AutoDrip Irrigation

Grow More With Less

Sponsored by

Sea Cider Farm & Ciderhouse

AutoDrip Irrigation Project

Automated Irrigation for Sea Cider Farm

Written and Designed by the AutoDrip Irrigation Team

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Course Information

ECET 290 – Applied Research Project
ENGL 273 – Technical Communication

Recipients

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Sea Cider Farm & Ciderhouse

December 6, 2025

ENGL273 – Technical Communications
December 6, 2025
CP, MM, TJ, TM

Memorandum

To: Sea Cider Farm & Ciderhouse
CC: ECET Capstone Faculty, Camosun College
From: Colby Parker, Michael Moulden, Thomas Jordan, Thomas Murdoch
Date: Dec 6, 2025
Subject: Automated Irrigation Formal Report

AutoDrip Irrigation is proud to have completed the design and implementation of the proposed automated irrigation system for Sea Cider Farm & Ciderhouse. This report outlines the design decisions, technical implementation, financial breakdown and handover procedure for SeaCider Farm, as well as possible future enhancements for AutoDrip.

We have successfully kept our final design under the given budget while achieving all requirements and features. With close communication and support from our client, we delivered a project that our team is proud of and one that we hope will inspire future capstone teams.

The AutoDrip Irrigation system reduces water consumption by processing moisture sensor readings, weather forecasts and real time clock data to optimize irrigation schedules. Our system offers three modes of operation: Automatic, Timer, and Manual to offer flexible control of the system. Operations can be controlled from both a physical control box as well as an online web application that also offers live and historic data for sensors, water usage and weather forecasts. Our device runs directly off solar power creating a fully off grid system.

We thank Sea Cider Farm and supporting staff for their guidance and support throughout the project:

SeaCider Farm & CiderHouse ------------ Client and Sponsor
Kimberly Lemieux --------------------------- Technical Communications Instructor
Mel Dundas | Justin Curran | Wayne Mayes -- Capstone Project Instructors
Ryan Lindstone ------------------------------- Project Management Instructor
Camosun Innovates ------------------------- 3D scanning and laser cutting services

Executive Summary

The AutoDrip final report highlights the development and completion of a self-sustaining automated irrigation system. Our system offers a sustainable, smart solution at a fraction of the cost of competing products. Our sponsor, Sea Cider Farm and Ciderhouse, where the system will be installed, gave us three requirements for the project. Our client wanted the system to be easy to use, to offer multiple control options, and to match their farms aesthetic.

To achieve these goals, we designed a user-friendly system that offers three modes of operation which can be controlled physically on the enclosure and remotely via a web application. We used an ESP32-C3 microcontroller to make optimized irrigation decisions based on soil moisture sensors and local weather forecasts, and to drive a MOSFET that controls our water solenoid valve. The entire system is housed in a compact wooden enclosure featuring the solar panel, charge controller, battery and control box.

Key Features

- Three modes of operation: Manual, Timer, and Automatic.
- Sustainable solar-powered design using a 45 W PV panel, battery storage, and charge controller.
- Uses soil moisture data, local weather forecasts, and a real time clock to irrigate only when needed.
- Remote control via our web app from anywhere with an internet connection.
- Designed for both consumers and commercial farms at an affordable price point.
- Tracks historic and live data of soil moisture, temperature, and estimated water use.

Recommendations

To ensure the system performs as intended and provides effective results, our team recommends monitoring crop health, consistent soil moisture trends, and water usage throughout the first irrigation season. For further expansion recommendations, see page 19.

Conclusion

Our project offers a practical, affordable, and scalable design to make irrigation smarter and inspire others to grow more with less. The AutoDrip irrigation system was completed on December 2, 2025, and is ready to be used in the upcoming irrigation season at Sea Cider Farm.

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Introduction

Agriculture is one of the largest global industries, impacting millions of lives every day. Its success depends strictly on water resources that support crop growth and livestock production. A recent article [1] states that agriculture is proven to account for 70% of global freshwater consumption, making it by far the largest consumer worldwide.

This enormous water demand consequently arises a major challenge: almost half [2] of the water used in these irrigation systems is wasted due to outdated or inefficient systems that leads to overwatering, runoff and evaporation. As climate change and water scarcity emerge as major focuses today, efforts on conserving this vital resource have become imperative.

These issues caught the attention of our team and presented an opportunity to showcase our knowledge and experience towards an innovative, sustainable technology that could solve a real-world problem.

Our Client

With a connection through our team member Thomas Jordan, we were able to find a client and sponsor who was enthusiastic about our plan to find a sustainable solution for irrigation. That Client is Sea Cider Farm and Ciderhouse.

Sea Cider is a local organic apple orchard and cidery on the Saanich Peninsula that currently relies on manual irrigation and requires staff members to physically turn water taps on and off. Although this current system works well for Sea Cider, it can be prone to human error. We wanted to create a system that would conserve water, resulting in cost savings, as well as reduce time efforts around crop irrigation. Sea Cider provided a project criteria that included the following:

- A visually appealing, weatherproof enclosure
- Multiple modes of operation
- An easy-to-use interface

Project Scope

Sea Cider generously sponsored the AutoDrip Irrigation project by providing a $500 budget and a dedicated section of the farm where we could test and implement our system, using it as a trial zone with the potential for full-farm deployment in the future. Our project covered a 14-week period from September 2nd to December 2nd, 2025. Our primary objectives were to complete the following:

- Develop a fully autonomous irrigation control system
- Reduce water consumption
- Provide a simple user interface and eliminate the need for manual irrigation control
- Provide real-time monitoring and remote-control capabilities
- Implement solar and battery power for off-grid operation
- Complete project within the provided 500$ budget

Market Context

Current automated irrigation systems exhibit a significant gap between commercial and consumer users [3]. Commercial systems provide advanced features but can cost thousands of dollars and are difficult to set up and operate. Consumer products usually only provide basic timer modes and lack soil moisture and weather integration for conscious irrigation management.

AutoDrip Irrigation was designed to bridge this divide by providing advanced features at an affordable cost. By integrating moisture sensors, weather forecasts, and cloud-based monitoring and control, our system optimizes watering schedules for under $500.

The AutoDrip Team

Our team of four Electrical Engineering Technology students includes:

Thomas Jordan - led PCB design and manufacturing, as well as maintained client communications and helped create hardware interface and design.

Michael Moulden - led enclosure/interface manufacturing, designed CAD drawings, and assisted with PCB development.

Colby Parker – led web development and was responsible for cloud integration and technical documentation.

Thomas Murdoch - led software development, created system operational code, and integrated weather forecast and moisture sensor data for the Automatic mode.

Report Structure

The AutoDrip Irrigation project is documented in the discussion and will begin by showing the decision making and progress throughout the term. We then cover the project financials as well as the system handover process and recommendations for Sea Cider. Lastly, we outline the potential future enhancements and outlook for AutoDrip irrigation.

System Design and Technical Implementation

Our development is outlined in a chronological order, showcasing our progress and advances throughout the term, which includes microprocessor selection, water valve control, sensor communication, operating modes, breadboard prototyping, cloud integration, weather integration, PCB design and fabrication, and enclosure design. Figure 1 shows the outline of this discussion.

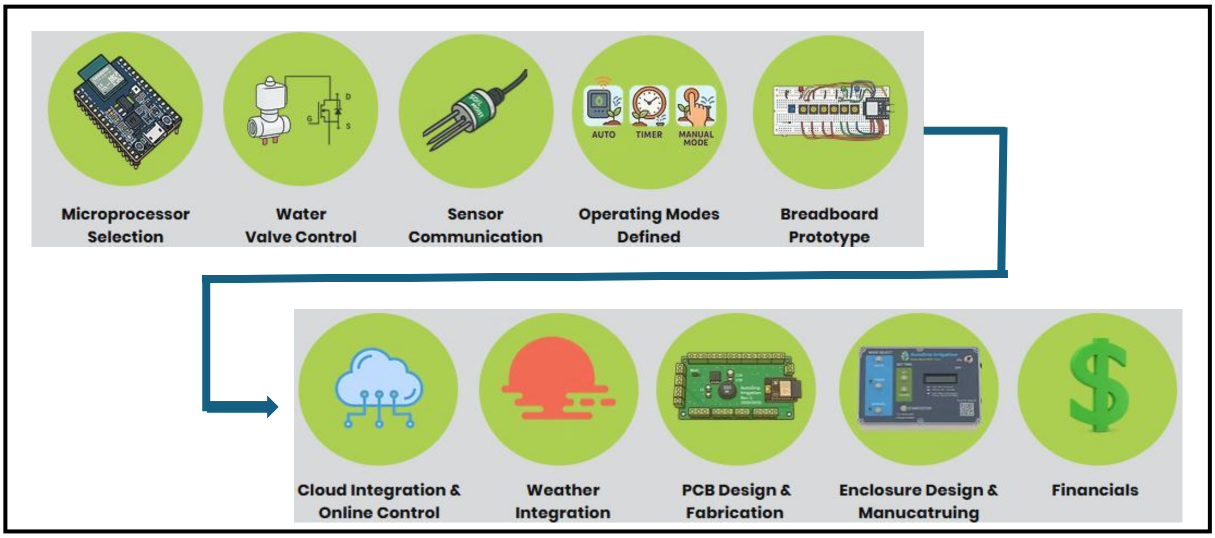


Figure 1 - Discussion Structure

System Overview

The AutoDrip system is a fully autonomous irrigation device that features an ESP32-C3 that processes moisture sensor and weather forecasting data to determine optimal watering schedules, as well as a solar and battery setup to power the entire system. A control box houses our ESP32's and all external hardware connections and contains the system's physical control interface on top. The AutoDrip irrigation system overview can be seen in Figure 2 below.

