DrawYourWay – An EPS@ISEP 2025 Project

Abstract. The European Project Semester (EPS) is a capstone program offered to engineering students by a network of European universities, including ISEP, the engineering school of the Polytechnic of Porto. EPS@ISEP adopts project-based learning, organizes participants into multidisciplinary international teams, and challenges them to find solutions to real-world problems. In the spring of 2025, the *DrawYourWay* team aimed to transform the waiting time in metro stations into a meaningful and enriching activity. The designed solution creates a digital art experience, converting the time spent in metro stations into moments of creativity. Using tablets provided at the station or personal smartphones, people can draw and see their creations projected in real-time onto a station wall. Weekly themes and drawing challenges keep the concept fresh and engaging, inviting passengers and visitors to become part of an evolving public work of art. To assess the viability of *DrawYourWay*, the team developed and successfully tested a proof-of-concept prototype. This document reports on the different steps of this learning journey.

Keywords: Collaborative Learning · Digital Art · Engineering Education · European Project Semester · Project-based Learning

1 Introduction

The European Project Semester (EPS) is a programme offered to engineering students by a network of European universities, including ISEP, the engineering school of the Polytechnic of Porto [5]. EPS@ISEP adopts project-based learning, challenging student teams to find solutions to real-world problems through state-of-the-art and market analyses, supported by ethical and sustainable decisions. These teams, which consist of members from various cultures and engineering disciplines, collaborate to develop, design, and prototype a proof-of-concept product over one semester [8].

In the spring of 2025, the *DrawYourWay* team decided to tackle how to transform waiting times in metro stations into meaningful and enriching activities. For most travelers, the waiting experience at transportation terminals is often described as a waste of time. These spaces lack interactive stimulation and offer few opportunities for intellectual activity or creative expression. The goal of this project is to turn waiting at train and metro stations into a vivid, interactive, and creatively rewarding experience for travelers.

The paper outlines the essential aspects behind this initiative's development, highlights its unique features and benefits in the market space, and compares it to traditional approaches toward urban interactivity and passenger engagement. Furthermore, it reports on the processes involved in the conceptualization of this

product as well as the development and testing of a proof-of-concept prototype, along with the challenges faced and the methods used to resolve them.

In addition, it can represent a starting point for discussion that focusing positive energies on constructive and socially approved activities would reduce vandalism through graffiti and other kinds of antisocial behavior seen in such spaces. By going towards legitimate and meaningful opportunities, it's possible to create a sense of responsibility for individuals and create a better experience related to the transportation system as a whole.

Lastly, transforming public transit centers into active, engaging and sustainable places can potentially optimize individual satisfaction and community welfare, and in the process, help achieve overall community development and urban sustainability objectives.

2 Preliminary Studies

This section looks at what already exists around the topic of this project. It includes similar projects and technologies, as well as ethical, marketing, and sustainability points that were taken into account. These elements helped guide the key choices made while designing *DrawYourWay*.

2.1 Related Work

Several commercial products and research projects helped us understand the possibilities and limitations of interactive public art. Below are some examples that inspired the current work.

ArtLens Gallery [6] at the Cleveland Museum of Art is an interactive installation where users can create and exhibit digital artwork via an app and explore the museum's collection in multiple ways. However, it is limited to the museum environment and requires physical presence. The cost of this setup is above 100 000 €, targeting mostly large institutions.

Augmented Reality Panel [7] or the AR Panel at the Bucharest Metro lets metro passengers scan a QR code to see short animations using an Instagram filter. While it adds fun to the waiting time, users view the content but cannot actively create or change anything themselves. The setup is estimated to cost between 5000 € to 15 000 €, depending on infrastructure and scale.

Poietic Generator [2] is a creative online tool where people can draw together on one large canvas. Everyone adds their part in real time, making the artwork grow and change with each user. It helped shape the idea of including multiple people in one shared art experience. The software-based nature of the project keeps costs relatively low, estimated at around 2000 € to 10 000 €.

Digital Drawing Apps like Procreate [12] or Adobe Fresco [1] are made for personal use and give artists a lot of tools and freedom. However, they are focused on individual use and not designed for sharing or creating art together in public places. These apps are low-cost, typically under 20 € per user.

