based on the usual salary in Spain. [19]

The chosen budget has been taken into account as if we were a company in this case the UPC and if the webapp was fully completed that would come to the total hours that are reflected in the table.

Internal cost table

	Hours	Money for hour	Persons	Cost
Computer Engineering	300 h	40 €/ hour	1	12.000€
Product Design Engineering	200h	35 €/ hour	2	14.000€
Marketing Person	125h	20€/ hour	1	2.500€
			Final costs	28.500€

Table 2: Internal cost table

External costs

Currently our app is a web app that does not need to be downloaded, but if we wanted to incorporate it in one of these platforms for people to download it, we would have to pay these taxes. Here are the license fees, data storage costs, maintenance and updates.

The cost of uploading the application to the different app stores.

- How much does it cost to have an application in the Play Store? The registration as a developer has a cost of \$ 25 (**23,04€**) (one-off payment). For each application uploaded, a further one-off payment of \$25 will be made.
- How much does it cost to publish an app in the Apple Store? The developer registration fee is \$99 (**91,22€**) with annual renewal. With this license you can upload apps to the App Store.

13.3. Monetary Advertisements

Ad rates in the app can vary depending on a variety of factors, including the types of ads, where the ad is placed, what ad revenue sharing agreements are in place, who is supposed to see the ad, whether the goals of the ad campaign are to generate revenue or simply increase brand recall, and so on. [20]

In this case the museum can use the ads to add them to the app, so that the museum raises some money through the app.

We have spoken with the museum and they consider themselves a **non profit enterprise** company, therefore they would not charge for the ads that appear in the webapp or not at all, but even so in case the company would like to incorporate them in the webapp they would have an estimation of the profits and advantages of adding ads from other companies.

Advantages

There are several advantages to placing ads in apps, including:

Monetisation: Ads can provide a source of revenue for app developers.

Interaction with users: Ads can be used as a way to interact with app users by providing information about new products or services.

As for the cost of in-app ads, this can vary depending on several factors, such as the advertising platform used, the size of the ad, the duration of the ad campaign and the target audience.

Types of advertisements that may appear in the app

The ads will be targeted at businesses that are related to the museum. Future companies that could be part of the app could be: the city council, the Victor Balaguer museum and other interested companies. A future advertisement could be for the writer Miquel Altadill i Giner as he could advertise his books about Vilanova i la Geltrú, Francés Gumá and other outstanding books of his through an advertisement.

Money for advertisements placed on the museum's app

The market price for advertisements is around 3-5€ per 1000 impressions. This price is used in apps such as Instagram, Snapchat, the difference in price is whether the appearance of the ad goes to a more specific or more general audience, the research of the user to whom the ad will be sent in the app.

In the case of the railway museum app, the ads will be sent in a general way without a specific audience, i.e. neither gender nor age will be taken into account. After discussions with the company, it has been specified that the rate for ads appearing in their app will be 3€ per 1000 impressions (1 impression per person).

Finally, some calculations will be made in order to know how much profit the museum will get from the ads. It should be noted that this calculation is a rough estimate.

- To begin with, we will assume that we have a number of (4.000 -4.500) users with the museum app downloaded. Why this number? We believe that all the followers that the museum has on instagram, which are about 4411, can be public with this type of app.

- So 3€ per 1000 visits per month gives us **12€** per ad from one company.

- In the case that 4 companies are interested in posting ads such as: The city council, the museum of Victor Balaguer, Renfe and the writer Miquel Altadill the profits are **48€ per month**.

Prototype of what the advert would look like in app will be advertisements. Below is an example of how an ad would look like in our app.



14. Conclusions

After completing the development of this dissertation, there are several aspects to comment on in this section of conclusions:

Nowadays technologies are very integrated in people's lives. Everyone spends their daily lives on their mobile phones, which is why the Vilanova i la Geltrú railway museum could not be left behind and needed to create an app. The aim of creating this app was to draw the attention of all the people who pass through the station and make them aware of their surroundings.

During this work we have carried out an exhaustive study of information about the museum and the various apps that we found on the market. This was a big challenge for us as many of us didn't know much about creating apps and how to start developing them.

At the beginning we brainstormed a lot of impressive and innovative ideas for this app, but as we were not experts in this field we had to narrow them down due to lack of time and knowledge. One of the ideas they wanted to introduce was artificial intelligence and a 360° view to be able to see how Vilanova train station looked like a few years ago through the camera.