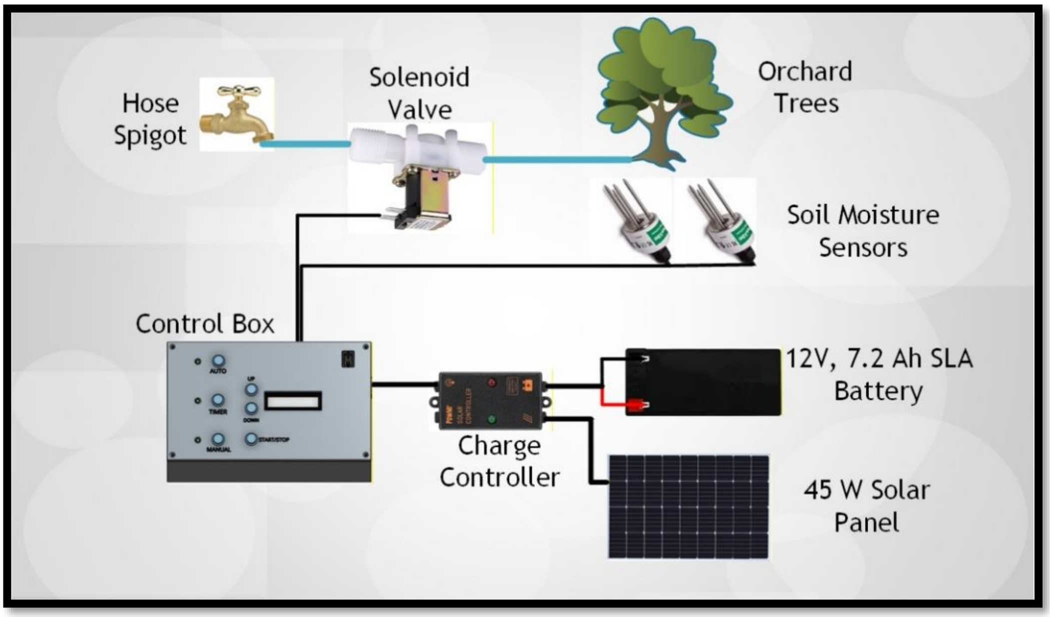


Figure 2 - AutoDrip System Overview

Microprocessor Selection

Within the first two weeks of our project term, we faced a critical decision: what microprocessor should we use for our system. Our initial plan before the term was to use either a Raspberry PI5 [4] or an Arduino UNO R3 [5] to run our code, however after careful consideration and planning, we resolved to use the ESP32-C3 Dev Kit microprocessor [6] in our final product. Looking at our original options, the Raspberry Pi5 microprocessor was a strong contender for our project as it has a high processing speed of 2.4GHz, 4GB of chip space, and internet availability. The Raspberry Pi5 was, unfortunately, lacking an easy way to get SDI-12 data from our sensors without a specialized SDI-12 adapter, so it was off the table. Our other contender was the Arduino UNO rev 3 as it has the existing libraries to collect data from our SDI-12 sensors, however it lacked an onboard internet connection, meaning we would need an external Wi-Fi adapter if we wanted our system to be controllable online. After evaluating all microcontroller options (Figure 3), we deemed the ESP32-C3 Dev kit to be the single best pick for the AutoDrip project as it had all the essential features we rely on, including onboard Wi-Fi connection, available SDI-12 sensor libraries, 4MB of flash memory, and a processor speed of 160MHz.

This combination of features made the ESP32-C3 the only option that satisfied every requirement of our system, which is why it became our final choice for the AutoDrip controller.

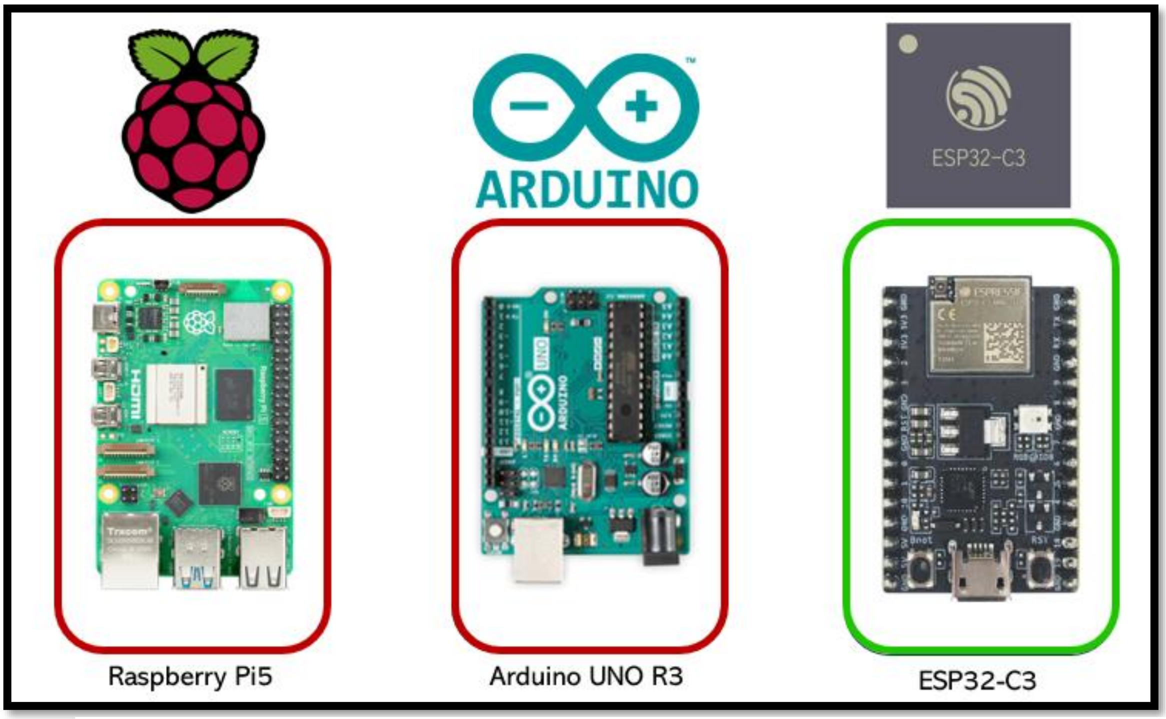


Figure 3- Microprocessor Candidates

Water Valve Control

With our microprocessor selected, we needed to address the water flow control for the drip irrigation lines we had installed on the farm. We decided to incorporate a 12V DC solenoid valve shown in Figure 4 to control the irrigation flow.

Figure 4 - 12V Solenoid Valve

Choosing a 12V solenoid matched our existing 12V solar and battery system that we had already obtained before the project term, which eliminated the need for voltage conversion, simplified the power distribution, and maximized energy efficiency.

Since the ESP32's GPIOs (General Purpose Input Output) only output 3.3V, we needed to design a switching circuit that would allow the battery voltage to energize the solenoid. We ended up choosing an N-channel MOSFET with a gate threshold voltage of 3.3V to switch the 12 volts to the solenoid. We also added a flyback diode in parallel with the solenoid—a diode that safely redirects the sudden voltage spike created when the solenoid is switched off—to protect the MOSFET from inductive kickback [7]. Shown in Figure 5 is the complete *Multisim* designed switching circuit that we validated through breadboard testing. In our initial circuit test, we used a light bulb to represent the solenoid as our first parts order had not yet been delivered. Our tests with this circuit were successful and confirmed that this switching concept would work for our project.

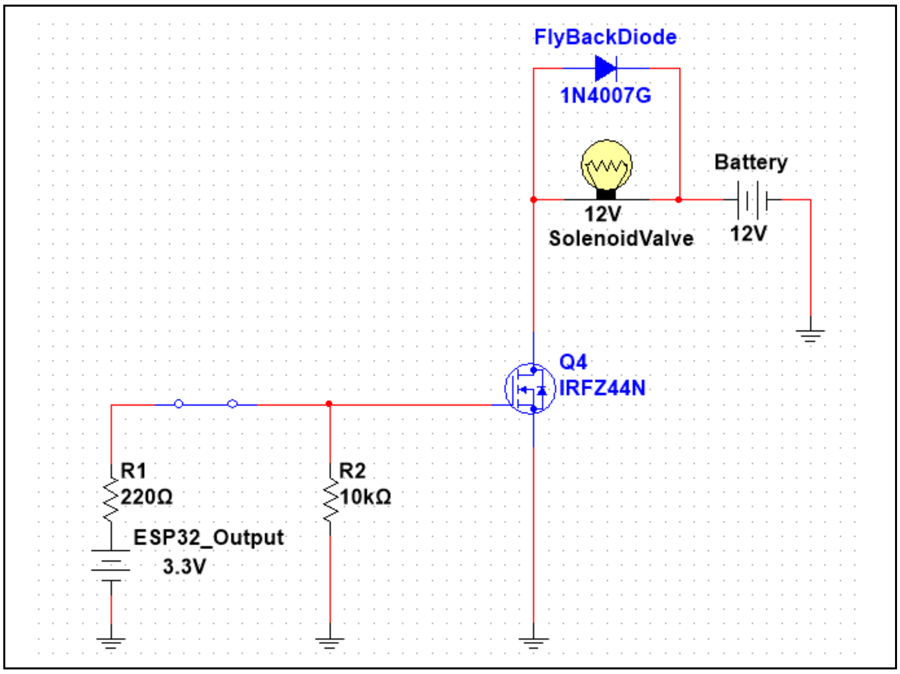


Figure 5 - Multisim Solenoid Control Circuit

The next step forward for the project was to gather relevant moisture sensors readings, as this data would be a key factor in our irrigation logic.

Sensor Communication


Figure 6 - Initial Sensor Testing

Obtaining accurate moisture data from our sensors was a critical step for efficient irrigation and water conservation. Measuring the volumetric water content or moisture in the ground, our code can decide not to water when the soil is already sufficiently moist, saving water and reducing costs. The sensors shown in Figure 6 are ISS Rain Bird moisture sensors [8] and were kindly provided by a local golf course.

