• Good effort
Methodology could be more specific. But as sensors details are given so UC could gather the information from there..
Testing should be done with varied environmental conditions (natural or simulated).

Smart WiFi Based House Plant/Urban Garden Irrigation System

Group 24

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1. Motivation and Project Benefits

At a broader level, this project aligns with global movements toward sustainability. By ensuring plants receive just the right amount of water, it can promote water conservation. In addition, by reducing the effort in planting, this project can help to encourage more people to plant trees or small plants contributing to slow down the global warming issue.

There is a significant amount of research supporting the use of smart irrigation systems, especially in regard to water conservation. Numerous studies report large amounts of water savings through the use of soil moisture sensors, humidity sensors, and rain sensors all while maintaining little or no reduction in crop yields . A 2023 study found a sensor-based irrigation system can save up to 60% of water compared to manual irrigation methods [1]. In addition, a 2019 study found an average decrease of 59% in water usage in sub-humid areas [2]. And our own City of Perth reported 27% water savings during the 2020/21 financial year through the use of smart irrigation [3].

Applications of smart irrigation extend beyond rural agricultural settings and into urban environments. There are a number of smart home irrigation products on the market that save households water and money while maintaining the health of their gardens and plants. These products can encourage homeowners to start planting in an effort to combat climate change. There is plenty of research about urban agriculture and climate change. Rooftop gardens are a form of urban green infrastructure that can help to mitigate the effects of climate change by reducing urban heat island effect, improving air quality, enhancing stormwater management, and increasing biodiversity [4].

In conclusion, this project utilises technological advancement in an effort to contribute to sustainable agriculture. We not only see huge conservation of water, but also a shift towards environmental consciousness in an urban setting. Ultimately, smart irrigation in urban gardens provides a pivotal step to a greener planet.

Good explanation of the motivation.

2. Problem, Solution, and Impact

The main problem this project aims to solve is inefficient water usage in urban agriculture. This has high relevance when considering water scarcity, especially in Australia's dry climate. Second to this, the project aims to promote greener practices in urban environments and the development of more urban green infrastructure by reducing the labour and cost involved in tending to plants.

Our project addresses the problem of water scarcity and inefficiency by utilising sensors and automation to water plants based on their needs. This ensures optimal hydration while minimising water wastage. By incorporating real-time data and analytics, the system prevents overwatering and underwatering, promoting healthier plant growth. The automated system will greatly reduce the amount of time and labour involved in keeping/tending to plants. Our solution when implemented will be similar to some existing projects using the ESP32 [5] [6].

As discussed in the first section, the impact of this project is multifold. Firstly, it has the potential to save up to 60% of water compared to manual irrigation methods. This has a direct positive impact on the environment and wider community by mitigating water scarcity and reducing pressure on local water supplies. In addition, this translates to large financial savings for homeowners/urban agricultural organisations. Secondly, the potential development of more urban green infrastructure due to this project has huge potential impacts on the environment and community such as reducing urban heat island effect, improving air quality, enhancing stormwater management, and increasing biodiversity.

In terms of reach, these impacts extend beyond the project's immediate users. Fully scaled smart irrigation technology can be applied in regions all over the world, potentially contributing to a significant reduction in water usage and associated costs on a global scale. In addition, this project would contribute to global sustainability and greener environmental practices.

3. Implementation Method

Phase 1: Planning and Component Sourcing

Objective

Our first objective will be to identify the necessary project requirements and procure all the necessary components within our budget constraints.

Methodology

We will create a comprehensive list of required components, ensuring they are available from approved vendors such as Jaycar and Altronics. Once the list is finalised, we will proceed with the purchasing and validate their functionality upon arrival. ✓

As items are identified in the hardware list, so better give reason for the choice here.

Phase 2: Prototyping

Objective

In this phase, our plan is to build a prototype. The goal of having a prototype is to test whether our system works as designed and planned.

Methodology

We will develop a breadboard layout to connect all the sensors, actuators, and the FireBeetle Board ESP32-E. Initial code for sensor data collection and basic decision-making will be written. We will test the system's functionality in a controlled environment to ensure reliability. ✓

Phase 3: Software Development

Objective

The objective of this phase is to build out the software functionalities, ranging from data collection to Home Assistant integration. ✓

Methodology

We will write, test, and refine the code necessary for data collection, preprocessing, decision-making algorithms, and actuator controls. Additionally, functionalities for data logging and real-time monitoring will be implemented. We will also work on integrating this setup with cloud service like Home Assistant, Blynk or AWS via Wi-Fi.