So finally, we had to manage to create a slightly simpler app and it was there where it was decided to create a game where it will show you a part of the history of the station, this will make people want to know more about the trains and encourage them to enter the railway museum.

The creation of the appweb has been created in a simple way so that the museum can incorporate more information into it at any time and implement another game located inside the museum. In addition, other functions could be incorporated into the app that would be of great benefit to the museum, such as: an audio guide, online ticket booking, special events notification and others. But given the lack of time we have focused on our initial objective, which was the creation of the game. But future work at the UPC could finish the development of the app.

Throughout the process, the app and with it its design has been changing, taking into account different aspects analysed, including accessibility, functionality, and that the information is seen in an orderly and pleasant way. But we would have liked to have finished it earlier to show it to a few users of the museum and for them to give us feedback on whether they liked the app or not, such as the design, the ease of use, the game, the prizes.

Another problem we have encountered is that it has not been possible to create an app itself, i.e. the work done is a website that will be seen on the mobile through a link. This has been because to upload an app on the Appstore or Google Play platforms you have to meet many requirements and acceptance criteria that take many weeks to be accepted. But in case in the future the museum wants the app it has the interface and the commands done. Another obstacle we have had has been the adaptability of the app to the different sizes and resolutions of screens on various devices, that is to say that the application contains the same proportions on a mobile, a tablet, as on a computer, although it is created to be seen on a mobile.



It should also be noted that when it came to incorporating the content inside the app when researching the history of the railway museum, it was difficult for some of us as most of the texts were in Catalan and Spanish.

But despite all the problems we have encountered, we believe that we have overcome our initial objective in an adequate way.