Smartboards [14] like Microsoft Surface Hub or Google Jamboard are large touchscreens used in classrooms and workplaces. While they support digital drawing, they require physical proximity and are not designed for public, remote interaction. Hardware costs for these devices range from 2000 € to 9000 € per unit.

In comparison, the proposed solution combines public interaction, accessibility via personal mobile devices or a shared public device, real-time projection, and weekly creative themes. With an estimated price of 6999 €, *DrawYourWay* offers an affordable and scalable alternative. Table 1 provides a comparison of key features between the related works and *DrawYourWay*.

Table 1. Comparison of related works and *DrawYourWay*

Solution	**Interaction**	**Usage**	**Site**	**Price** (€)
ArtLens Gallery	Drawing[1] Projection	Individual	Museum	$>$ 100 000
AR Panel	QR code AR view[2]	Individual	Metro station	5000–15 000
Poietic Generator	Drawing[3]	Collaborative	Online	2000–10 000
Drawing Apps	Drawing[4]	Individual	Personal	$<$ 20/user
Smartboards	Touchscreen	Individual Collaborative	Institutional	2000–9000
DrawYourWay	Drawing[5] Projection	Individual Collaborative	Metro station	6999

[1] Draw on a personal mobile device; [2] View on mobile device;
[3] Draw online; [4] Draw on a personal mobile device;
[5] Draw on a public device at the station or on a personal mobile device.

2.2 Ethics

From the start of the project, ethical concerns were taken into account to make the solution fair, accessible, and responsible:

- **Privacy**: Users have the option to draw without creating an account. No personal information is collected unless the user agrees.
- **Accessibility**: To include everyone, a tablet is installed at the station for people who don't have a smartphone or mobile internet.
- **Content Moderation**: Drawings are checked before being shown publicly, to make sure nothing offensive appears on the screen.
- **Transparency**: Participation is completely optional, and the steps are explained clearly to avoid confusion.

These design decisions make the solution inclusive and respectful of users' rights and safety.

2.3 Marketing

A market analysis [10,16,11] was performed to understand how to make the project attractive and engaging for two main groups: the public and local authorities.

- **Target Users**: Mainly metro commuters, including students, workers, and tourists. The product adds entertainment and creativity to their waiting time.
- **Public Awareness**: Posters, leaflets, and social media will be used to promote usage. Two types of flyers are planned — one for users and one for stakeholders (like the city or metro authorities).
- **Customer Stakeholders**: City governments or public transport companies are considered buyers. The product will be presented as a way to reduce vandalism and improve the atmosphere in stations.
- **Marketing Choices**: Simple, clear messaging and attractive visuals are used in the promotional materials. A video was also created to show how the app works.

These points helped shape the visual identity of the project and how it is presented to the public.

2.4 Sustainability

Sustainability is one of the core values of the project. The team followed eco-friendly practices wherever possible:

- **Second-hand Hardware**: Refurbished tablets and projectors are used to reduce electronic waste.
- **Recycled Materials**: The tablet's plastic casing and the projector's stainless steel casing incorporate recycled plastic and aluminum whenever possible. Additionally, the packaging utilizes a plywood box for the tablet and the stainless steel casing serves also as the the projector's package box [3].
- **Energy Efficiency**: A laser projector was chosen because it consumes less energy and lasts longer than other types [4].
- **Transport and Sourcing**: Materials and components are sourced from local suppliers (Portugal/Spain) to reduce emissions from transportation.
- **Second Life Packaging**: The transport box becomes a usable element onsite (e.g., a step for children).

These decisions ensure that the product not only entertains and engages, but also aligns with environmental responsibility.

This project supports several of the goals set by the United Nations to improve sustainability and social well-being. While the main idea is to make waiting time in metro stations more enjoyable, it also connects to global challenges that affect many communities [15]. This is the case for SDG 11 - Sustainable Cities and Communities and SDG 12 - Responsible Consumption and Production. By

turning waiting moments into creative opportunities, the project helps make public spaces more inviting and inclusive. It encourages people to express themselves in areas that are often ignored or feel impersonal. By using second-hand tablets and energy-efficient laser projectors, the team reduces electronic waste and avoids unnecessary use of new materials. Recycled packaging and smart installation choices help lower the overall environmental impact. Even though the project is small, it makes conscious choices regarding sustainability. Through reuse, low-energy devices, and an open approach to design, it contributes in a practical way to building a more responsible and creative public space.