Phase 4: Integration and Testing

Objective

Our main goal in this phase is to integrate the hardware and software components and perform rigorous testing for reliability.

Methodology

The team will assemble the final hardware setup and integrate the finalised software into the system. We will conduct comprehensive tests to verify that the system performs as expected under various environmental conditions.

Phase 5: Deployment and Monitoring

Testing phase?

Objective

Once testing is complete, we will test the system in real world environment with real-time monitoring.

Methodology

The assembled system will be placed in an actual plant environment. Monitoring and adjustments will be made via the Home Assistant dashboard to ensure long-term stability and functionality.

Phase 6: Documentation and Analysis

Objective

The final phase will involve comprehensive documentation of the project and preparation for the project presentation.

Methodology

We will compile all technical documentation, including code, schematic diagrams, and user guides. Historical data will be analysed for insights into plant health and system efficiency. Lastly, we will prepare a presentation to showcase the functionalities and insights derived from the project.

Methodology need to be specifice. Referring the rubric, it could be seen that it needs to be specific as it has higher marks.

4. Software Functionality

Data Collection and Preprocessing

Our software's primary function is to collect data from the various sensors. The FireBeetle Board ESP32-E reads the humidity, temperature, and light levels in real-time from the PiicoDev Atmospheric Sensor BME280 and the PiicoDev Ambient Light Sensor VEML6030. The board also reads the soil moisture level from the Rain Sensor for Arduino. This data is preprocessed to filter out any noise or inconsistencies before being used for decision-making.

Decision-making Algorithms

We will be implementing algorithms that interpret the preprocessed sensor data. If the soil moisture drops below a preset threshold, or if the environmental conditions like temperature and light level reach certain limits, our software triggers actuator controls. The decision-making algorithms will be flexible and can be fine-tuned to accommodate different types of plants and environments.

Actuator Control

Upon making a decision based on the sensor data, the software will send a command to the 5V Single Channel Relay Module 10A. This relay, in turn, activates the Amphibious Horizontal Submersible Pump to water the plant. This ensures that the plant is in its optimal growing condition at all times.

Real-time Monitoring and Data Logging

The software will also log all sensor readings and decisions made, which can be useful for tracking the plant's health over time. This historical data will be stored and can be viewed for analytical purposes.

Integration with Cloud Service

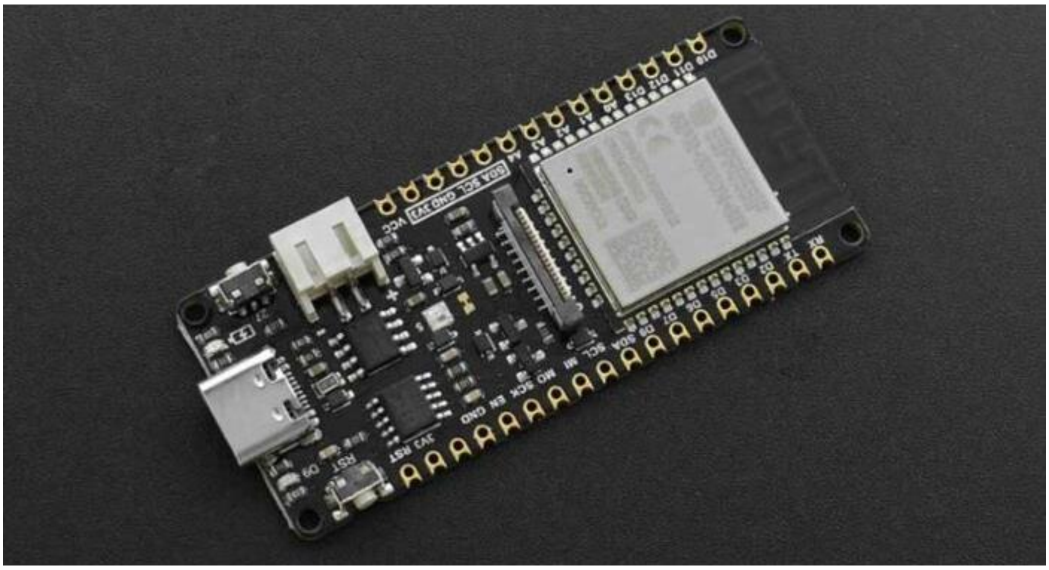
We will employ Wi-Fi to directly send this sensor data and decision logs to a cloud service. Once integrated, it opens up possibilities for more advanced features like remote monitoring, additional automations, and receiving alert notifications. We have set up a dashboard within the cloud service where real-time and historical data can be viewed, and notifications are received if conditions go beyond set limits.