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16. Annexes

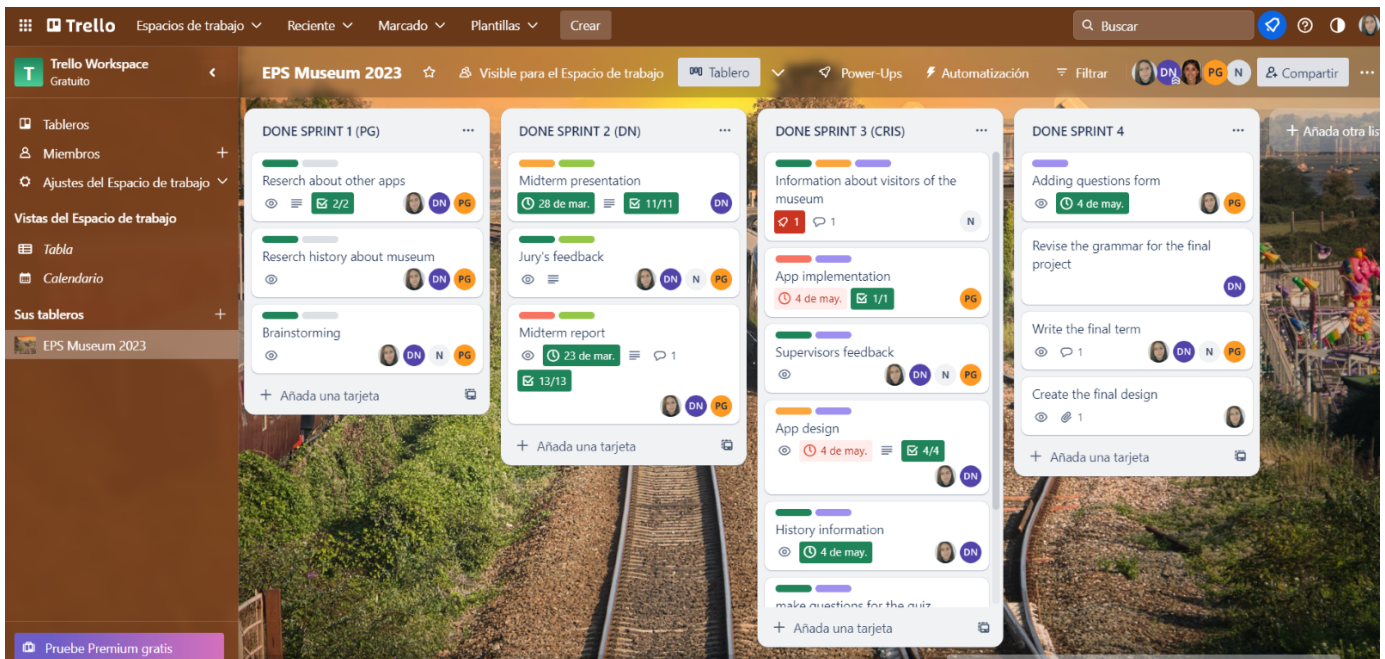
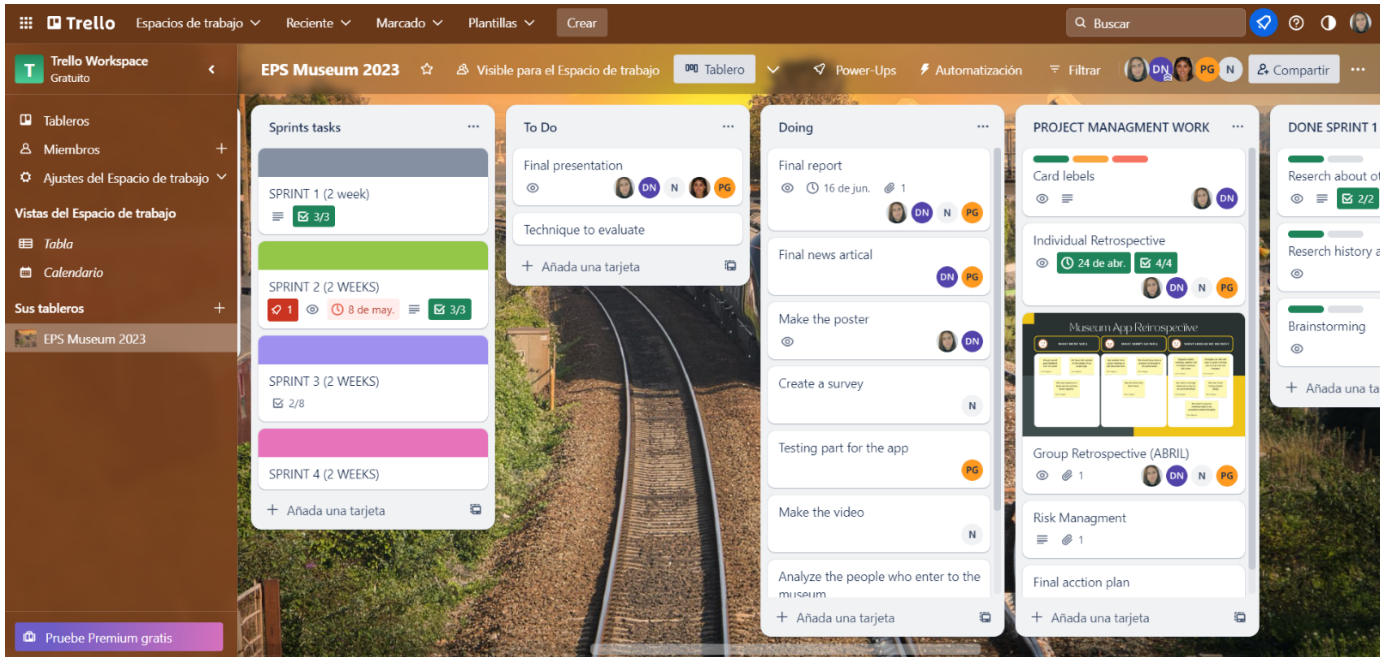
16.1 Project management

Project Management is the set of skills, knowledge, tools and techniques used to plan, execute and control projects in order to achieve defined objectives and goals.

Project management involves identifying the resources needed to carry out a project, defining timelines and budgets, managing the team and coordinating project activities. It also involves monitoring and controlling risks and issues that may arise during the project, and adapting to changes in project needs and requirements.