These sensors work by measuring how much water is in the soil (its *volumetric water content*) using four metal rods and an internal "capacitance" principle: essentially, the sensors read the capacitance (the ability of a material to store electrical charge) between the metal rods. Water has a greater ability to store charge, meaning when the soil is moist, our sensors will read a different capacitance. This change allows our system to accurately determine the amount of water in the ground, giving us a reliable measurement of moisture. They also measure soil temperature and salinity.

In week two, when we received the sensors, we immediately tested them using our ESP32-C3 microcontroller. We programmed in the *Arduino Integrated Development Environment (C++)* and used a prebuilt SDI-12 communication library [9] to send specialized SDI-12 commands [10]. These commands address each sensor individually, signals them to start measuring, and then requests data. When the "start measurement" command is sent, each sensor records soil data. When we issue the "send data" command, the sensor transmits back its identification number or address, the soil moisture, salinity, and temperature.

Operating Modes

After gathering accurate sensor data, we decided that defining our modes of operation for the system would be the next step. Since Sea Cider requested multiple modes of operation, we agreed that having an automatic, timer, and manual mode would provide the most flexibility while also maintaining a simple control scheme. Each mode of operation is detailed below.

Manual Mode - Provides direct control to turn the watering on or off with no time limits. Manual mode will also serve as a failsafe, allowing users to turn off the solenoid if needed. See flow chart in Appendix A (Figure 22).

Timer Mode - Allows the user to control watering duration. After selecting the timer mode using its push button, three additional buttons are used: one to add time, one to subtract time, and one to start or stop the timer. If the timer is running, the solenoid will remain open, allowing users to set a fixed watering period. See flow chart in Appendix A (Figure 22).

Automatic Mode – Showcases the system's most complex and advanced mode that aims to conserve the most water. Automatic mode will check soil moisture readings from sensors every hour and determine whether watering is necessary. The ESP32 device has a built-in clock that can pull real-time data if connected to WIFI on startup, meaning that we can easily start and stop processes depending on the time and date. Using the clock, we can start irrigation consistently at the same time of day. The real-time clock will also allow us to check local weather forecasts consistently each day to check if rain is expected, and to do this, we are implementing *Open Weather* [11], a free online service that provides weather data, including temperature, humidity, wind speed, and most importantly, the amount of rain for an area in millimeters. Using all these different variables combined with the moisture readings from the sensors, we will be able to irrigate crops without overwatering or leaving crops dry. See flow chart in Appendix A (Figure 23).

Breadboard Prototyping and Circuit Validation

After defining our modes of operation, we developed test code to demonstrate the functionality of the three operational modes. To validate our design and interface before committing to an enclosure design, we built a breadboard prototype shown in Figure 7. This prototype served as our testing device for all development code and provided assurance for the circuitry components used to switch the solenoid valve. Figure 7 identifies all the key components on our breadboard prototype.

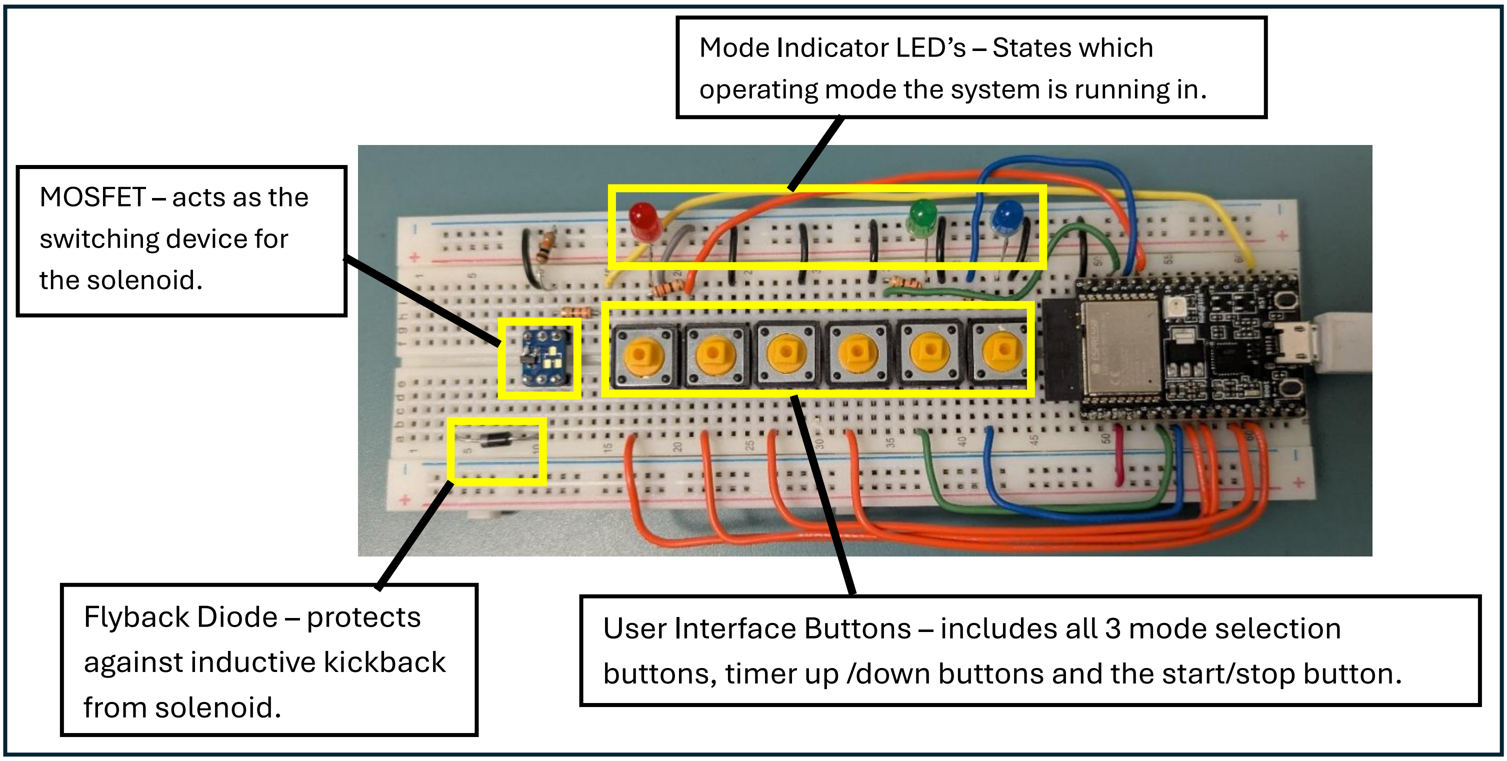


Figure 7 - Breadboard Prototype Labelled

This testing process was important because it confirmed all the components our system needed before we designed our PCB. We successfully verified that each mode selection button turned on the corresponding mode indicator LEDs, the timer up/down buttons adjusted the time, and the start/stop button began the countdown timer and toggled the solenoid in manual mode. After testing this board for weeks, we finally had a fully functional prototype that confirmed our control interface operated as we wanted. The next step in our project was to replicate this interface for remote online control of our system.

Cloud Integration and Online Control

Having created a physical control interface, we also wanted to implement an online control feature so that Sea Cider would be able to have full access to the system from anywhere, at any time, with an internet-connected device. We developed our cloud integration using *Firebase* [12], a web hosting platform and Realtime Database that would allow us to integrate bidirectional data communication between the ESP32 and a web control application. Our web control application was built using *HTML* (Hypertext Markup Language), *CSS* (Cascading Style Sheets), and *JavaScript* to leverage Firebase's *JavaScript SDK* (Software Development Kit), which allows us to communicate with the Realtime Database [13] seen in Figure 8.

The database updates automatically when a user either changes inputs using physical or online control. For example, the **Mode** node uses three states to represent the three operating modes: 0,1, and 2 (Auto, Manual, and Timer, respectively). Figure 8 shows the system running in Manual mode since the node is a 1. This database ensures both control interfaces will remain synchronized and update displays and operational settings whenever changes are made from either end. Additional nodes in the database include live sensor data, solenoid status, start/stop button status, timer settings, and water usage.

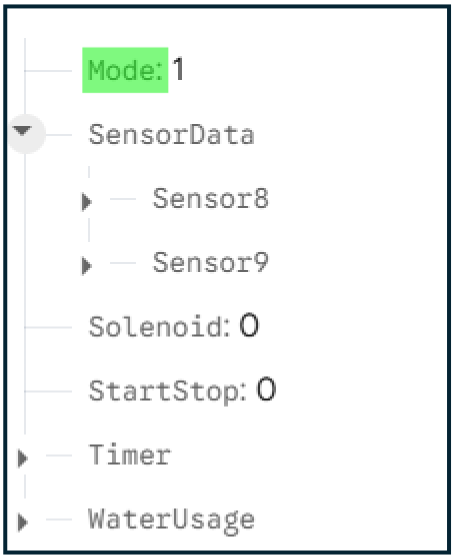


Figure 8 - Realtime Database

Figure 9 showcases the control panel within the web application, which features the same control scheme as our physical control box with only 1 added feature: a 2.8-hour preset button, which is the calculated ideal watering time for Sea Cider's crab apple trees [14].