5. Hardware Required and Costs

S. Nr	Items Description	Available at UWA	Cost ($)	Web address	Delivery Time
1	FireBeetle Board ESP32-E (Arduino Compatible)	Yes		https://core-electronics.com.au/firebeetle-board-esp32-e-arduino-compatible.html	
2	PiicoDev Atmospheric Sensor BME280	Yes		https://core-electronics.com.au/piicodev-atmospheric-sensor-bme280.html	
3	PiicoDev Ambient Light Sensor VEML6030	Yes		https://core-electronics.com.au/piicodev-ambient-light-sensor-veml6030.html	
4	Rain Sensor Breakout For Arduino	Yes		https://www.altronics.com.au/p/z6378-rain-sensor-breakout-for-arduino/	
5	5V Single Channel Relay Module 10A	Yes		https://core-electronics.com.au/5v-single-channel-relay-module-10a.html	
6	Amphibious Horizontal Submersible Pump	Yes		https://core-electronics.com.au/amphibious-horizontal-submersible-pump.html	
	Total		0		

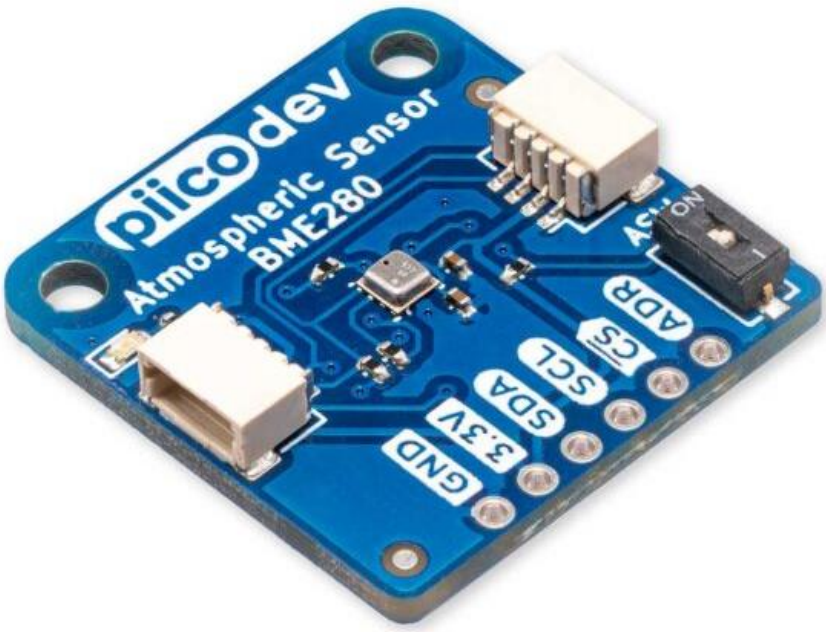
The Components

1. FireBeetle Board ESP32-E:



This board serves as the central control unit, responsible for data collection from the sensors and decision-making for actuator controls like the water pump. It is also capable of interfacing with Home Assistant for real-time monitoring and remote control.

2. PiicoDev Atmospheric Sensor BME280:

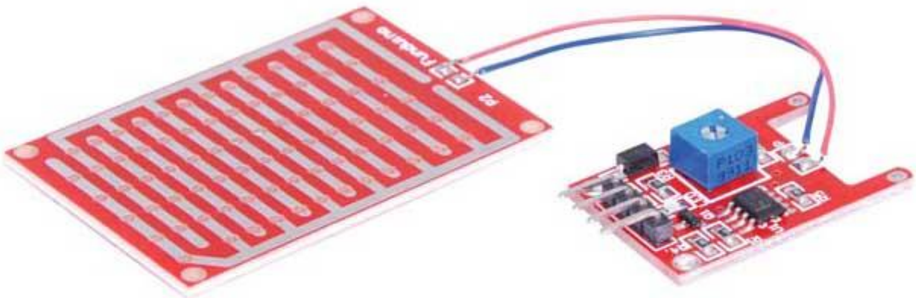


This sensor measures key environmental parameters like temperature and humidity around the plant, providing valuable insights into its immediate surroundings.

