ENTRY TO THE STOCKHOLM JUNIOR WATER PRIZE 2025

AQUAWISE

Smart Irrigation and Water Management System

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AquaWise - Smart Irrigation and Water Management System

Preliminary Pages

*(i) **Summary of the Project***

AquaWise is a smart irrigation system designed to optimize water usage by enabling fully customizable irrigation schedules, including start and stop times, duration, water flow rate, and total water volume. The system connects to the irrigation network via a pump when needed and adjusts water distribution based on real-time environmental data. The system collects and processes information from a weather station, along with publicly available meteorological data such as precipitation forecasts, wind speed, relative humidity, ambient temperature, and illuminance. It also integrates input from local soil moisture sensors to further refine irrigation decisions. By combining these data sources, AquaWise significantly enhances water management efficiency, contributing to substantial water conservation- a critical need amid the rising frequency of droughts and water scarcity. Highly adaptable and scalable, AquaWise can be implemented in gardens, farms, or larger agricultural operations. Its hardware requirements are minimal: commercially available, affordable soil moisture sensors and a Raspberry Pi, programmed in C++, serve as the core components. The system can be tailored to meet the specific watering needs of different plant types, as it includes machine learning. AquaWise controls a hydraulic valve and, when necessary, activates a pump to regulate water flow. If the irrigation network already provides sufficient pressure, no pump is required. For demonstration purposes, the system has been implemented on a small garden plot within our school grounds.

(ii) Table of Contents

(iii) List of Acronyms and Abbreviations

AquaWise refers to our smart irrigation and water management system. Other key terms used throughout the project include: **AI** (Artificial Intelligence), **API** (Application Programming Interface), **DOM** (Department of Meteorology), **NOAA** (National Oceanic and Atmospheric Administration), **WRF** (Weather Research and Forecasting Model), **VWC** (Volumetric Water Content), **ESP32** (low-power microcontroller with integrated Wi-Fi and Bluetooth), **LoRa** (Long Range wireless communication technology), **SJWP** (Stockholm Junior Water Prize), **UV** (Ultraviolet radiation index), **C++** (programming language used for system development), **IoT** (Internet of Things, a network of connected smart devices), **Raspberry Pi** (a small, affordable computing device used to control the irrigation system), **PASCO** (manufacturer of the PS-3228 wireless soil moisture sensor), **XML** (Extensible Markup Language used for retrieving meteorological data), **GPS** (Global Positioning System, for potential future integration), and **ML** (Machine Learning).

(iv) Acknowledgments

As part of our project, we visited the Department of Meteorology (DOM) in Nicosia, where we gained valuable insights into the department's operations and the use of meteorological data. We learned about radiosonde systems and how atmospheric data are collected and used in forecasting. The experts also guided us on integrating weather data into our project to enhance its effectiveness. By connecting to online APIs, our system now incorporates real-time meteorological data, allowing dynamic adjustments to irrigation schedules based on current weather conditions. This integration improves precision in water distribution and prevents over-irrigation.

Data Processing and Optimization: Our system employs an advanced algorithm that processes real-time data from both weather sources and soil moisture sensors. It determines the optimal irrigation timing and water volume required, taking into account plant type, weather forecasts, and environmental conditions. This data-driven approach ensures efficient water use tailored to each plant's needs.

Benefits of Using Live Data: Integrating real-time meteorological data offers multiple advantages. It conserves water by preventing unnecessary irrigation when rain or high humidity is expected, and it enables precise water delivery based on actual plant needs—avoiding overwatering and stress. By maintaining optimal soil moisture levels, the system enhances agricultural efficiency and supports sustainable farming. Overall, it acts as a smart, eco-friendly irrigation solution - vital for regions facing water scarcity.

Documentation of Data from the Department of Meteorology (DOM): To incorporate meteorological data into our project, we retrieved both forecast and near-real-time information from the Department of Meteorology (DOM).

Forecast Data (WRF Model v4.1.3): To incorporate meteorological data into our project, we retrieved both forecast and near-real-time information from the Department of Meteorology (DOM). By visiting dom.org.cy, we accessed the Weather Research and Forecasting (WRF) Model v4.1.3. We selected run times 00 (night) or 12 (morning), offering 5-day forecasts. Forecast data were retrieved at 9:00 AM and 9:00 PM to compare conditions between the school and the local town hall. We chose the Cyprus region and extracted point-specific data for Lakatamia.

