



Product: Recycled

Team: Lucky 13



1. Introduction

Recycled is an automated bin that identifies waste items and delivers them into the appropriate bin (recyclable or non-recyclable) by a cart. The cart drives over the pre-determined bin and drops the waste by opening the trapdoor. The project aims to reduce recycling contamination. The clients interact through a website to get dynamic statistics related to their bins that are updated every time the bin is used.

2. Contribution

The website for Recycled acts as an interface for the users to interact with the product. It presents the users with statistical data on the working of the registered bins owned by the users. The development of the website ensures the online presence and competitiveness of the business in the real-world scenario (Kaplan, 2020). Therefore, my task was focused on developing the front-end of the website.

2.1. Task and achievement

The development of the front-end involved a comprehensive approach conducted in four main steps: branding, design, development, and evaluation.

Branding was conducted first as it is important to set the tone and identity of the project. This provides a clear direction for the subsequent web development process. As the project was named "Recycled", the logo was designed with a recycling symbol embedded into it. We strategically chose bright green as the main color scheme to convey our commitment to sustainability (Hartney, 2023). This creates an image that aligns with our core values and communicates our dedication to environmental responsibility.

Designing the front-end of the web app commenced with user research to gain insights into the main users' preferences and needs. We identified three main stakeholders, companies with offices, office workers, and cleaners. As the marketing target of the project, companies with offices were considered as the main users. With a better understanding of the users' requirements and expectations for the website, decisions were made towards user-focused design. Here are the main requirements from the users:

- Functional:
 - The website should start with a landing page that is introductory and descriptive about the product. (Figure 2)
 - The website should allow users to create accounts and log in.
 - The user can review their personal details on a profile page.
 - The website should deliver statistics from bins in the appropriate format of figures. (Figure 3)

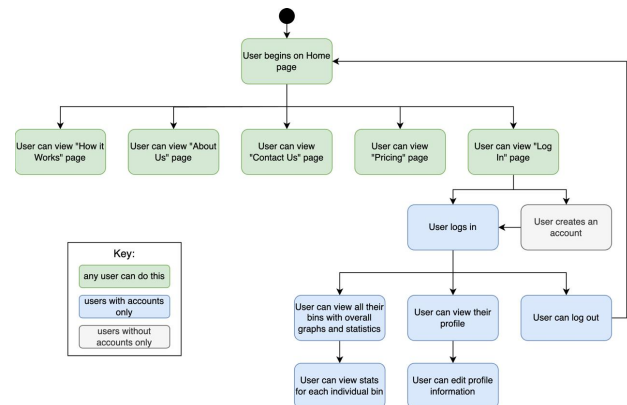


Figure 1. User journey map

- Non-functional:
 - The website pages should load in 3 seconds.
 - The website should feature a bright green colour in its main theme.

Based on the requirements, we mapped out the user journey through the main functionalities, which was useful to wireframe the web design (Figure 1). Figma was used as the primary design tool due to its robust capabilities in prototyping and collaboration. Prototyping designs ensured clarity and consistency throughout the design process, preventing any deviation from the project's objectives (Hannah, 2023). By establishing a solid foundation for the design, we navigated the design process with confidence and precision, ultimately delivering a web app with a user-focused interface.

The development of the website followed a component-based architecture. This decision was made strategically to ensure performance, flexibility, and scalability. This would not only enhance efficiency but also simplify the coding process, allowing for modular development and easy modification. Next.js was chosen as it enables frameworks and supports component-based architecture (Clarke, 2022). Moreover, TailwindCSS was selected to enhance our development process as it offers a utility-first approach for visuals on the website. This allowed for rapid prototyping and streamlined UI development, empowering us to focus more on functionality and user experience (Solecki, 2023).

After the designs were implemented with frameworks, the website was evaluated on its effectiveness and reliability through usability testing and implementation of a CI pipeline. The usability tests involved recruiting representative users to navigate the website and provide feedback on various aspects of their experience, including navigation, functionality, and overall user satisfaction. From the observation of participants and their feedback on the website, the front-end was modified to mitigate any issues or improve the user experience (Table 1). The modifications