3. PiicoDev Ambient Light Sensor VEML6030:

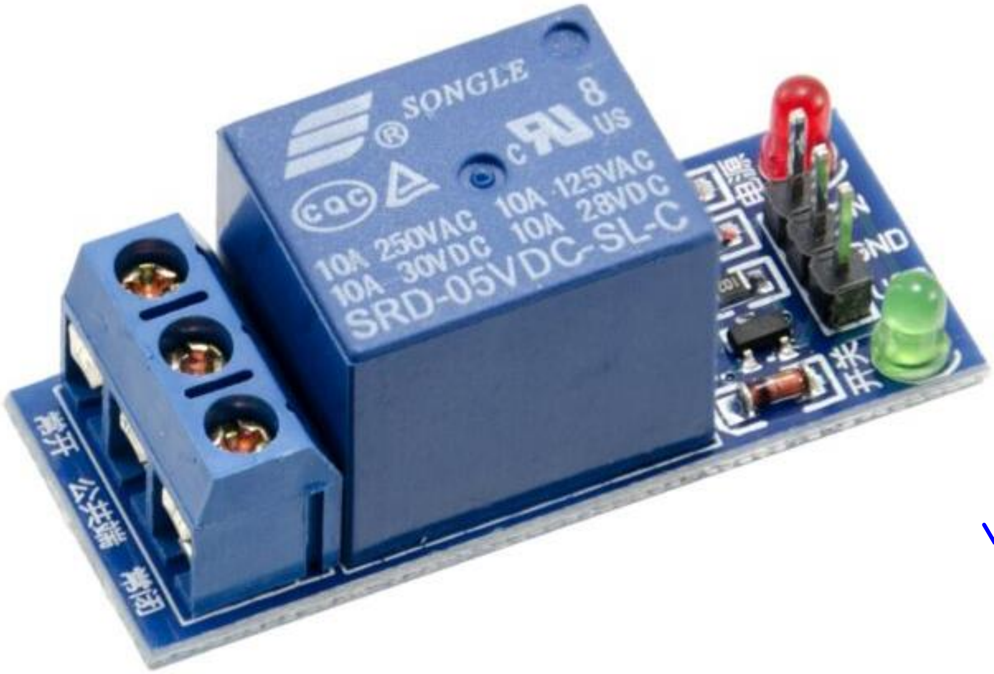
This sensor monitors light conditions, triggering alerts if light levels drop below a certain point for a sustained period.

4. Rain Sensor for Arduino:



Acts as a soil moisture metre, indicating when the plant needs water based on soil moisture levels.

5. 5V Single Channel Relay Module 10A:



This relay serves as an electronic switch, which the FireBeetle Board activates to turn on the water pump.

6. Amphibious Horizontal Submersible Pump:

This pump, activated by the relay, maintains the soil's moisture level as needed.

How It All Works Together

1. Sensors and FireBeetle Board: The sensors send real-time data to the FireBeetle Board for processing.

2. Decision-making: Based on the received data and predefined conditions, the board decides whether or not to activate the pump.

3. Actuator Control: If a decision is made to activate the pump, the board triggers the relay module, which in turn activates the pump.

4. Data Transmission to Home Assistant: Data is directly transmitted to Home Assistant via Wi-Fi for real-time monitoring and additional automation possibilities.

6. Initial Task Allocation

Name of Student	Work Assigned
Hung Hoang	Research and test how to assemble sensors and FireBeetle Board ESP32-E together
Evan Willcocks	Initial sensor integration and ESP connection + Blynk research
Pritam Suwal Shrestha	Researching home assistant and Esphome Integration
Zihan Zhang	Home assistant and ESPhome integration

7. References

[1] O. H. Embarak, N. Aldhanhani, M. Almansoori and J. Aldarmaki, "Smart Irrigation with Recycled Water: A Promising Solution for Sustainable Farming," 2023 9th International Conference on Information Technology Trends (ITT), Dubai, United Arab Emirates, 2023, pp. 157-162, doi: 10.1109/ITT59889.2023.10184258.

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[3] "Smart Cities," perth.wa.gov.au. https://perth.wa.gov.au/en/live-and-work/smart-cities.

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[5] "ESP32 - Automatic Irrigation System," ESP32 Tutorial. https://esp32io.com/tutorials/esp32-automatic-irrigation-system (accessed Aug. 31, 2023).

[6] "Indoor Plant Watering System project using ESP32 - 2023," iotcircuithub.com, Feb. 20, 2023. https://iotcircuithub.com/indoor-plant-watering-system-esp32/ (accessed Aug. 31, 2023).