Near-Real-Time Data: We also used the DOM's automatic weather station outputs in various formats: tabular, meteogram, map view, and multi-map displays. These sources offered up-to-date information critical for accurate irrigation decisions.

<u>Main Body of the Project (Research Paper)</u>

(i) Introduction

Water scarcity is a growing global concern, intensified by increasing freshwater demand, climate change, and inefficient usage. Agriculture, which accounts for nearly 70% of global freshwater consumption, is especially affected - making sustainable irrigation practices vital for ensuring food security and preserving natural resources.

AquaWise: A Smart Irrigation and Water Management System presents a technology-driven solution to this challenge. By combining automation with real-time environmental data and sustainable farming principles, AquaWise optimizes irrigation efficiency, reduces water waste, and supports improved crop productivity.

(ii) Research Background and Importance

Water scarcity - the limited availability of freshwater to meet human and environmental needs - creates significant economic, social, and ecological challenges. It disrupts agriculture, industry, energy production, and public health. Climate change further intensifies droughts, desertification, and competition for water resources, highlighting the urgent need for sustainable water management solutions.

Economic Impact of Water Scarcity: Water scarcity has far-reaching economic consequences. In agriculture, reduced supply lowers crop yields, raises production costs, and threatens food security. Energy production - particularly hydroelectric and water-cooled systems - becomes less efficient and more expensive. Industrial operations face disruptions that affect supply chains and employment, while limited access to clean water increases health risks and social instability. Addressing these challenges requires innovative solutions that combine conservation with economic and social sustainability. **AquaWise** rises to this need through smart, data-driven irrigation management.

(iii) Objectives

AquaWise supports the mission of the Stockholm Junior Water Prize (SJWP) by offering a scalable, practical solution for optimizing irrigation and improving agricultural water management. The system reflects the competition's values through:

1. **Novel Techniques** – Real-time data collection, sensor-based automation, and programmable controls to boost irrigation efficiency.
2. **Innovative Use of Existing Technology** – Combining affordable soil moisture sensors, meteorological data, and AI-driven decisions for precise water regulation.
3. **Practical Impact** – A real-world system applicable at local, regional, and global levels to combat water waste.

By reducing agricultural water use and promoting sustainable practices, AquaWise contributes to water conservation, improved quality of life, and greater climate resilience.

(iv) Conclusions

Water scarcity poses a serious threat to ecosystems, economies, and communities, calling for innovative, sustainable solutions. **AquaWise** addresses this challenge by combining automation, real-time data, and efficient irrigation to optimize water use. Through collaboration, education, and smart technology, it supports a more sustainable future and aligns with the **SJWP** vision for global water conservation and equitable access to clean water.

(v) Methodology

1. Data Collection

AquaWise collects data through IoT sensors and meteorological APIs to enable real-time, adaptive irrigation management.

Soil Moisture Sensor: The system uses the PS-3228 (PASCO) or Mi Flora sensor to monitor soil moisture as volumetric water content (VWC). The Mi Flora additionally records air temperature (°C), light intensity (lux), and soil fertility (μS/cm). Sensor data is transmitted via

Bluetooth to the central controller, which activates irrigation when moisture levels drop below predefined thresholds.

Meteorological Data Integration: AquaWise accesses weather information from public APIs and local meteorological sources, including: expected rainfall, relative humidity, temperature, wind speed/direction, UV index, and light intensity. This data supports precise irrigation decisions based on current and forecasted conditions.

2. Data Analysis

AquaWise employs rule-based algorithms and AI-driven optimization to improve irrigation efficiency through real-time data processing.

Data Processing and Storage: To improve accuracy, weather data is averaged between Mammari and Lakatamia (Cyprus). Real-time data is retrieved in XML format from the Cyprus Meteorological Service. Both sensor readings and weather forecasts are stored on a centralized platform, enabling continuous monitoring and data-driven irrigation decisions.

Irrigation Decision Rules

- Immediate activation if soil moisture drops below 10%.
- Irrigation is triggered below 30% soil moisture, provided meteorological conditions from the Department of Meteorology also justify it.
- Monitoring is performed every 10 hours to adapt promptly to changing conditions.

Optimization Parameters

- **Timing**: Early morning or late evening to minimize evaporation.
- **Duration**: Based on soil type, field size, and crop type.
- **Water Quantity**: Dynamically adjusted according to crop needs and available water reserves.