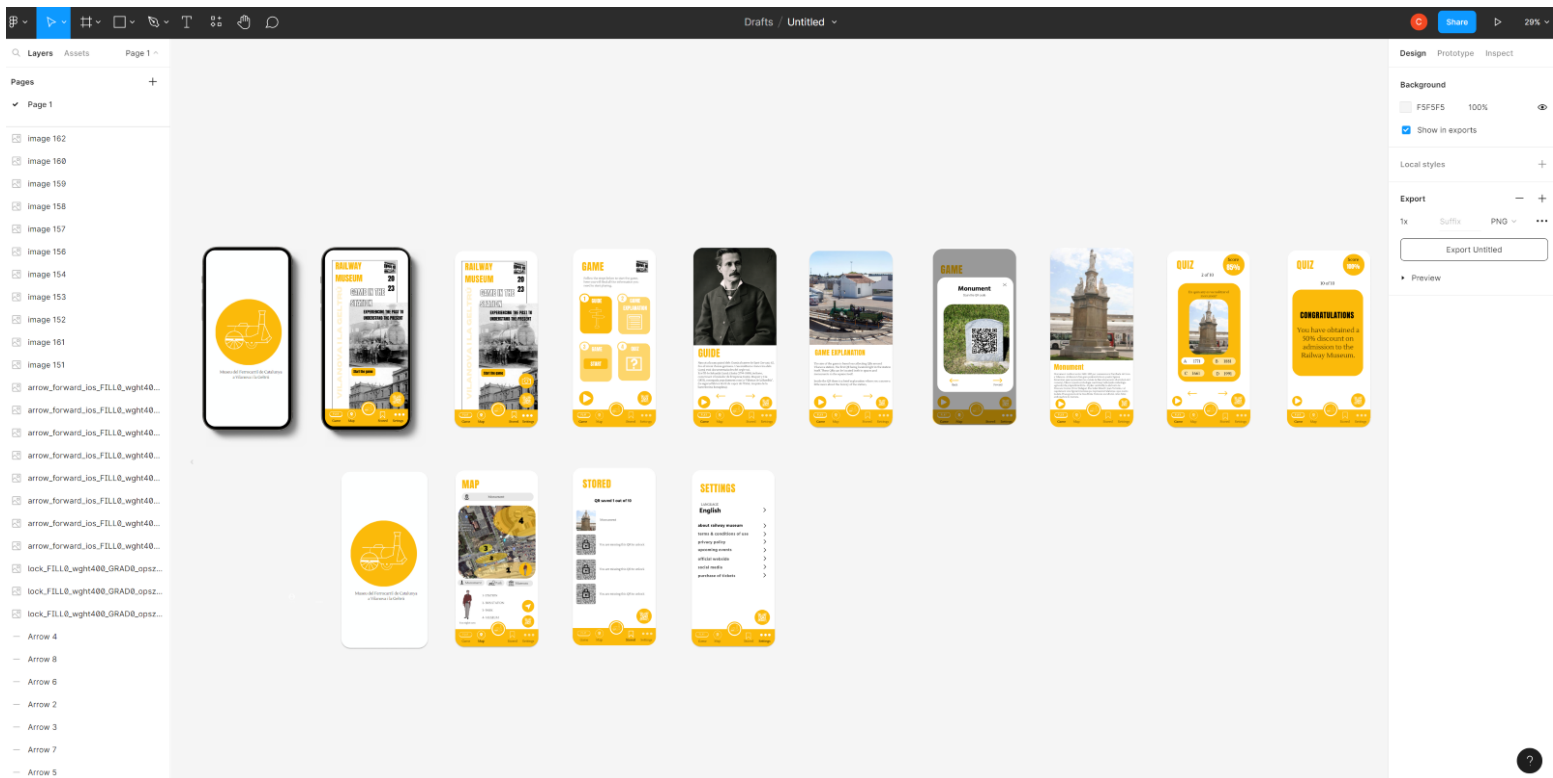
As a group we are using multiple different project management tools to help keep the group on track and keep the project streamlined and efficient, some of the tools we have used are Trello and a Gantt chart as well as completing a risk assessment.







16.2 Figma design





The screenshot shows a design tool's layers panel. At the top, there is a search bar with the text "Layers Assets Page 1 ^". Below this, there is a "Pages" section with a "+" icon and a checked "Page 1" item. The main list of layers includes:

- Museum
- Monument
- Park
- LANGUAGE
- Monument
- Monument
- You are missing this QR to unlock
- You are missing this QR to unlock
- You are missing this QR to unlock
- Monument
- image 126
- Rectangle 290
- Rectangle 288
- Rectangle 289
- Rectangle 287
- Z_guma_color-removebg-preview 2
- image 125
- 10 of 10
- Score
- 100%
- You have obtained a 50% discount...
- Rectangle 293
- QUIZ
- Polygon 13
- Ellipse 477
- image 138
- Ellipse 476
- Ellipse 475
- image 137