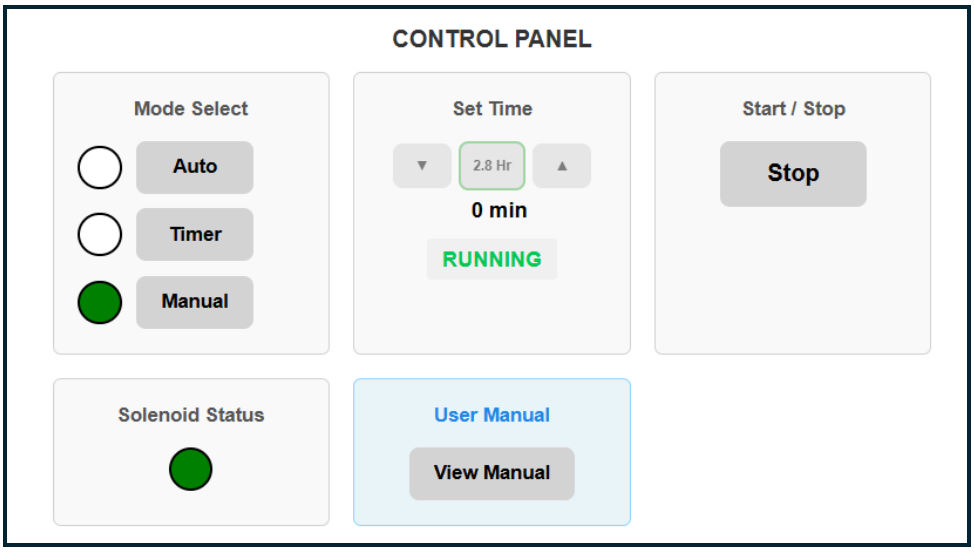


Figure 9 - Web App Control Panel

The Auto Drip web application also features multiple data displays (Figure 10), including water usage, live sensor data, and historic data. The web application also plots the daily water usage and sensor data into historical data graphs so users can compare irrigation patterns across different days. A full overview of the historical data charts is provided in Appendix B and represents what would be seen from selecting the "OPEN Historic Data" button on the web application.

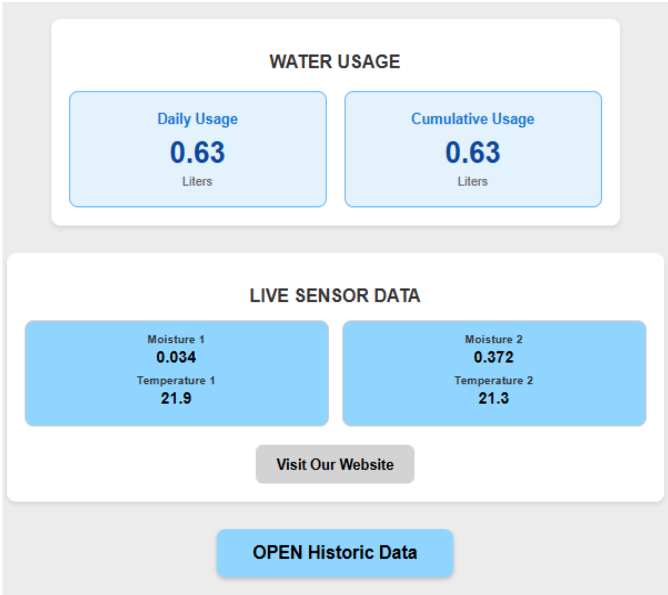


Figure 10 - Web Application Data

The historic data charts that we are using have been generated using *ThingSpeak* [15]. Our ESP32 code can send values to *ThingSpeak* and generate graphs to represent different values over time. To plot these graphs into our web application (such as Field 3 shown in Figure 12), we embedded the chart's Iframe [16] code (Figure 11) into the HTML code. This ensures that the charts on our web application would display live and accurate data directly from our *ThingSpeak* dashboard.

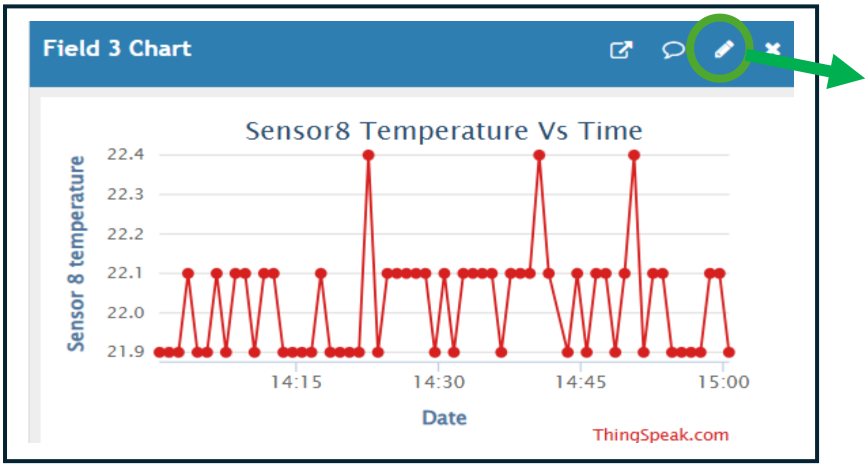


Figure 12 - ThingSpeak Field 3 : Sensor 8 Temperature

Figure11 - ThingSpeak IFrame for Field 3

With both ends of our control interfaces working in conjunction, we had achieved reliable bidirectional control for our system. Our focus could now be centered on enhancing our software capabilities, which includes adding weather forecasts into our systems watering schedule decision making.

Weather Integration

Although weather monitoring was not part of our original project proposal, our group quickly realized that adding weather forecasting would significantly improve water efficiency at our project site, Sea Cider Farm. To achieve this, we incorporated *OpenWeatherMap,* which is an online service that provides free weather data and forecasts. *OpenWeatherMap* offers predictions up to ten days in advance, with detailed information available in three-hour increments.

The service returns forecast data in a JavaScript Object Notation file or a JSON file, which is a text-based format that can be easily parsed by machines, which is perfect for our program. By supplying the latitude and longitude of Sea Cider Farm, we can retrieve localized weather information, such as the expected rainfall amount in millimeters for each three-hour window. Running our weather-update function multiple times allows us to gather all eight forecast segments for a full 24-hour period, giving a complete picture of the day's predicted water (Figure 13).

```
--- 3-Hour Forecasts (Next 24 Hours) ---
Time: 2025-11-29 00:00:00 | Rain: 3.98 mm
Time: 2025-11-29 03:00:00 | Rain: 1.51 mm
Time: 2025-11-29 06:00:00 | Rain: 0.00 mm
Time: 2025-11-29 09:00:00 | Rain: 0.93 mm
Time: 2025-11-29 12:00:00 | Rain: 1.46 mm
Time: 2025-11-29 15:00:00 | Rain: 0.00 mm
Time: 2025-11-29 18:00:00 | Rain: 1.09 mm
Time: 2025-11-29 21:00:00 | Rain: 2.07 mm
-------------------------------------
Total rain expected (next 24h): 11.04 mm
```

Figure 13 – OpenWeatherMap precipitation data for 24-hour period

Our system calls this function every night at midnight. From this data, the program determines whether significant rainfall is expected. If light rain is forecast, the system reduces irrigation time; if heavy rain is predicted, irrigation can be paused entirely. This integration of real-time weather forecasting greatly reduces unnecessary watering and enhances overall system efficiency.

Having completed the software development, we are pleased to present our client with a system that not only supports multiple modes of operation as specified by their requirements, but will save money, time, water, and can be fully controlled and monitored over the internet.

PCB Design and Fabrication

After completing the main software development of our project, we designed a printed circuit board (PCB) to act as a reliable interface between our microcontroller and our external components. This aspect of our project was key for our systems requirements by providing reliable mechanical connections, reduced electrical noise, and clean signal paths.

Layout and Design Considerations

To achieve a reliable and practical design, we used *Altium Designer*. In Figure 14 below, a 3D render of our final PCB is shown. The board features screw terminal connections along the outline, which provide a reliable connection to our sensors, status LEDs, user pushbuttons, solenoid valve, and the liquid crystal display (LCD). We included nine terminals for soil moisture sensors to allow future expansion, although our current application only uses two. Additionally, we included a terminal for a flow sensor, which could track water usage more accurately as well as alert users of potential leaks. However, the farm deemed the flow sensor unnecessary for the system's current application.

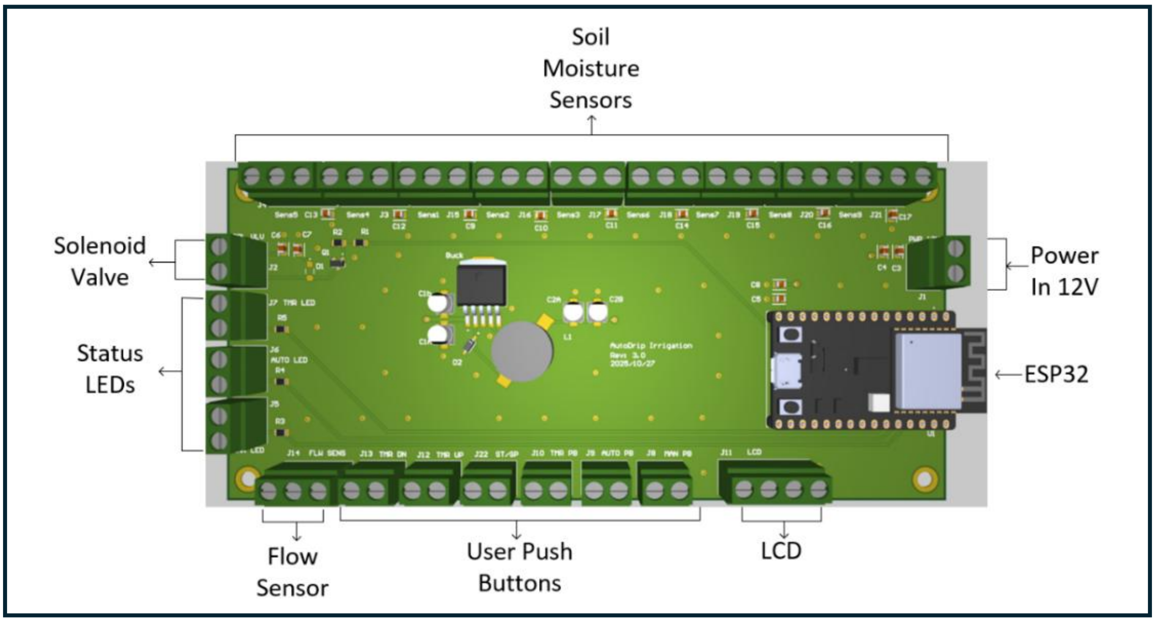


Figure 14 - Labeled 3D Render of Final PCB Design

The main purpose of our design was to both manage power between all our components and to create an interface for mechanical connections between the microcontroller and the external components.