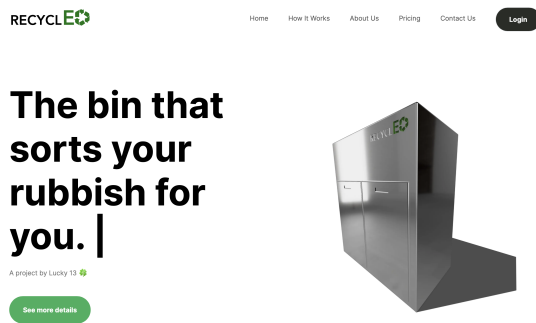


Figure 2. Home page

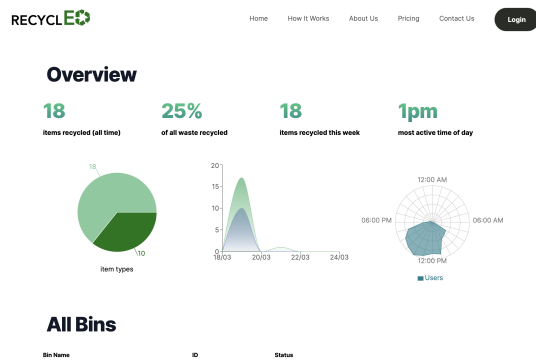


Figure 3. The statistics of register bins are shown

and improvement conducted on the website brought positive feedback on the user experience from the bigger group of people on Industry Day. Concurrently, the CI pipeline was implemented to make sure that any changes or updates made to the website were systematically tested, integrated, and deployed in a streamlined manner. Automating the testing and deployment process improved the website, making it easier to use and enhancing the overall user experience. The integration and deployment of the website stop when any issue is detected from the front-end or the back-end. In the real-world scenario, this will prevent misleading data or errors in important information from being shown to the users.

2.2. System Integration and Coordination

The integration of frontend, backend, and hardware systems within the project was essential for seamless communication and data flow throughout the system. In this scenario, where the statistics page serves as the interface for accessing and visualizing data, the integration is particularly vital for ensuring the accuracy and timely display of information.

Here's a breakdown of how each component interacts and how they are implemented:

- **Frontend:** The front-end of the web app serves as the user interface for accessing and displaying data. It sends a request to the back-end to send the data to be visualized. Once a request is made, the front-end sends the requested data to the back-end for processing.

Upon receiving a response from the back-end, the front-end updates the UI to display the requested data or visualizations to the user.

- **Back-end:** The back-end component, developed using the Flask Python framework, acts as the mediator between the front-end and other parts of the system. Upon receiving a request from the front-end, the Flask back-end processes the request data, interacting with the appropriate data sources and retrieving the requested information. Additionally, in cases where data needs to be fetched from or sent to the hardware component, the back-end handles communication with the hardware. Once the necessary data is obtained or actions are taken, the back-end formulates a response including the requested data or a confirmation message. This response is then sent to the front-end for display to the user.
- **Hardware:** The hardware component of the project collects real-time data. When the front-end sends a request for data or actions involving the hardware, such as retrieving sensor readings or controlling devices, the request is routed through the back-end. The back-end then communicates with the hardware component, sending commands or querying for data as necessary. Once the hardware has processed the request and generated a response, such as sensor readings or status updates, the information is sent back to the back-end.

Recognizing everyone's unique strengths and skills, we divided the tasks to work more efficiently and effectively. I worked closely with Lauren Cosgrove, maintaining constant communication for updates and decision-making during the project. Synchronized version control using GitHub facilitated smooth collaboration and prevented conflicts in code management. For integration of the website with other parts of the project, I collaborated with other team members:

- collaborated with Siddharth Sakriya to implement CI(Continuous Integration) pipeline.
- collaborated with Nik Peleshatyi and Siddharth Sakriya on deployment using Docker.

3. Reflection

3.1. Skills acquired

The project required both technical and project management skills. On the technical front, understanding the back-end implementation was a good opportunity to understand the principle of data flow and the structure of a website. Focusing on the development of the website, I learned how efficient and effective the framework method is.

On top of that, project management skills such as time management, communication, and problem-solving skills were improved by encouraging and navigating the team to complete tasks. Interaction with team members through collaborative tasks, discussions, and weekly meetings enhanced the ability to convey ideas clearly and concisely, leading to effective collaboration across the team. Understanding project timelines, resource allocation, and risk management was also improved by forming a responsible culture and navigating the project towards milestones and deadlines.

3.2. Learning about myself

The SDP process encouraged me to confront challenges head-on, pushing me outside my comfort zone and prompting self-reflection at every turn. I learned to recognize patterns in my behaviour and thought processes, which enabled me to make conscious efforts toward personal growth. For instance, I noticed that my perfectionism slowed things down. I learned to balance seeking perfection with being practical and flexible.

Through contributing to the website's user interface and visualization, I've recognized my proficiency in design. With sufficient understanding in this area, the website was implemented to elevate the overall user experience of the project. Furthermore, good problem-solving skills helped the tasks be completed punctually. As the project consists of different systems that were built by different individuals, it was important to address unforeseen issues when integrating the systems. For instance, despite being allocated to the software team, I also addressed unpredicted hardware problems.

However, it was not the case that I have only discovered my strength from the project. Throughout the project, I faced challenges and limitations in comprehensive project management. More frequently shared updates and progress across the team could have made the project managed better with more effective mitigations on potential issues of the project. Here is an example that happened during the project, when the frame of the hardware started to fall apart because of failing reinforcement engineering on the model. As it was significantly late in the timeline of the project, the problem had to be dealt with immediately. Considering the time predicted for requesting new prints, I came up with a sturdier frame with other team members, utilizing the given resources to the maximum.