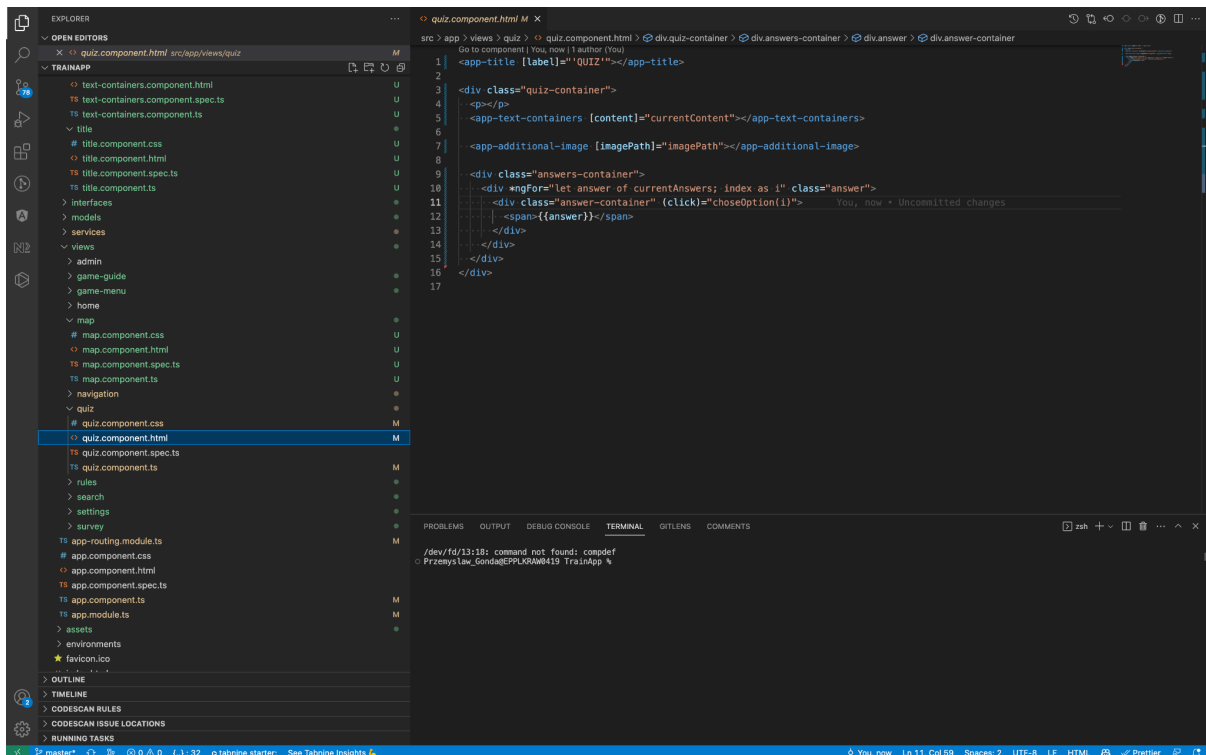
16.3 Programing part

Software Development is the process of conceiving, specifying, designing, programming, documenting, testing, and bug fixing involved in creating and maintaining applications, frameworks, or other software components.

Software development involves understanding the requirements of the application, defining the architecture and design, writing and testing code, debugging, and maintaining the system. It also entails identifying and mitigating potential issues, adapting to changes in requirements, and continuously improving the codebase to ensure optimal performance.

As a team, we leveraged multiple software development tools to streamline our work and maintain efficiency throughout the project. For code writing and debugging, we used Visual Studio Code (VS Code), a versatile and powerful code editor with built-in support for a wide array of programming languages and developer tools.

To help manage our codebase and facilitate collaborative development, we employed Git, a distributed version control system, which allows multiple developers to work on different parts of the project simultaneously without overwriting each other's changes. We hosted our code on GitHub, which also provided additional features for project management and code review.



The screenshot shows the Visual Studio Code interface. On the left, the Explorer sidebar displays a project structure with folders like 'views' and 'admin', and files such as 'quiz.component.html'. The main editor window shows the content of 'quiz.component.html', which includes HTML tags for a quiz container, text containers, an additional image, and an answers container with a click event handler. The terminal at the bottom shows an error message: '/dev/fd/13:18: command not found: compdef'. The status bar at the bottom indicates the current file is 'quiz.component.html' and shows various editor settings like 'Ln 11, Col 59'.