PCB Power Management

To power all these external components, we elected to use a Switch Mode Power Supply (SMPS) for its high efficiency and reliability. Our design, shown in Figure 15 is configured to step down our 12 V input voltage to a stable 5 V output to be used for the microcontroller and LCD. The power supply works by pulse width modulating (PWM) the input voltage, essentially switching on and off quickly [17]. We designed this power supply according to its datasheet specifications [18] and our desired output of 5 V.

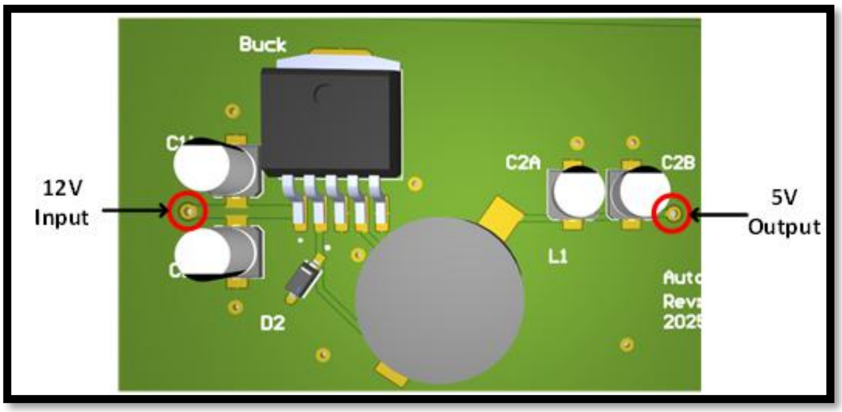


Figure 15 - Switch Mode Power Supply

PCB Assembly Process

Once we completed the PCB design and sent out the order for manufacturing, we moved into the assembly phase. Our group did not have much experience with PCB assembly, so the whole process was a great learning experience.

We used a reflow oven to solder all the surface-mount components. For this process, we used a stencil of our board and covered each footprint with solder paste. We then carefully placed each component on the board and put in the reflow oven. The oven works by heating up the solder paste enough for it to melt and make connections between the board and components without overheating the components themselves [20].

Following the reflow oven, we hand-soldered the remaining through-hole components. Once finished, we tested the board to make sure everything was connected properly. The final product was a fully functioning and reliable PCB shown in Figure 16 below.

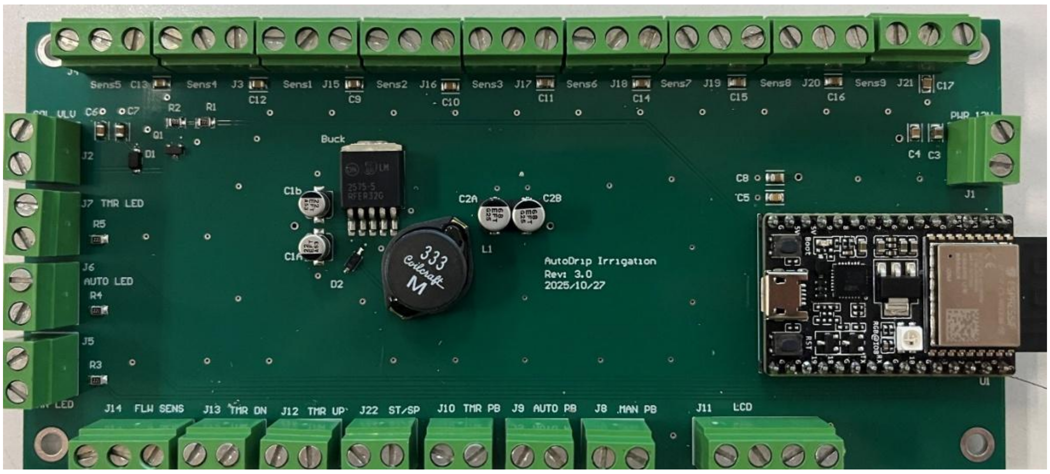


Figure 16 - Final Assembled PCB

Throughout the assembly process, we gained valuable experience in part selection and refined our soldering skills.

Enclosure Design and Weatherproofing

After countless hours of work building a functioning PCB, we designed a weatherproof enclosure to protect the electronics from the harsh conditions of the Pacific Northwest. Our enclosure shown in Figure 17) was designed with simplicity as a priority and features straightforward titles and control descriptions. Our control box is also water resistant and durable to protect against dirt and grime.

Figure 17 - Control Box Final Assembly

It took a few iterations of *CAD* models to finalize the optimal layout for the user interface. Our team decided on three LED indicator lights, six push buttons for control, and an LCD to display further information. Each LED corresponds to a watering mode: timer, manual, or automatic. When the mode is activated, the LED turns on to tell the user that the selected mode is running. To access each mode, a push button is pressed by the user for each corresponding mode. For redundancy, an LCD is used to display the selected mode and watering status, as well as wi-fi and weather data connectivity.

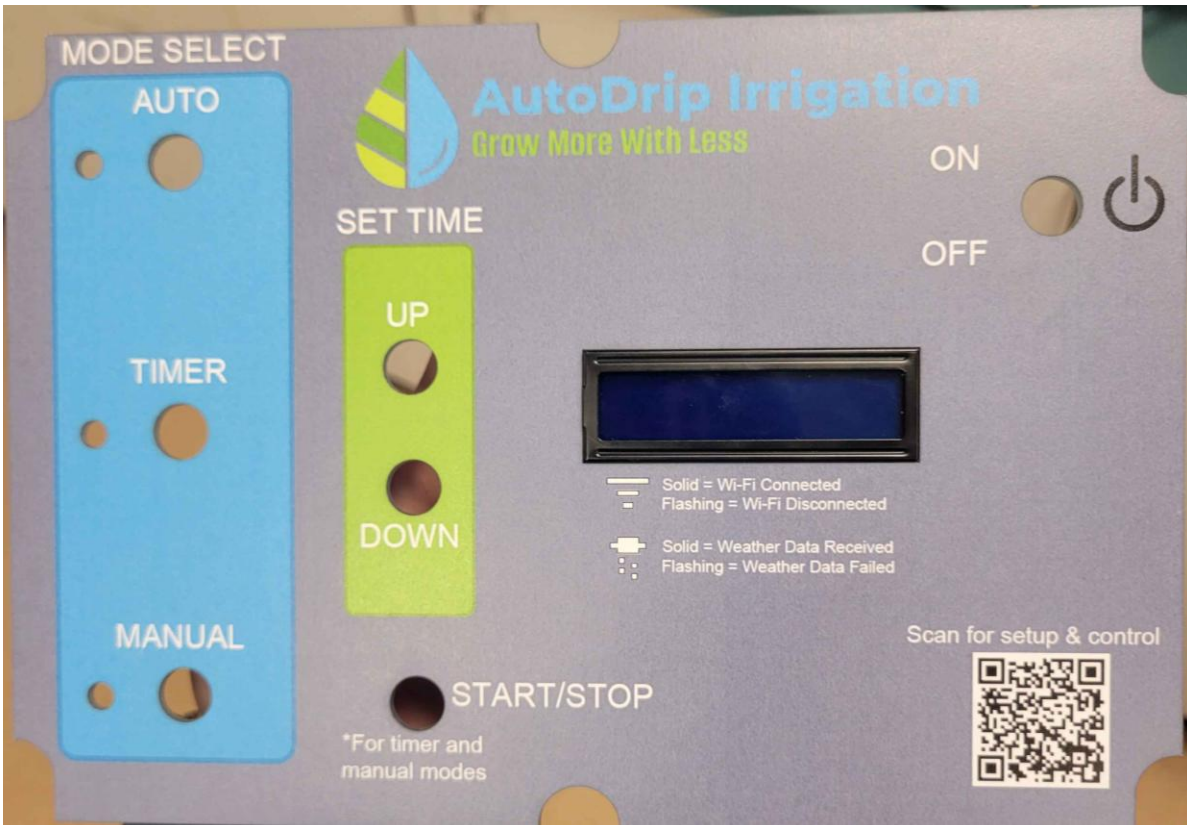


Figure 18 - Sticker on Faceplate

To ensure protection against varying weather conditions, we ordered an IP-65 rated enclosure. We selected this enclosure as a guarantee to protect against the environment, opposed to 3D printing our own design. The push buttons and LED lights are also IP-65 rated. Throughout the design process, we found it challenging to display the LCD while not losing the integrity of the enclosure. In the final version shown in Figure 18, we press fit the LCD into the acrylic back plate. By using the back plate as a mounting surface, the LCD can sit flush with the lid, providing the most optimal view of the display.

Solar Power System

To power our system, we chose to implement a sustainable solar power setup consisting of a solar panel, a charge controller, and a battery, simplified in Figure 19. We recycled a 45 W solar panel, which provides more than enough energy for our system's requirements, eliminating the risk of power loss. The panel was mounted at an angle of 33°, which helps maximise available solar energy [21]. A 12 V, 7.2 Amp-hour (Ah) sealed lead acid (SLA) battery [22] was selected to ensure our system can run for at least 48 hours without sunlight, according to our power calculations (Appendix C), while also remaining cost-effective. To regulate the power coming from the solar panel, we chose a waterproof pulse width modulation (PWM) controller for its simplicity, durability, and affordability. The controller manages the current flow from the solar panel to the battery, preventing overcharging and deep discharging [23]. This power system ensures that irrigation control will not be interrupted.