3 Proposed Solution

3.1 Concept

The main idea behind *DrawYourWay* is to create a digital art experience that transforms the time spent in metro stations into a moment of creativity. By using tablets provided at the station or personal smartphones, people can draw and see their creations projected in real-time on a wall. Weekly themes and drawing challenges keep the concept fresh and engaging. This setup invites commuters and visitors to be part of a public, evolving art piece.

3.2 Design

Structure The structure includes a mounted tablet encased in a custom protective box, which is designed to be robust and safe for public use. Acrylonitrile Butadiene Styrene (ABS) plastic was chosen for this enclosure due to its durability and resistance to wear [13], moisture, and heat. The case includes a sliding lid and locking mechanism to prevent tampering, and multiple mounting options (wall, table, or pole). To ensure accessibility for children, the tablet box is paired with a wooden step-up box, made of lightweight but sturdy plywood. This allows younger users to comfortably reach and interact with the screen.

Packaging To reduce waste and ensure sustainable practices, the packaging of *DrawYourWay*'s components was designed to be reused on-site. The transport packaging serves a second life as part of the installation.

The tablet and its protective case are transported in a plywood step-up box, which, once unpacked, becomes a support platform for children (Figure 4). The design was tested via a stress simulation, assuming a 150 kg load, confirming its strength and safety [9]. For the projector, the same stainless steel protective case used during operation also serves as packaging. The case is durable, rust-resistant, and fitted with ventilation fins and threaded rods for safe installation and height adjustment. This dual-use strategy saves material and minimizes transportation impact.

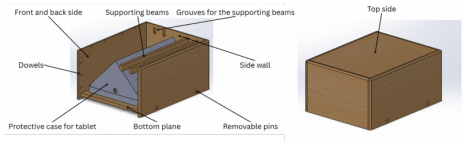

Fig. 1. Packaging concept step-up box

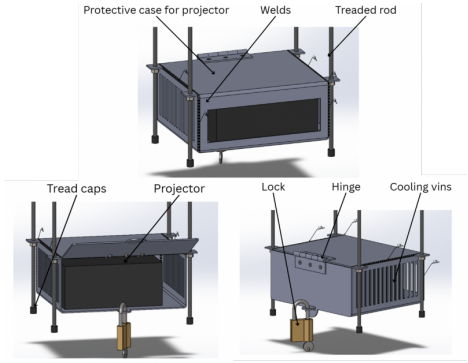

Fig. 2. Packaging concept protective case projector

Smart Control The system is powered by a Raspberry Pi 5, which manages the connection between the drawing devices and the projector. It receives inputs either from the tablet or user smartphones via a Quick Responde (QR) code, processes the drawings, and transmits them to the projector. A Wi-Fi booster ensures reliable internet access, and all hardware components are supported by a single power supply system. The power consumption of all devices (tablet, controller, and projector) totals approximately 102.5 W, translating to about 854.26 kW h yearly, with an estimated cost of around 159 €. This value was calculated based on Portugal's average elecricity rate.

Web/Mobile Application The interaction process (Figure 3) starts when a user scans the QR code displayed near the installation or uses the public tablet. They are directed to a web app where they can create a drawing. Once finished, the drawing is submitted with a button click, which triggers an automatic upload to the system. The image is then immediately shown on the public screen. The application is designed to be simple and intuitive, so people of all ages can enjoy it without the need for instructions. Weekly drawing themes and optional login functionality enhance the experience and allow for future features like profiles and saved artworks.

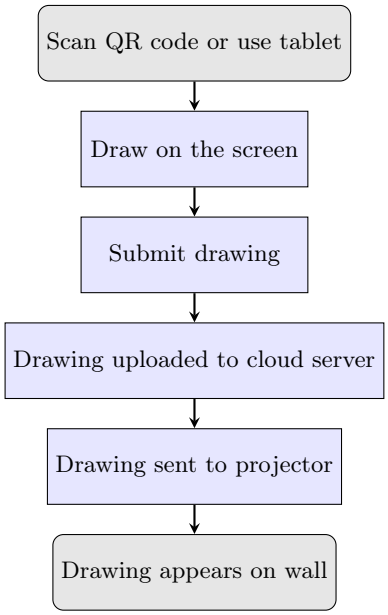

Fig. 3. Application flow

4 Prototype Development

This section outlines the development and evaluation of the *DrawYourWay* prototype. The system integrates both hardware and software components to create an interactive digital art platform for metro stations. The section includes the assembly process, software and hardware components, and results from a series of structural, functional, performance, and usability tests.