Tools and Technologies

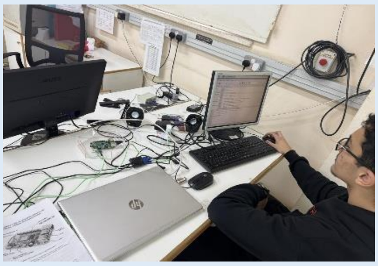
- **Programming**: C++, Python
- **Hardware**: Raspberry Pi Model B
- **APIs**: OpenWeatherMap

- **Data Analysis**: Google Sheets, Microsoft Excel

By integrating live environmental data with intelligent logic, AquaWise achieves water conservation and maximized crop performance through precise, automated irrigation.

3. Pilot Testing

AquaWise underwent structured pilot testing to verify the accuracy, reliability, and real-world applicability of its algorithm and components.



Testing our algorithm

Expected Results and Validation

- The PS-3228 Wireless Soil Moisture Sensor successfully transmitted real-time data via Bluetooth.
- Weather data from the Cyprus Meteorological Service ensured accurate, up-to-date environmental input.
- The C++ irrigation algorithm was validated using live soil moisture and rain probability data, demonstrating effective, automated decision-making.
- AI-based predictions for soil moisture trends and irrigation needs were refined through historical data analysis.
- Sensor outputs were visualized using **SparkVue (PASCO)**, clearly presenting AquaWise's potential for water conservation and sustainable farming.
- Additionally, the **Mi Flora sensor** was tested with our algorithm, and readings were cross-validated against the official **Flora Sensor App**, confirming the reliability of the system's data interpretation.

(vi) Implementation

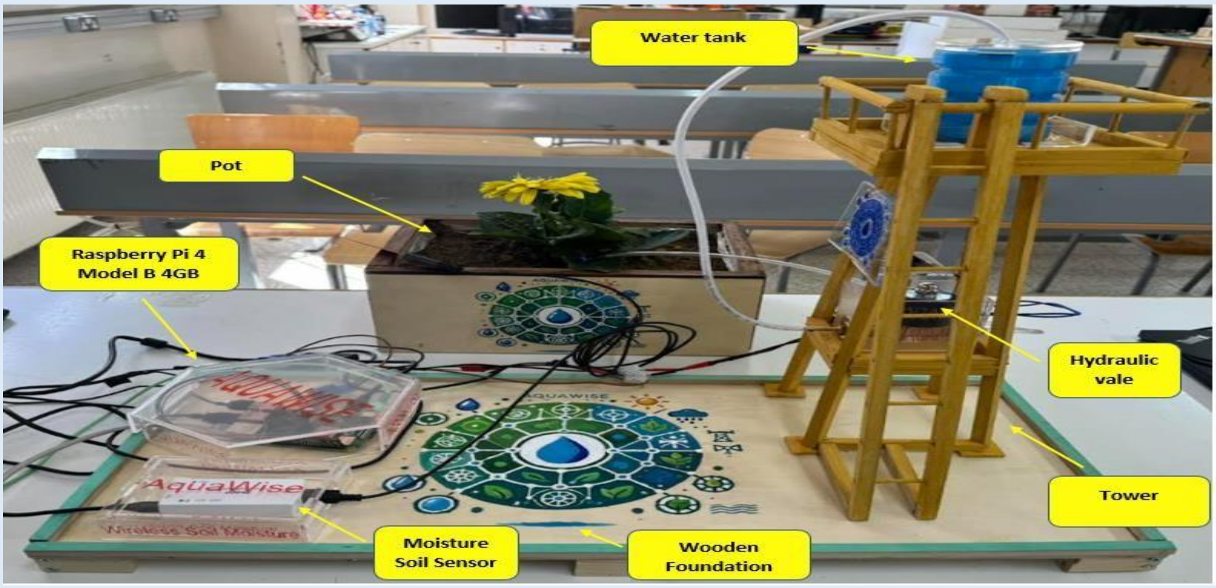
AquaWise was implemented through a structured deployment strategy focusing on efficiency, functionality, and reliability.

1. Prototype Components

- **Soil Moisture Sensor**: Captures real-time soil humidity data.

