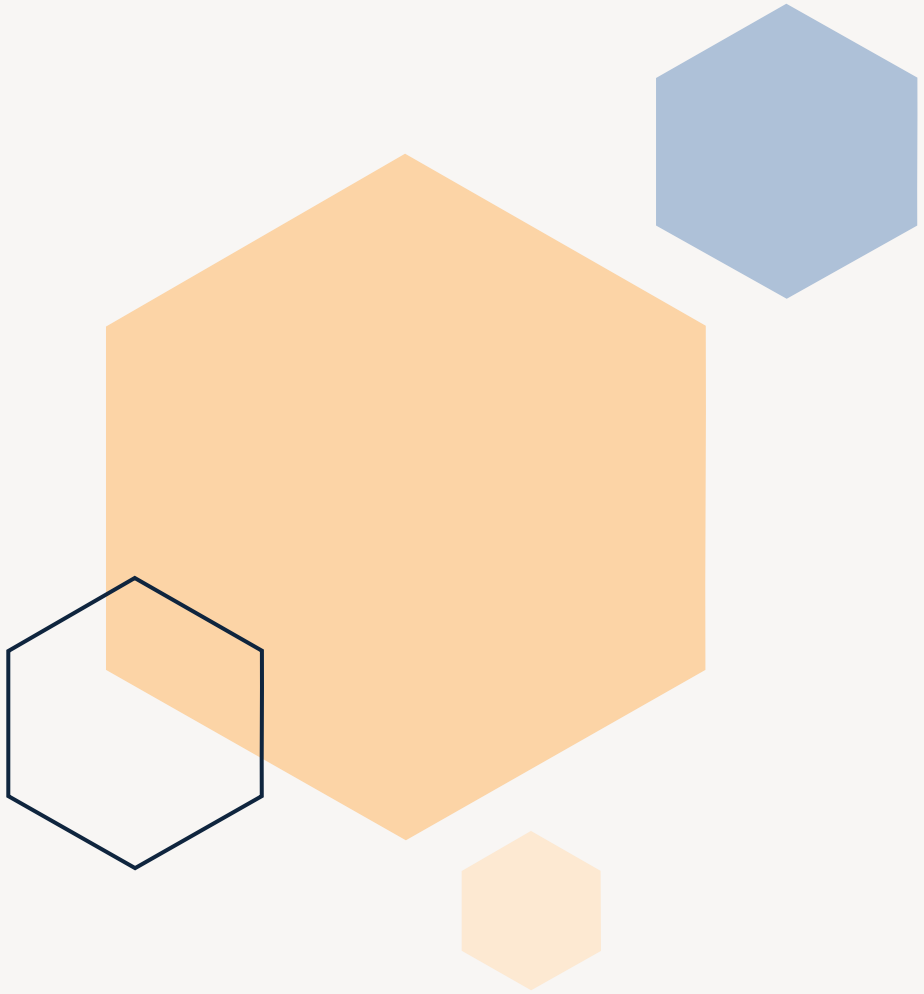
WEATHER API INTEGRATION PROJECT

Engineering Design, Innovation and Entrepreneurship (ENGG 200) – Winter 2024

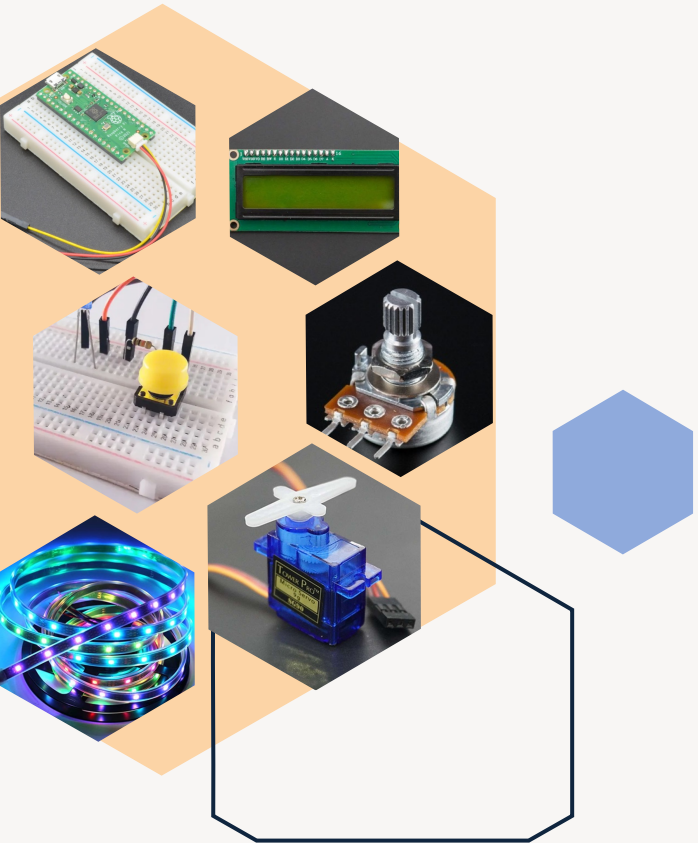
Krishna Patel



Project Objective

The objective of this project was to engage with the engineering design process by developing and building an art display that served as a physical representation of real-time data sourced from the internet. This project required the integration of engineering principles with artistic creativity, using the Raspberry Pi Pico to control various electronic components such as lights and buttons.

Project Requirements



Key requirements included:

- 1. Design and Ideation: We were tasked with conceptualizing an art display that not only functioned as a data visualization tool but also engaged and intrigued viewers through its artistic design. The project required us to brainstorm and prototype multiple ideas, ultimately selecting a solution that effectively combined form and function.
- 2. Technical Implementation: The Raspberry Pi Pico served as the core of the display, gathering real-time data via an Application Programming Interface (API) and dynamically updating the output. This required precise electronic wiring and programming to ensure the data was presented in a visually engaging manner. A key requirement was that all electronic components had to be securely enclosed within the display, ensuring they were not visible. Additionally, the display itself needed to be robust and sturdy, capable of withstanding movement without falling apart.