Figure 41: Visual studio code

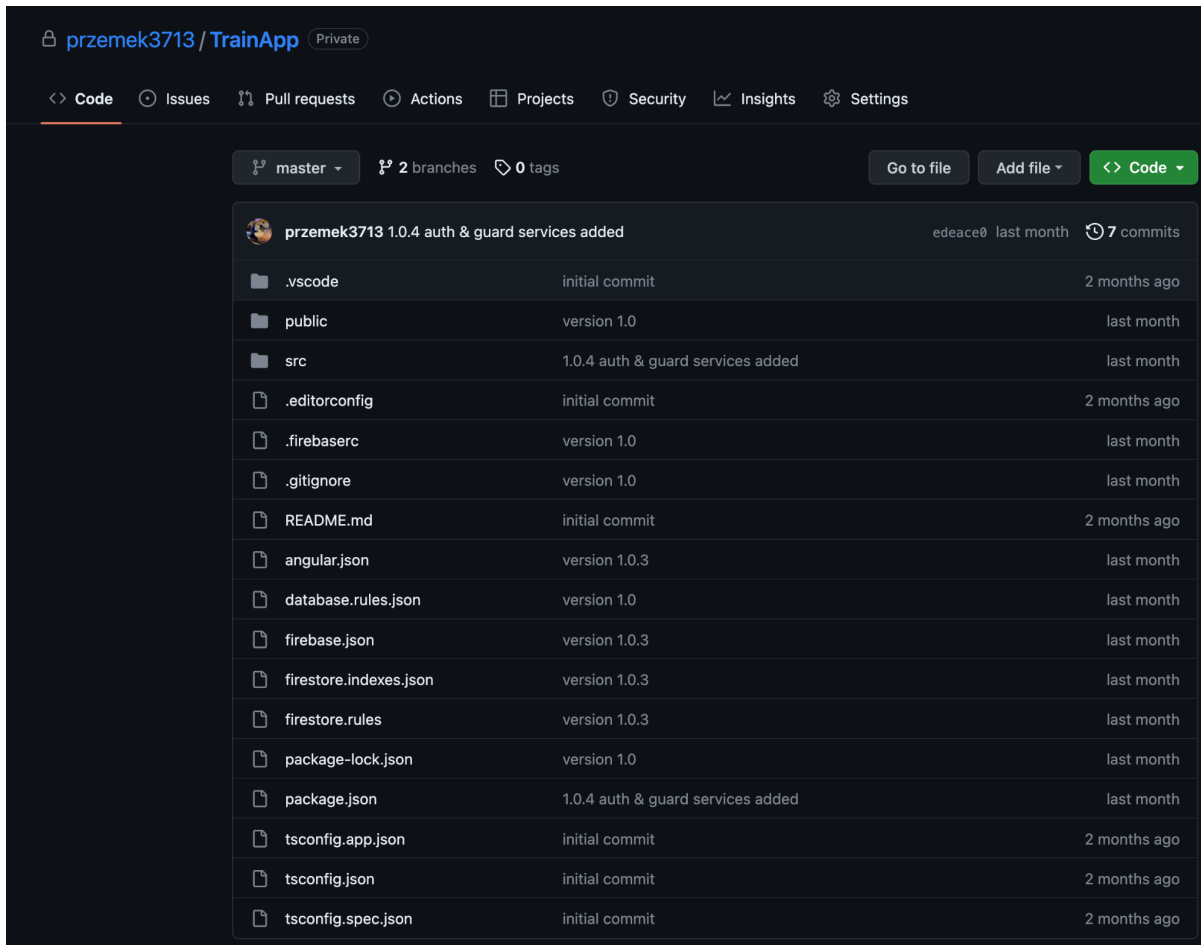
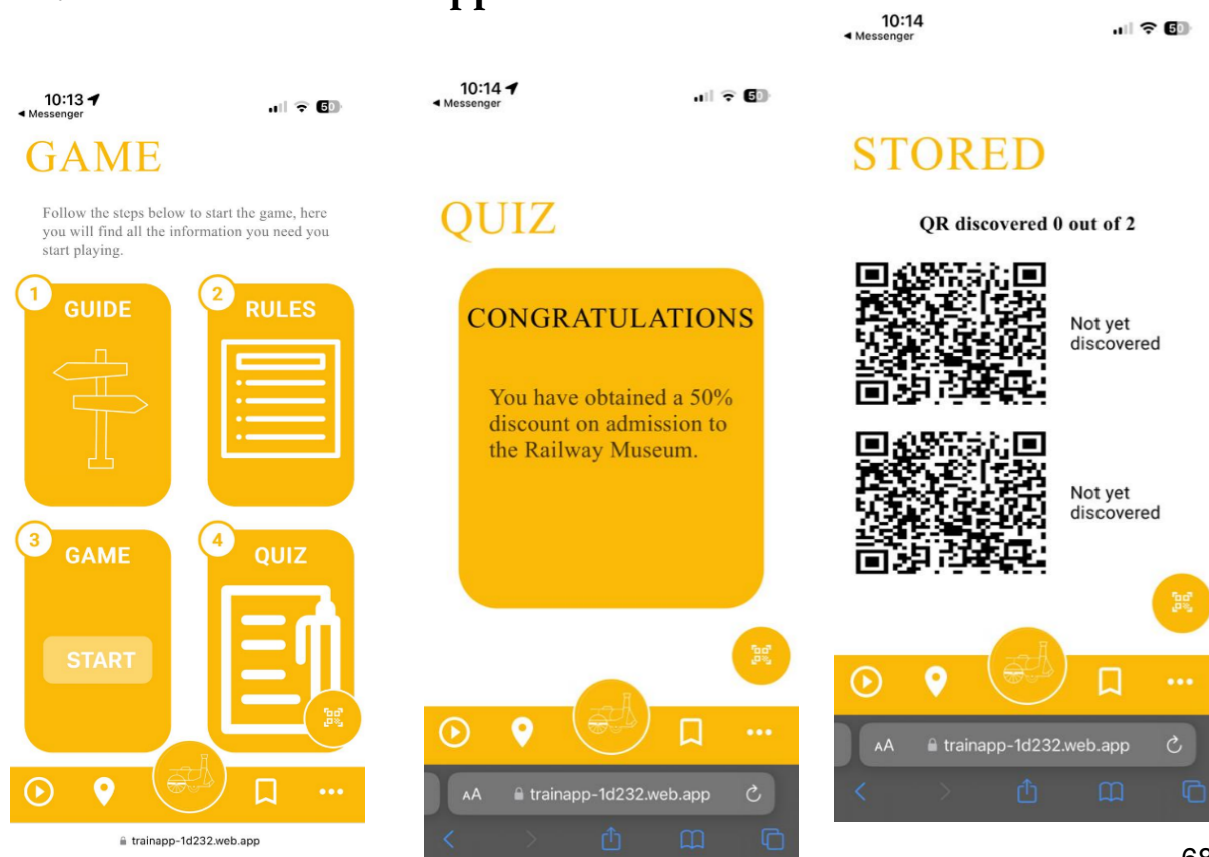