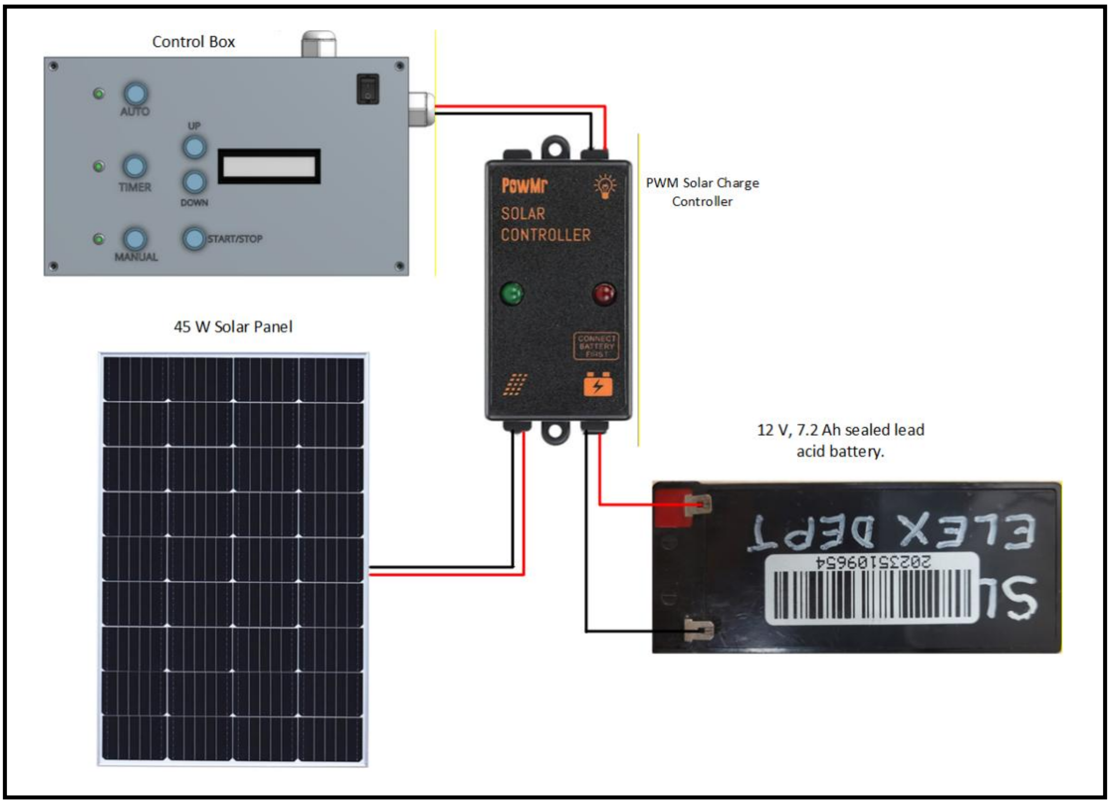


Figure 19 - Solar Power System Diagram

Wooden Box

To encapsulate both the control box and power system, we built an additional wooden enclosure. The interior and exterior of the box are shown in Figure 20. It features a hinged roof with a solar panel attached to act as a rain cover for the box, along with vents on either side to prevent dangerous gas build-up from charging the lead-acid battery. In addition, the cable glands were mounted to prevent water ingress. The wooden lift support allows the roof to be propped open for operating and maintaining the system. We then painted the box to match the farm's aesthetic and protect the wood from rotting. The box rests on four legs, which were designed to allow for airflow underneath and to prevent water buildup at the bottom.

Figure 20 - Final Enclosure Interior and Exterior

Financials

Sea Cider Farm and Ciderhouse provided the $500 budget for the AutoDrip Irrigation team to build a fully functioning and reliable product. Throughout the semester, our team carefully evaluated all parts (Appendix D) before ordering, to avoid mistakes and prevent unforeseen expenses. The bulk of the cash spent went towards the control box, wooden enclosure, and irrigation supplies (Figure 21). The project remained under budget, with the total expenses being $336.28, resulting in $163.72 of budget remaining.

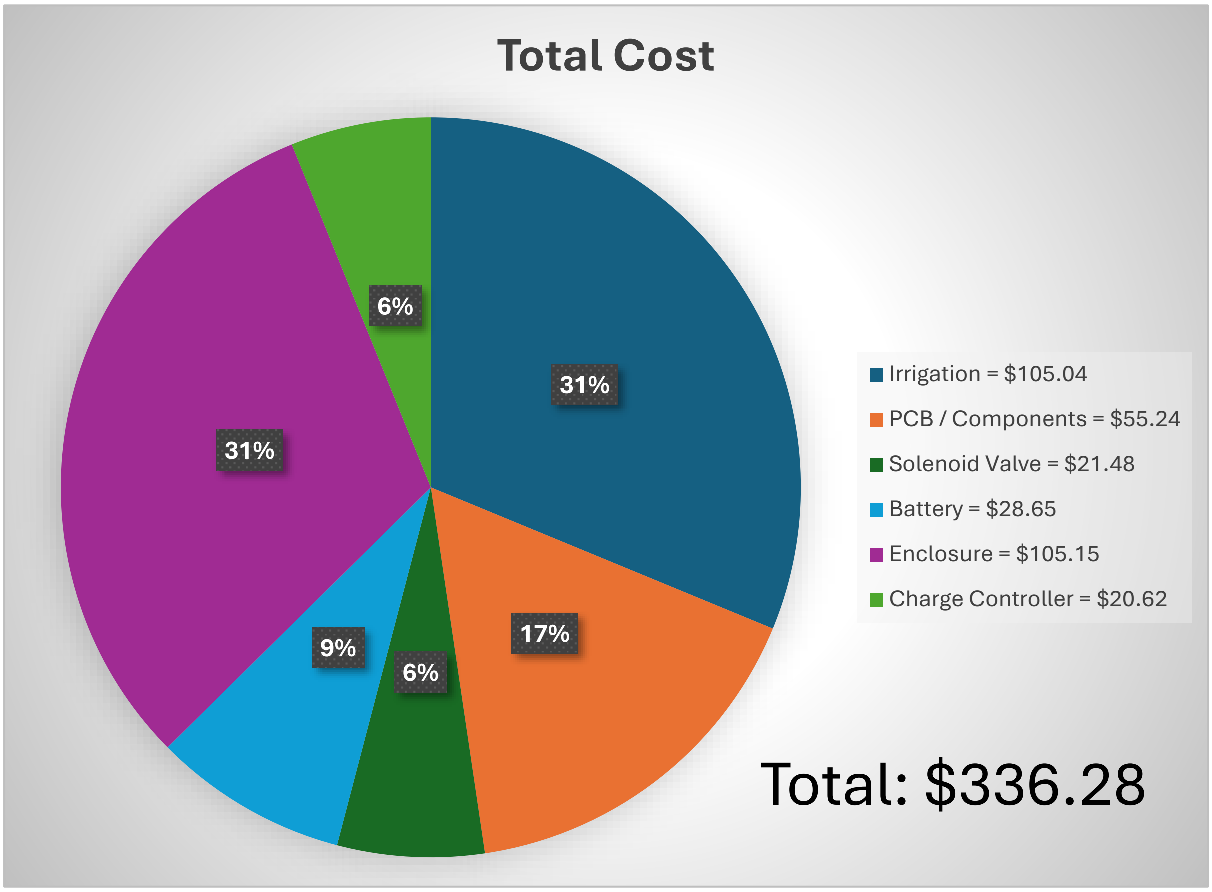


Figure 21 - Pie Chart of Cash Spent

We followed a strict budget and saved money by recycling an older solar panel, and the soil moisture sensors were donated by a local golf course. This supported our commitment to sustainability with the reuse of equipment that might have been discarded otherwise.

System Handover and Deployment

With Sea Cider's irrigation season concluded, the Auto Drip Irrigation system will be stored indoors until next season. In preparation for deployment, we will provide Sea Cider with an in-person demonstration of the complete system operation as well as a comprehensive user manual. We will remain available and maintain communication leading up to the next growing season to ensure smooth system deployment and verify that all components are functioning as intended.

Recommendations for Sea Cider Farm

We recommend the following measures to fully optimize the AutoDrip Irrigation system:

- Review soil moisture data over the first month using the historic charts to confirm consistent trends.
- Monitor crop health during the first irrigation season to confirm proper watering.
- Compare water usage across Timer, Manual, and Automatic modes to validate that Automatic mode delivers the greatest efficiency.

Future Enhancement Opportunities

Throughout the project, we discovered some potential improvements and features that we were unable to implement due to time and financial constraints. Listed below are some of the potential improvements we could implement in the future.

Multi-Zone Irrigation

Implement extra solenoid valves to create multi-zone irrigation to improve maintenance procedures and allow individual control of multiple sections for different watering needs.

Flow Monitoring

Implement the in-line flow sensor to detect leaks and pressure drops that can alert users. It can also create more accurate water usage tracking.

Dual Power Option

Implement a 120 VAC input port to power the system directly.

Wi-Fi Setup via Web App

Update Wi-Fi configuration through the web application instead of reprogramming the ESP32 inside the control box.

SMS/Email Alerts

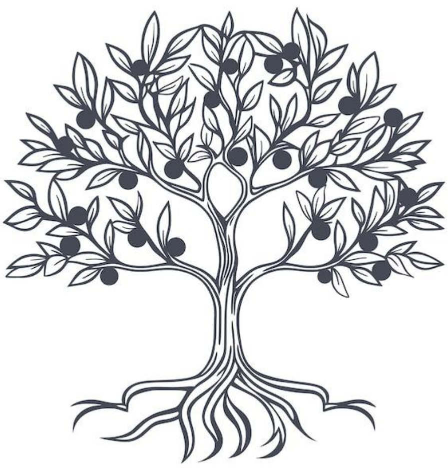
Send notifications for sensor faults, long watering cycles, low battery, Wi-Fi drops, and other system errors.