3.3. Learning about teamwork

From encountering major and minor conflicts during the project, every aspect of coordination taught me about teamwork. I learned to value the diverse perspectives and skills within the team, understanding each member's unique strengths. Furthermore, I gained a deeper understanding of the importance of clear communication and effective leadership in achieving the team's goals. When challenges arose, the collective problem-solving and mutual support within the team were impressive. However, stronger accountability and transparency within the team would have helped address obstacles more smoothly during the project.

3.4. Learning from experience

Our project has taken an Agile approach for high flexibility and minimising risk. Although such an approach made it comfortable to address modifications and problems during the project, there were limitations of control and documentation. A possible alternative is lean project management that maximises resource allocation and enables better control for high efficiency of the project. Continuous feedback and update from team members would provide opportunity to anticipate more potential issues and mitigate. An action for the project management approach would have been justified at the time when there were some concerns or issues about project progress noticed. However, as the team was aiming to maintain flexible and responsible working environment, keeping the Agile approach was considered to be more justifiable at the time. Learning from experience throughout the project, it is clear that the lean approach could have enhanced collaboration, efficiency, and adaptability within the team by fostering a culture of continuous improvement and empowering teams to make autonomous decisions.

Reflecting on the experience from the project highlights opportunities for improvement in upcoming projects. In the future, prioritizing thorough planning, effective communication, and more efficient decision-making management will be essential to achieving project success. By incorporating these insights into project management practices, I can handle challenges and uncertainties better, leading to more valuable and impactful work.

A. Appendix

A.1. Usability test

	Tasks				Summary
	Home Page	Explore Pages on Navbar	Login (with the detail provided)	Explore Statistics Pages	
Participant 1	The design is simple and intuitive, but I think there is too much text on the page.	The pricing page should be more informative - I don't understand the difference between the plans.	It works - nothing really to change	The statistics seem helpful for bin management. It could be better if the table and the graphs can be seen together without having to scroll down.	The website would be better if there was less text on home page and the pricing page was more informative.
Participant 2	The page looks good but the image of the product isn't very realistic, and therefore it doesn't make me want to buy it.	I can't see the navbar when I open the website on my phone but I could see it when I used my laptop.	It works but the login button doesn't match the theme of the website. It might look better if it were green.	The statistics are organic sed well and they seem useful for improving the company's sustainability.	In general, there should be some improvement in user interface design so that all the components are visible and match the theme of the website.
Participant 3	It looks nice and is easy to understand.	The navbar works and the pages display useful information.	The login form works.	The graphs and statistics look nice, but when I tried resizing the window, the graphs were no longer visible.	The design of the website is good, but the statistics page should be fixed so that it can be viewed on all screen sizes.

Table 1. Usability Test Results for the Front End of the Web Application

A.2. Website Wireframe

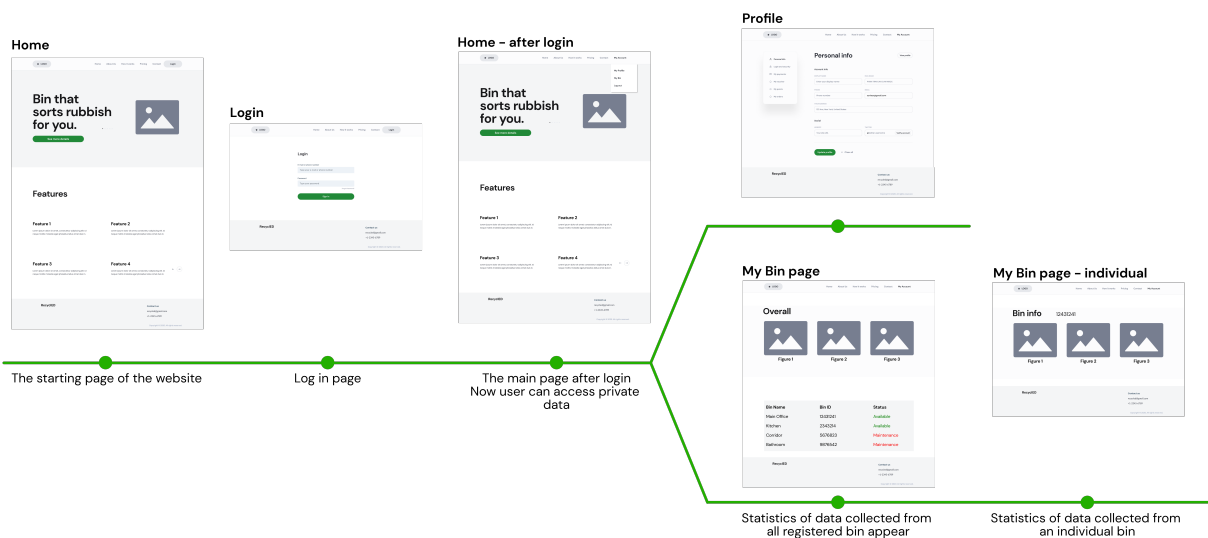


Figure 4. webapp wireframe

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