Figure 42: GitHub project structure

16.4 Screenshots of the app





- Add question
- Question list
- Add QR
- QR list
- Add translation
- Translation list

Add question to quiz

Question title

Question content

Answers

Add question to quiz

Navigation bar with icons: play, location, scales, bookmark, and a menu icon. A circular button with a plus sign is located above the menu icon.



Add question
Question list
Add QR
QR list
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Title	Content	Answers	Actions
Train operators	Which train operator(s) serve the Vilanova i la Geltrú train station?	Rodalies de Catalunya Renfe Talgo AVE	
Main lane name	What is the name of the main line that the Vilanova i la Geltrú train station is located on?	R2 South R4 West R5 East R7 North	
Designer	Who designed the Vilanova i la Geltrú train station?	Antoni Gaudí Santiago Calatrava Salvador Dalí None of the above	
Amount of platforms	How many platforms does the Vilanova i la Geltrú train station have?	2 3 4 5	
Year of opening	When train station in Vilanova i la Geltru was opened?	1881 1902 1906 1789	



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Add QR

Translation label

















Language

Content

Add QR



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Label	Langauge	Content	Actions
NOT_DISCOVERED_LABEL	eng	Not yet discovered	 
TRANSLATION_LABEL	eng	Translation label	 
QUIZ_SUCCESS_CONTENT_LABEL	eng	You have obtained a 50% discount on admission to the Railway Museum.	 
SELECT_LANGUAGE_LABEL	eng	Select language	 
TRANSLATION_CONTENT_LABEL	eng	Content	 
SELECT_LANGUAGE_LABEL	pl	Wybierz język	 
ADD_QR_LABEL	eng	Add QR	 
TRANSLATION_LANGUAGE_LABEL	eng	Language	 
QUIZ_SUCCESS_TITLE_LABEL	eng	CONGRATULATIONS	