- 3. Materials: A critical aspect of the project was the requirement to use only the materials provided, which included a Raspberry Pi Pico, LCD screen, button, potentiometer, servo, and lights. If additional materials were needed, they had to be recyclable or 3D printed. This requirement encouraged creativity in material selection and ensured that the final product was both functional and environmentally conscious.
- 4. Aesthetic and User Engagement: The project emphasized the importance of creating an art display that intuitively communicated data to a general audience. Rather than merely displaying numbers, the design had to creatively convey information through the interplay of lights, buttons, and other permitted electronics, making the data accessible and engaging to viewers.

Design Process

Brainstorm/Research

Plan/Strategize

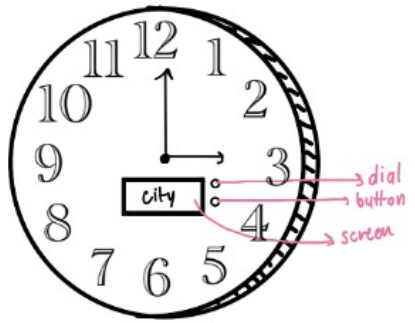
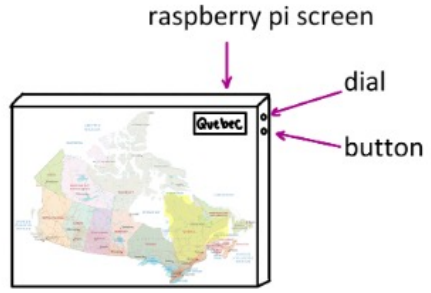
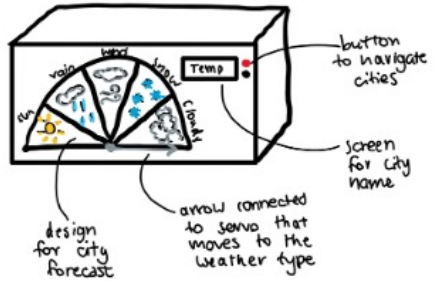
Design

Test/Troubleshoot

Final Product

Brainstorm/Research

Given that this was our first integration project involving electronic components and APIs, my team of four initiated the process by conducting a comprehensive analysis of the electronic materials provided and exploring how APIs function. This research phase was crucial in identifying and understanding the limitations and constraints of our components. With this foundational knowledge, we proceeded to brainstorm potential project ideas, focusing on how best to utilize the electronic components and an API to create a successful project.