- **Raspberry Pi 4 Model B**: Processes inputs and controls irrigation logic.
- **Hydraulic Valve**: Automates water flow regulation.
- **Water Tank & Tubing**: Delivers water via a small-scale irrigation system.

By adjusting irrigation in real time based on environmental conditions, AquaWise significantly reduces water waste and promotes more efficient, sustainable farming.



AquaWise Prototype

2. Hardware Setup & Integration

AquaWise enables automatic irrigation by using a Raspberry Pi to control a hydraulic valve through a relay module.

Key Components

- **Raspberry Pi 4 Model B** – Central processing unit
- **Relay Module (5V)** – Switches the valve on/off
- **Jumper Wires** – Connect all components
- **External Power Supply (9V DC)** – Powers the valve independently
- **Hydraulic Valve & LED Indicator** – Regulates water flow and provides visual feedback

Wiring Summary: The relay module functions as an electronic switch, allowing the Raspberry Pi to control the hydraulic valve without drawing excessive current. An external power source ensures safe and stable operation.

3. Project Execution Plan

AquaWise was implemented through a four-phase implementation strategy, beginning with prototype construction.

Phase 1: System Design & Component Procurement (Weeks 1–2)

- Defined system requirements and finalized the irrigation model.

- Procured key hardware: PS-3228 Soil Moisture Sensor (Pasco), Raspberry Pi 4 Model B, Micro SD card, hydraulic valve, and IoT connectivity modules.

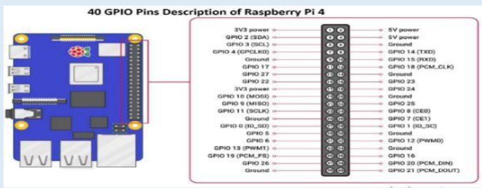
- Set up the C++ programming environment for system development.

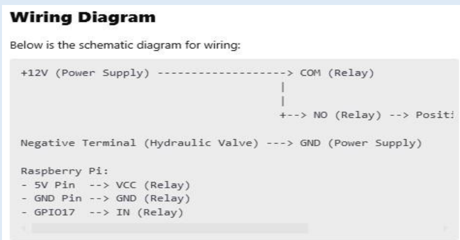
Construction of our prototype

Phase 2: Hardware Setup & Sensor Integration (Weeks 3-4)

- Assembled and configured the Raspberry Pi.

- Integrated and tested the soil moisture sensor and verified connectivity.



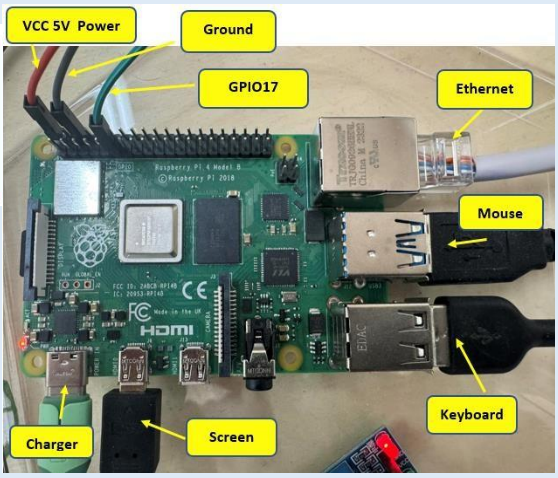


Wiring Diagram

Below is the schematic diagram for wiring:

```
+12V (Power Supply) -------------------> COM (Relay)
                                          |
                                          |
                                          +--> NO (Relay) --> Positi
Negative Terminal (Hydraulic Valve) ---> GND (Power Supply)

Raspberry Pi:
- 5V Pin  --> VCC (Relay)
- GND Pin --> GND (Relay)
- GPIO17  --> IN (Relay)
```



Raspberry Pi

- Connected the system to the irrigation network (hydraulic valve and water tank).