4.1 Assembly

Structure The physical structure of the *DrawYourWay* system consists of a protective casing for a tablet and a projector mount. The casing in the case of the prototype was 3D-printed using PolyLactic Acid (PLA), ensuring both lightness. The design takes into account public use and potential vandalism by including locking mechanisms and anchoring points to prevent theft or tampering.

The structure was designed with accessibility in mind, allowing users of all heights and physical capabilities to interact with the system. The layout supports natural interaction without blocking visibility for other commuters.

Smart Control The smart control system includes a Raspberry Pi as the main controller, running Ubuntu OS. This microcontroller handles the QR code generation, communication with the server, and the projection of the drawings onto the wall in real-time.

The tablet connects to the same local network and communicates with the Raspberry Pi to send user drawings. The system was configured to operate with minimal input from staff, requiring only periodic maintenance.

Web/Mobile Application The application, accessible via a QR code, allows users to draw directly from their smartphones without installing additional software. It includes features such as brush selection, undo/redo, theme prompts, and real-time submission of drawings. The front end was developed using React, while the back end was built with Node.js and a MongoDB database to store artwork and session data.

4.2 Tests & Results

To ensure reliability and performance in a public setting, the prototype was subjected to several types of tests: structural, functional, performance, load, and usability. These were designed to simulate real-world usage and environmental conditions.

Structure To validate the mechanical integrity of the *DrawYourWay* hardware components under public-use conditions, three separate stress simulations were performed: one for the step-up box used in packaging and user access, one for the tablet protective case, and one for the projector case.

Step-Up Box Simulation To ensure the step-up box can support a person standing on it (e.g. a child or adult), a simulation was done assuming a load of 150 kg. The box was constructed from multiplex wood, which has an all 3.377×10^6 N/m^2, well below the material limit, confirming the box's safety under intended use conditions.

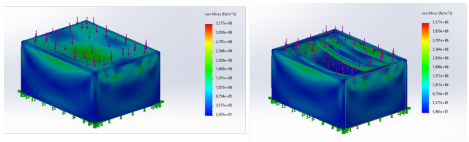

Fig. 4. Stress simulation of the step-up box under 150 kg load.

Tablet Case Simulation The ABS protective case for the tablet underwent two critical stress tests simulating human interaction:

- **Pull test:** Simulates theft attempt or accidental force – 100 kg pulling on the tablet slide.
- **Push test:** Simulates someone falling against or pushing on the tablet – 100 kg vertical load.

The resulting stresses were:

- **Pulling:** $3.768 \times 10^6\,\mathrm{N/m^2}$
- **Pushing:** $1.161 \times 10^6\,\mathrm{N/m^2}$

Both results fall well below the allowable stress for ABS ($15 \times 10^6\,\mathrm{N/m^2}$), confirming the case can withstand typical forces in public use.

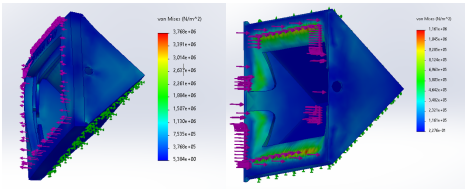

Fig. 5. Stress simulation 100 kg pulling and pressing ipad slide

Projector Case Simulation The protective case for the projector is made from stainless steel and designed to both protect the device and serve as transport packaging. A stress simulation confirmed that the applied loads (self-weight plus projector) result in stress levels well below the yield stress of stainless steel, making it a reliable and safe enclosure for real-world use.

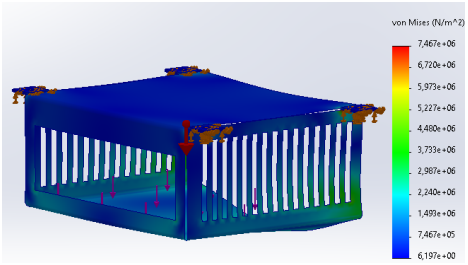

Fig. 6. Stress simulation protective case projector.