Ideas/Solutions	Design/Visual
Idea 1: World Clock • the user chooses a city from the screen using the dial. • they use the button to select the city. • the hands of the clock move to depict the time of the city on the clock using real time data. • the clock lights up blue if it is nighttime and yellow if it is daytime. Idea 2: Quality of life • User picks a province inside Canada using the dial (potentiometer) to scroll on the screen and the button to select the province that they want. We pull real life data about the quality of life of that province. • Quality of life includes happiness, cost of living, resources etc. If the quality of life is good - the LED light lights up green for that province, medium - the LED light lights up yellow for that province, bad - the LED light lights up red for that province Idea 3: Location Forecast • Users can find out the weather for a certain location. • Button to navigate for a location/city in Canada and to start the whole program. • The screen will display the cities for the user to see as well as the temperature when a place is selected. • Servo used to move an arrow to the type of weather in that city.	  

Plan/Strategy

Following the ideation and formulation of potential solutions, my team collectively decided to pursue the location forecast project. This decision was made after carefully considering our available timeframe, materials, and resources.

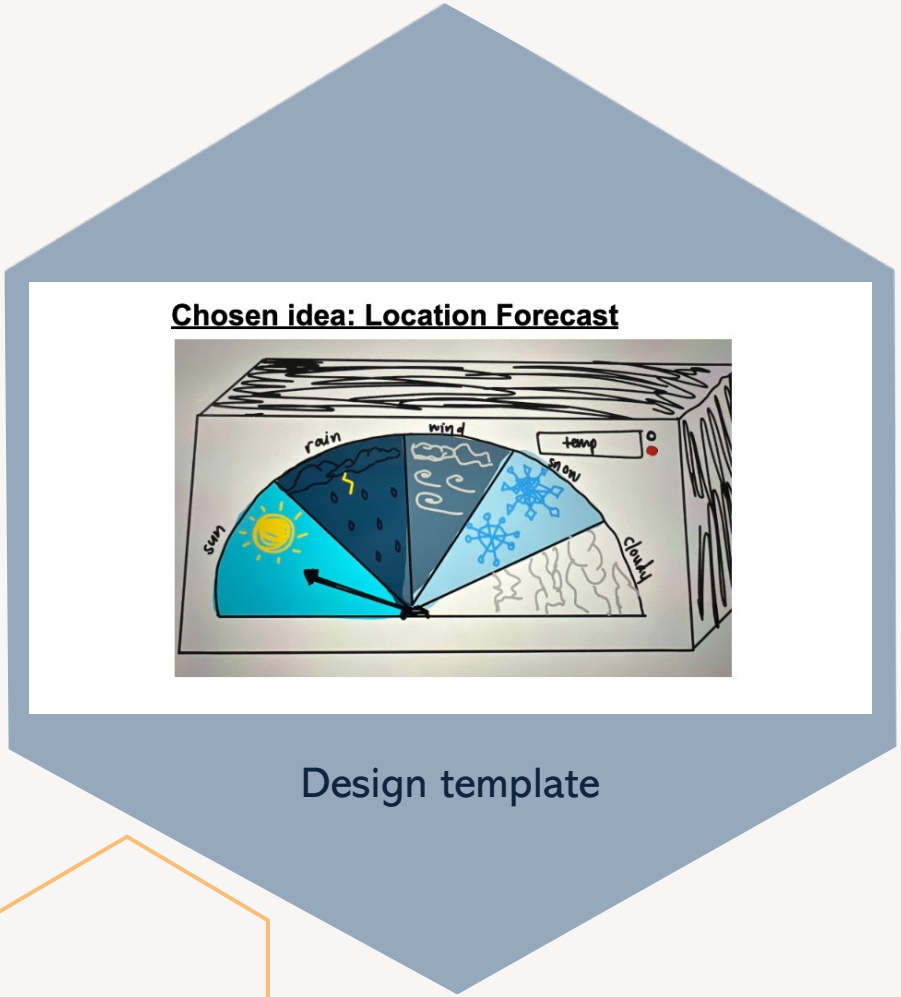
We adopted a collaborative team approach, opting to work together closely rather than following a traditional project management structure. This approach allowed us to efficiently assign tasks based on each member's strengths:

Team Member 1: Coding/Wiring
Team Member 2: Coding/Wiring
Myself: Coding/Wiring
Team Member 4: 3D Printing

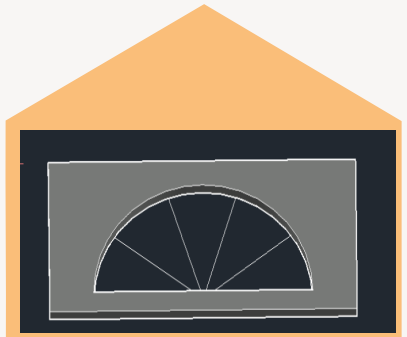
To ensure the project progressed smoothly, we developed a comprehensive timeline that accounted for potential challenges, providing us with the flexibility to address any issues that might arise. Our timeline was structured as follows:

Week 1: 3D printing and initial coding/wiring of electrical components
Week 2: Complete 3D printing and continue coding/wiring
Week 3: Finalize coding/wiring
Week 4: Assembly of all components
Week 5: Presentation

This plan allowed us to stay on track while ensuring we had ample time to troubleshoot and refine our work as needed.



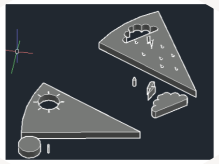
Design template

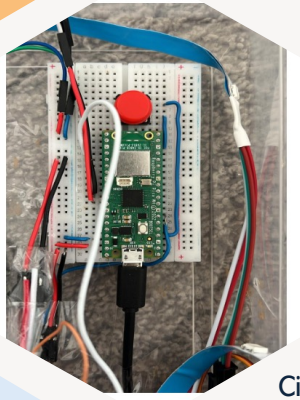


3D printed vessel - front

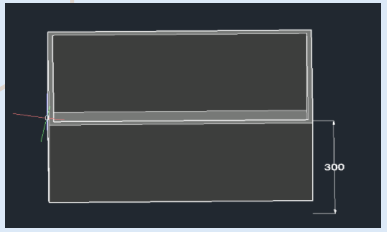
Arc sections with weather icons

D printed arc sections





Circuit



3D printed vessel

Design

During the design process, we regularly checked in with each other and referenced the timeline we had created to ensure we were on track and to identify any potential delays.

Coding/Wiring: We decided to take a simultaneous approach to coding and wiring, rather than completing one before the other. We began by coding and wiring the LCD screen, carefully adjusting the code to ensure the text displayed correctly and was properly centered. Next, we moved on to coding and wiring the button, ensuring it allowed the user to select a city when pressed. Before proceeding to the servo, we focused on coding the API to parse real-time data. We utilized the OpenWeather One Call API 3.0 to fetch weather data for the selected city. Once the API was successfully integrated, we coded and wired the servo, programming it to move to specific arc sections based on the weather data retrieved. Finally, we wired and coded the LED light strips, configuring them to change color according to the weather conditions in the chosen city as provided by the API.

3D Printing: For the 3D printing aspect, our team member began by measuring the breadboard and other components to design a custom enclosure. This enclosure featured cutouts for the LCD, button, and servo, as well as an arrow to be placed on top of the servo for aesthetic appeal. The design also included arc sections, each marked with different weather icons, to visually represent the forecasted weather conditions.