Conclusion

The AutoDrip Irrigation project successfully automated an irrigation system for Sea Cider Farm and Ciderhouse, while staying under budget and ahead of schedule. Our team designed, assembled, and tested a fully functioning autonomous system that will be deployed at Sea Cider for use in the upcoming irrigation season.

By utilizing an ESP32-C3 microcontroller that reads real-time soil moisture data and local weather forecasts, our system optimizes irrigation schedules and reduces both time and cost for farmers. Our system provides both physical and remote control, with three different modes of operation, offering practical, advanced control at a fraction of the cost of competing products.

We want to thank our instructors, Mel, Justin, Wayne, Todd, Ryan, and Kimberly, for their support and guidance throughout the project. Thank you as well to the backroom staff for all their help, Camosun Innovates for aiding in 3D scanning and laser cutting, and Sea Cider for their financial and moral support throughout the term. It has been a pleasure to create a meaningful product for a local business, and we are excited to see it in action at Sea Cider Farm in the upcoming irrigation season.



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Appendix A : Code Flow Chart for Irrigation Modes

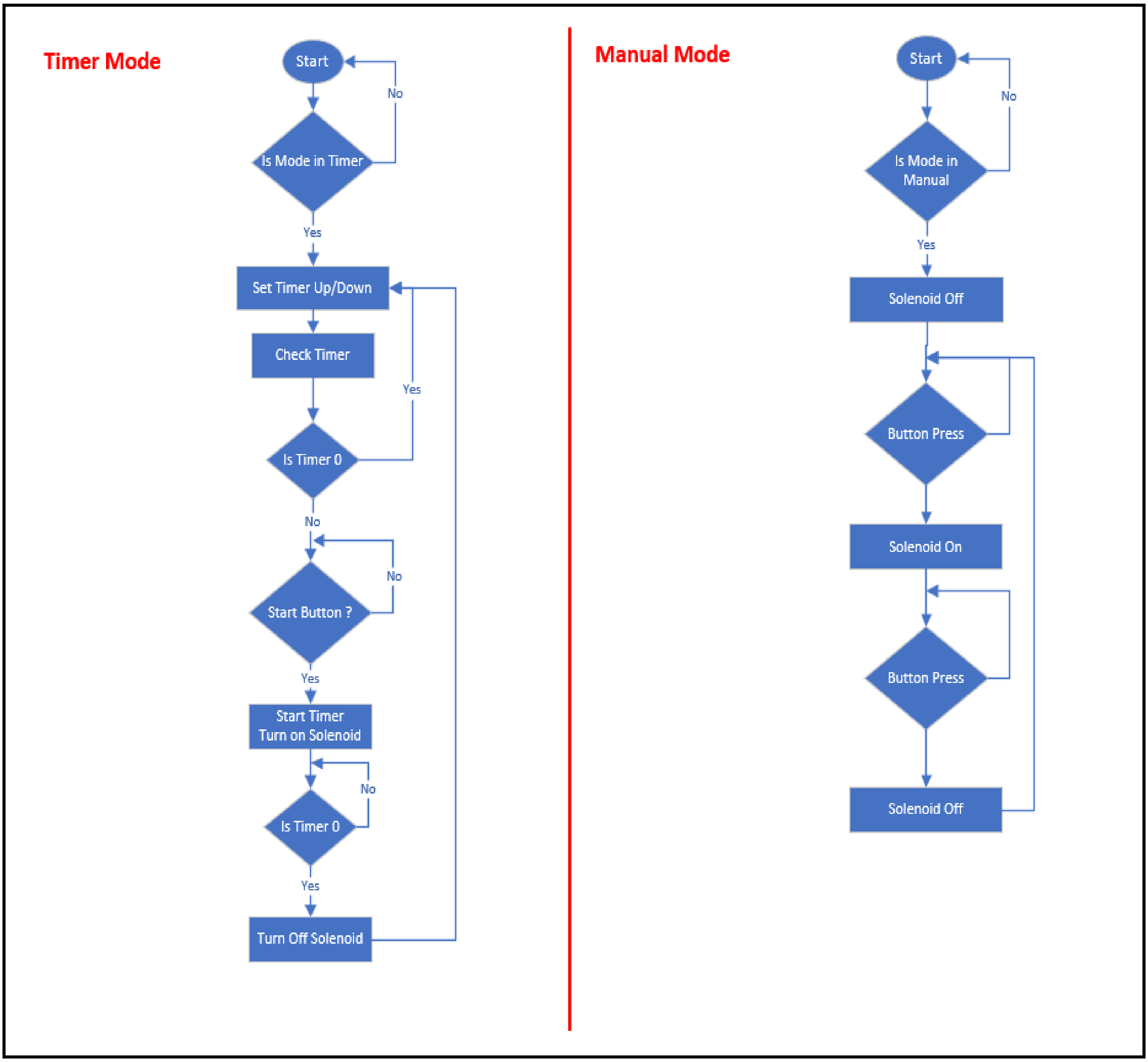

Figure 22 – Timer and Manual Mode Flow Charts

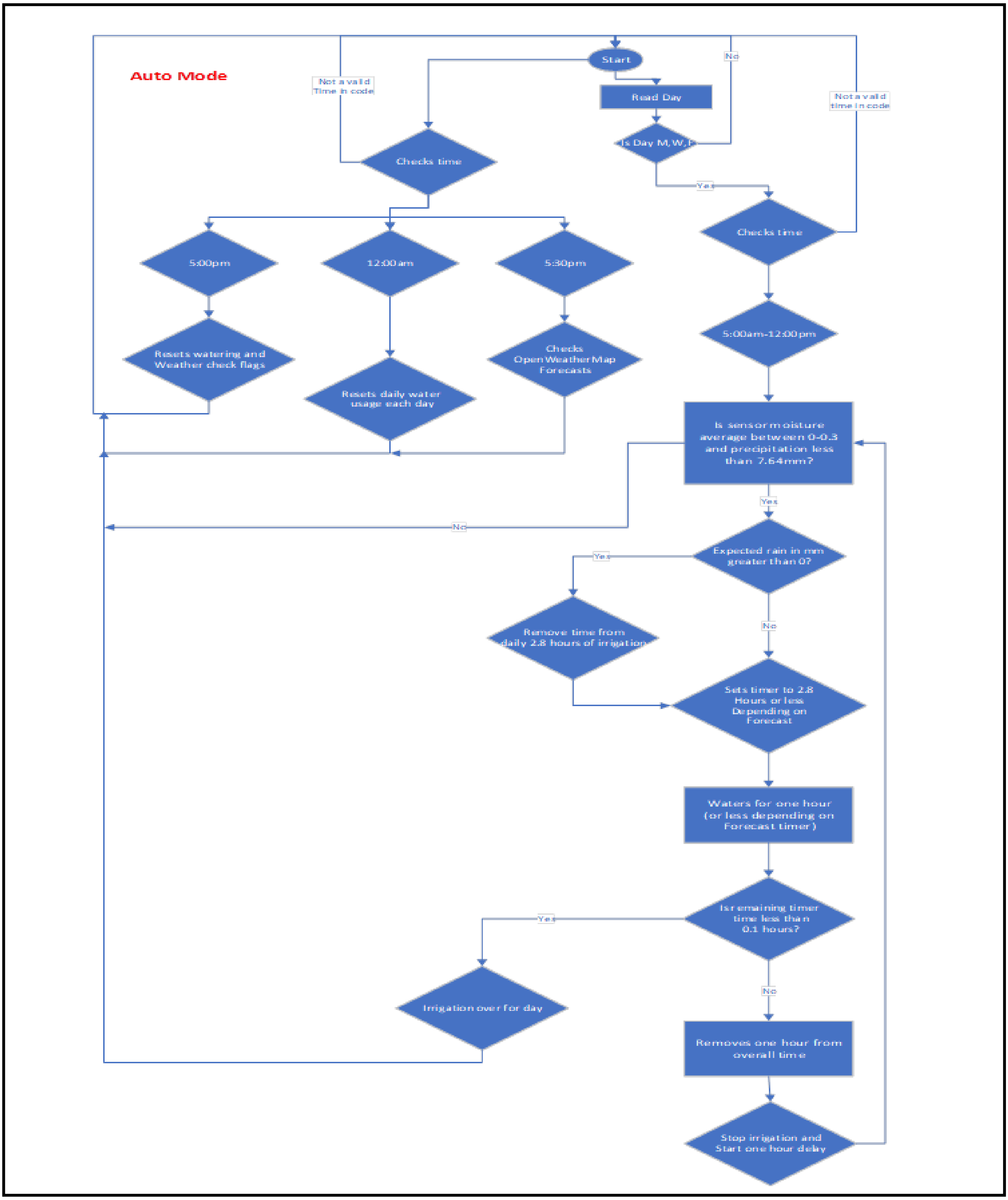

Figure 23 - Auto Mode Flow Chart

Appendix B : Historic Data Graphs on Web App

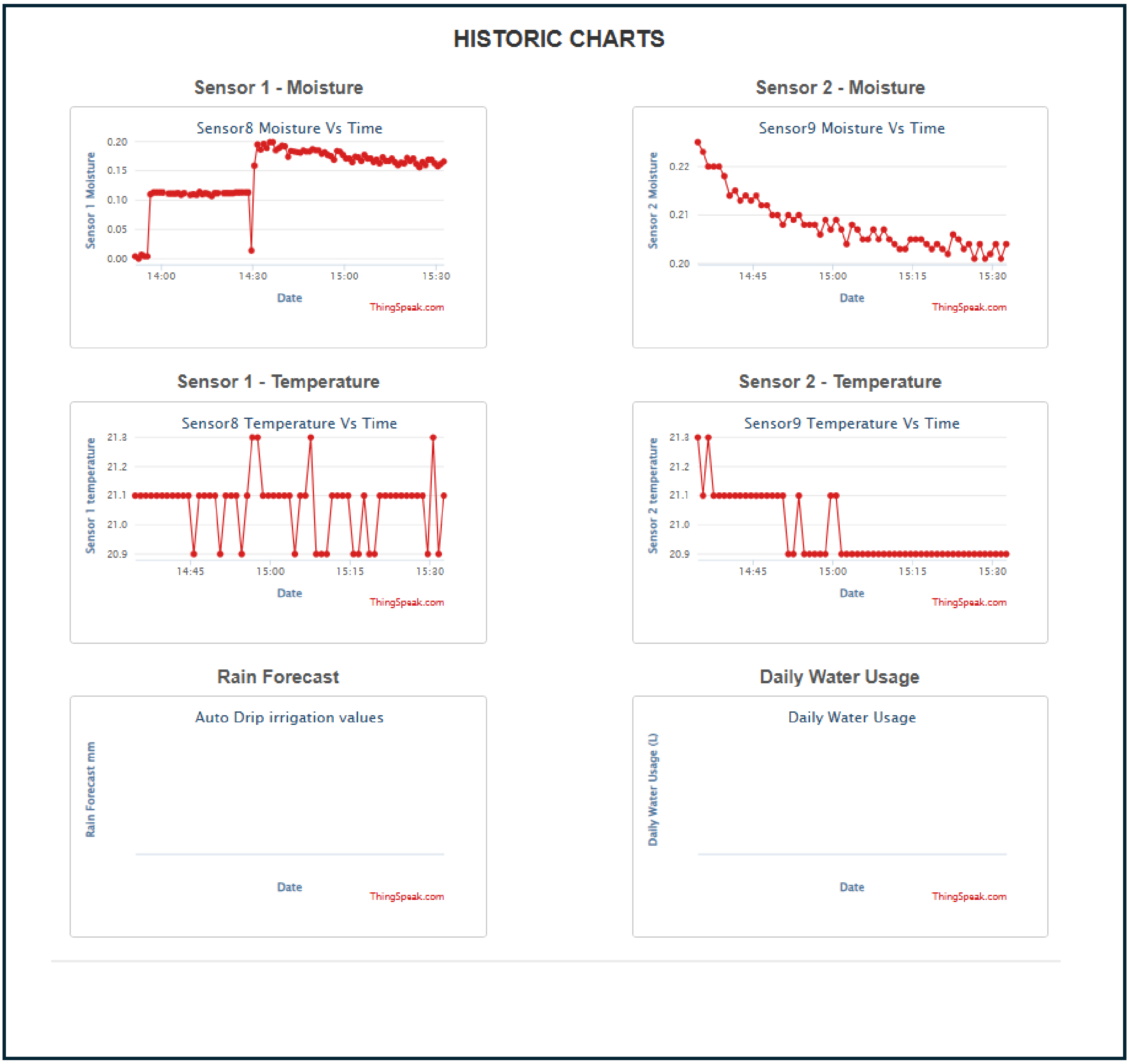

Figure 24 - Historic Data Graphs on Web App

Appendix C: System Power Calculations

Table 1 System Power Requirements

Device / Mode	Power (W)	Hours/day	Energy/day (Wh)	Battery-side Energy/day (Wh)
Solenoid valve	4.8 W	4 h	19.20 Wh	19.20 Wh
ESP32 - WiFi TX	1.98 W	1 h	1.98 Wh	
ESP32 - Active CPU	0.5 W	1 h	0.50 Wh	
ESP32 - Idle	0.0165 W	22 h	0.36 Wh	
ESP32 total (3.3 V)			2.84 Wh	3.69 Wh
Sensor	0.36 W	1 h	0.36 Wh	1.20 Wh
MOSFET/misc	0.01 W		0.10 Wh	0.01 Wh
Buck	0.12 W	24 h	2.88 Wh	2.88 Wh
TOTAL				26.98 Wh

Appendix D: Project BOM

Table 2: AutoDrip BOM

No.	Vendor	Qty	Vendor Part#	Manufacturer Part#	Description	Link (URL)	Unit Price	Extended
1	DigiKey	13	732-10955-ND	691137710002	TERM BLK 2POS SIDE ENTRY 5MM PCB	ronik | Connector	$0.50	$6.46
2	DigiKey	12	732-10956-ND	691137710003	TERM BLK 3POS SIDE ENTRY 5MM PCB	ronik | Connector	$0.80	$9.61
3	DigiKey	3	732-10957-ND	691137710004	TERM BLK 4POS SIDE ENTRY 5MM PCB	ronik | Connector	$1.05	$3.15
4	DigiKey	4	PCE5003CT-ND	EEE-FT1E220AR	CAP ALUM 22UF 20% 25V SMD	lectronic Compon	$0.52	$2.08
5	DigiKey	5	732-8045-1-ND	885012207045	CAP CER 0.1UF 16V X7R 0805	th Elektronik | Ca	$0.10	$0.50