These stress results validate the design decisions regarding materials and structural configuration for *DrawYourWay*'s components, confirming that the prototype is safe and durable for public metro environments.

Smart Control Table 2 displays the functional results of the smart control system.

Table 2: Device: functional results

Use Case	**Result**
Switch on/off	Pass
Setup database	Pass
Drawing submit on screen	Pass
Upload data to cloud	Pass
Create Drawing	Pass
Notify user automatically	Pass

These results show that all key functions of the device work correctly. The system can turn on/off, manage data, display and upload drawings, and send notifications. This confirms the device is fully operational and ready for real-world use.

Web/Mobile Software Application Table 3 holds the functional and performance results of the back-end Application Programming Interface (API) implemented.

Table 3: API: functional and performance results

Operation	**Method**	**Result**	**Size** (B)	**Latency** (ms)	
				μ	σ
Login	POST	Pass	541	765.23	260.45
Refresh	POST	Pass	269	30.33	3.56
Register	POST	Pass	42	759.98	311.12
Place for Drawings	GET	Pass	973	80.67	3.02
Create Drawings	POST	Pass	89	137.90	4.87
Get places	GET	Pass	404	37.65	4.48
Submit places	POST	Pass	352	59.73	3.55

All main API functions worked correctly and passed the tests. Response times were acceptable, with most operations staying well under 1 s.

Table 4 displays the load results for the longest API request.

Table 4: API: load results

Requests	**Use Case**	**Method**	**Results**	**Size** (B)	**Latency** (ms)	
					μ	σ
10	Place for Drawings	GET	10	973	1.61	0.36
100	Place for Drawings	GET	100	973	11.31	0.25
1000	Place for Drawings	GET	1000	973	136.26	3.37

The API handled up to 1000 requests without errors. Even under high load, the response time stayed low and stable.

System Usability Scale To assess the usability of the *DrawYourWay*, the team distributed the System Usability Scale (SUS) questionnaire among several potential users and got six answers. The average SUS score was **73.1**, which is considered above average. This suggests that most users found the system easy to use and well-integrated, though one notably low score (27.5) may indicate that certain users encountered usability challenges that warrant further investigation.

5 Conclusion

5.1 Project Outcomes

The main goal of the DrawYourWay project was to make waiting in metro stations more fun and interactive. This was done by creating a system where users can draw something and have it projected on a wall in the station. The system uses a QR code, a tablet with a pen, and a step-up box, so it's easy for anyone to use. The prototype worked well, and all main features were tested.

There are several possible improvements. The system was only tested on a small scale, so its ability to handle large crowds during busy hours remains uncertain. Additionally, there is currently no mechanism to prevent the upload of inappropriate drawings. It is also unclear how many people would use the system over time or if the wall is large enough to display all the drawings clearly. Finally, to determine if the system effectively reduces graffiti, it would need to be in place for an extended period.

5.2 Personal Outcomes

The team members found the overall EPS learning experience enriching in terms of both technical and personal development. On the technical side, they refer new skills such as working with Raspberry Pi, basic programming, and design. Their abilities in 3D modeling, animation, and rendering were enhanced, and their technical English proficiency improved. They also became familiar with various team and project management tools. In terms of personal development, the experience significantly improved their communication, patience, and flexibility when working with diverse, multicultural teams. They developed essential team management skills, including organizing, planning, and working with sprints. Their problem-solving abilities were notably enhanced, particularly in adapting to unexpected challenges during prototyping and user feedback sessions. The experience also increased their independence and ability to work autonomously. Additionally, they grew through group work, maintaining work pace, and ensuring team adherence to schedules via weekly meetings. Finally, they reported that interdisciplinary collaboration led to innovative and user-focused solutions.

5.3 Future Development

In the future, *DrawYourWay* could be installed in various locations beyond metro stations, enabling more people to access and use it. With minor language adjustments in the app, it could also be deployed in other countries.

Adding rewards for people who draw often, such as daily or weekly challenges, could make the experience more fun and engaging. Also, having more tablets or other ways to draw would help during busy times, since drawing on a phone did not work as well.

Another idea is to use Artificial Intelligence to provide feedback on drawings. For example, it could compare the drawing of a user with the style of a famous artist. This would make the experience more interesting and help users improve their drawings.

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