Test/Troubleshoot

During the testing phase, we conducted thorough evaluations to ensure everything was functioning correctly. We also invited others to test our code, providing us with an external perspective and valuable feedback on its performance. The testing process went smoothly, with suggestions focusing on minor adjustments such as text alignment and button responsiveness. We promptly implemented these suggestions, ensuring our code met the highest standards of accuracy and functionality.

Challenges Encountered:

1. **Breadboard Stand:** We initially overlooked the need for the breadboard to be positioned vertically, which required a stand. With no time to 3D print one, we had to think quickly and improvised a stand using cardboard, securing it with tape to ensure stability.
2. **3D Printed Vessel:** We intended for the 3D-printed vessel to be translucent, but the final product was completely opaque. This issue prevented us from placing the LED strip lights inside the vessel, as they would not be visible. To resolve this, we modified the design by creating a small hole in the back of the vessel, allowing the LED strips to connect to the breadboard and be positioned on the outside of the box.

These challenges required quick thinking and adaptability, ultimately leading to effective solutions that allowed us to maintain the integrity and functionality of our project.

Final Product

The final product is a 3D-printed vessel equipped with external LED strips, an LCD screen, a button, and a servo. The LCD screen presents different city options, allowing the user to press and hold the button to select a city. Once a selection is made, the API retrieves the relevant weather data, and the LCD displays the current temperature for that city. Simultaneously, the servo rotates to indicate the correct weather icon, while the LED strips illuminate in a specific color corresponding to the weather condition represented by the icon.

Entrepreneurship

Entrepreneurship played a crucial role in the design and execution of the Weather API Integration Project:

Presentation Innovation: Entrepreneurship drove the team to think creatively, developing a unique solution that combined data visualization with artistic design. The challenge was to make weather information both informative and engaging, which required an entrepreneurial mindset to balance technical functionality with user experience.

Resourcefulness: Faced with material and time constraints, the team displayed entrepreneurial resourcefulness by innovating with available resources. For example, when the 3D-printed vessel turned out opaque, the team quickly adapted by placing the LED light strips on the outside of the vessel instead of the inside, demonstrating the ability to pivot and solve problems on the fly.

Iterative Improvement: Reflecting the entrepreneurial process of iteration, the team actively sought feedback during testing and made improvements based on suggestions. This willingness to refine and optimize the product ensured that the final version was polished and met the project's goals.

Effective Problem-Solving: When unexpected challenges arose, such as the need for a vertical breadboard stand, the team demonstrated entrepreneurial problem-solving by quickly devising and implementing a practical solution, ensuring project continuity without compromising quality.

Overall, entrepreneurship was at the heart of the project, driving innovation, problem-solving, and user-focused design.

Light bulb in my brain

Teamwork

- The biggest takeaway from working in a group on a collaborative project, especially one where none of us had prior experience, was the importance of clear **communication, open-mindedness** and maintaining **focus** on our end goal
- The most surprising aspect was how much my team and I were able to directly apply what we learned from our classes to the project, making the transition from theory to practice almost seamless.
- The most rewarding part was seeing our efforts culminate in a **practical** and **functional final product**.
- I gained a deep understanding of how to work effectively within a **diverse team**, learning to **trust my team** members, make **collaborative decisions**, and **problem solve** together.

End of Project Reflection

The most valuable lesson I've learned from working on a collaborative project is the importance of effective communication and unwavering commitment to the end goal. Although the project was challenging and frustrating at times, in retrospect, it provided an incredible learning opportunity since it pushed me to think creatively and approach problems from new angles. This experience has deepened my appreciation for project-based learning, as it not only reinforces theoretical concepts but also challenges my understanding in a practical, hands-on way.

I've always enjoyed working on projects, but what truly set this ENGG 200 class apart was the emphasis on design and the opportunity to demonstrate my comprehensive knowledge through a project rather than traditional exams that focus primarily on memory.

As I enter my 2nd year of engineering and begin to apply for internships, I'm excited to apply the technical experience from clubs/courses and my soft skills that I have spent 5 years developing, to help me in a job setting.

Thank you

Krishna Patel

krishnapatels@hotmail.com