6	DigiKey	10	490-16824-1-ND	GRM21BR61E106KA73K	CAP CER 10UF 25V X5R 0805	Murata Electronic	$0.09	$0.90
7	DigiKey	5	PCE5006CT-ND	EEE-FT1E680AR	CAP ALUM 68UF 20% 25V SMD	lectronic Compon	$0.58	$2.90
8	DigiKey	2	2457-DO5022P-333MLD-ND	DO5022P-333MLD	FIXED IND 33UH 3A 66MOHM SM	nductors, Coils, C	$3.50	$7.00
9	DigiKey	3	1N5819HW-FDICT-ND	1N5819HW-7-F	DIODE SCHOTTKY 40V 1A SOD123	ited | Discrete Se	$0.27	$0.81
10	DigiKey	2	LM2575D2T-5GOS-ND	LM2575D2T-5G	IC REG BUCK 5V 1A D2PAK-5	ni | Integrated Ci	$2.25	$4.50
11	DigiKey	2	1528-2003-ND	997	Solenoid Valve 12VDC	Adafruit Industrie	$10.79	$21.58
12	DigiKey	5	IRLML6344TRPBFCT-ND	IRLML6344TRPBF	N-Channel MOSFET	IRLML6344TRPBF	$0.55	$2.75
13	DigiKey	5	5272-1N4007WCT-ND	1N4007W	Surface mount diode	1N4007W EVVO	$0.15	$0.75
14	DigiKey	10	311-10KARCT-ND	RC0805JR-0710KL	1/8 W Surface Mount 10K resistor	RC0805JR-0710KL	$0.02	$0.17
15	DigiKey	10	CR0805-JW-221ELFCT-ND	CR0805-JW-221ELF	1/8 W surface mount 220 resitor	CR0805-JW-221ELF	$0.05	$0.48
16	Amazon	1	B00K8V30D0		7.2 Ah 12 V SLA battery	Battery Brand Pro	$28.65	$28.65
17	Amazon	1	Im201803261124		IP65 Enclosure	GIBIMjQEhQba-f-	$25.99	$25.99
18	Amazon	1	B00XTQ76WW		Charge controller	Rated, 24Hours L	$20.62	$20.62
19	Amazon	5	B0CCXZLNBV		Waterproof green LEDs	DC with Wire, LED	$2.40	$12.00
20	Amazon	6	B08R9P9DFC	GQ12H2	12V Momentary PB	Pushbutton Small	$1.27	$7.62
21	Amazon	1		FNK0079A	I2C LCD 1602	splay, Compatible	$12.95	$12.95
22	Site One	200	DRIP-060-005-100		Polytubves poly Drip Tubing 1/2 inch		$0.26	$52.00
23	Site One	3	1401-005		1/2 Tee Ins x Ins x Poly fitting	ition & Agronomi	$1.31	$3.93
24	Site One	1	1436-005		1/2 insert male adapter	ition & Agronomi	$0.60	$0.60
25	Site One	1	ASP-105		1/2 in x 3/4in. Swivel Adapter Fipt x Fht Swivel	ition & Agronomi	$6.87	$6.87
26	Site One	5	1449-005		1/2 insert poly plug fitting	ition & Agronomi	$1.08	$5.41
27	Site One	10	1406-005		1/2 90 elbow Ins x Ins Poly Fitting	ition & Agronomi	$1.20	$11.95
28	Site One	1	42315		Key Punch Yellow Antelco	ition & Agronomi	$1.53	$1.53
29	Site One	2	PT-RTSS-6-25		Pro-Trade 6in. Sod Staple Round Top 25/bag	ition & Agronomi	$2.19	$4.38
30	Site One	1	n/a		3/16" X 1-3/4" HEX C PK	ition & Agronomi	$5.59	$5.59
31	Amazon	1	B07T6YNRZS		Safety toggle switch marine	vL0np_iI9zJJJF04j	$9.59	$9.59
32	DigiKey	8	732-10955-ND	6.91138E+11	TERM BLK 2POS SIDE ENTRY 5MM PCB	ronik | Connector	$0.50	$3.98
33	DigiKey	10	732-10956-ND	6.91138E+11	TERM BLK 3POS SIDE ENTRY 5MM PCB	ronik | Connector	$0.77	$7.70
34	DigiKey	15	732-8045-1-ND	8.85012E+11	CAP CER 0.1UF 16V X7R 0805	th Elektronik | Ca	$0.10	$1.50
35	Sleggs	1			Misc Hardware and Brackets		$17.00	$17.00
36	Interior Electronics	1			Misc Cable		$20.00	$20.00
37	New Line	1			Solenoid Valve Irrigation Fittings		$12.77	$12.77
							Total	**$336.28**