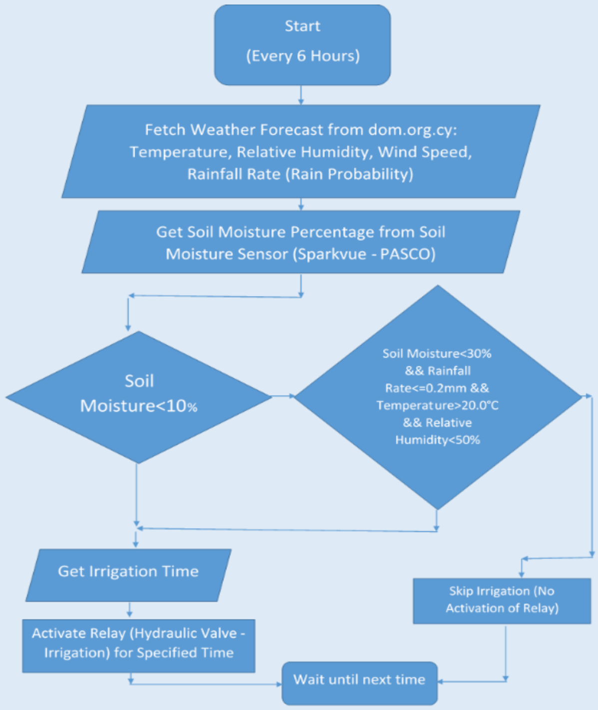
Phase 3: Software Development & Data Processing (Weeks 5-6)

- Developed the irrigation decision-making algorithm in C++ and integrated real-time weather data via API services.

- Implemented AI-based optimization for adaptive irrigation.

Phase 4: Pilot Testing & Optimization (Weeks 7-8)

- Deployed AquaWise in the school garden and collected baseline soil moisture and weather data.
- Tested automated irrigation cycles and compared results with manual watering.
- Analyzed data trends and refined system settings for maximum efficiency.



Flowchart

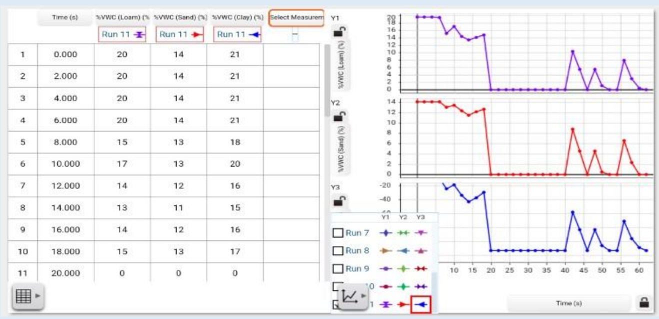
4. How AquaWise Works

AquaWise automates irrigation by continuously monitoring soil moisture and adjusting water flow in real time. When moisture levels fall below defined thresholds, the sensor transmits data to the Raspberry Pi, which activates the relay module to open the hydraulic valve. Water is then delivered through the irrigation system with flow dynamically regulated based on current conditions. The system relies on gravity-assisted water flow, minimizing the need for electric pumps and enhancing energy efficiency and cost-effectiveness.

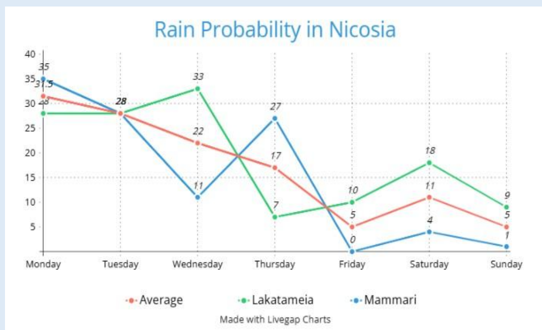
5. Conclusion

AquaWise delivers efficient, scalable, and sustainable irrigation by combining automation with AI-driven decision-making. Its gravity-fed system reduces energy consumption, while intelligent irrigation cycles optimize water use - making it both cost-effective and environmentally friendly.

(viii) Results Presentation and Discussion



Spark vue values and graph



Rain probability graph

AquaWise demonstrates effective water management by optimizing irrigation through real-time meteorological and soil moisture data. This integration allows for precise, need-based watering, preventing both over- and under-irrigation.

Key Findings

- **Water Conservation**: Irrigation is dynamically adjusted based on soil moisture levels and rain forecasts, reducing water waste and promoting sustainability.
- **Agricultural Efficiency**: Improved watering schedules help prevent root diseases, lower operational costs, and support healthier plant growth.
- **Climate Resilience**: AI-based adaptability enables the system to respond to shifting weather patterns, making it effective under erratic rainfall conditions.

Comparison of PASCO and Mi Flora: A Critical Improvement

A key turning point in AquaWise's development was the decision to replace the **PASCO PS-3228** soil moisture sensor with the **XIAOMI Mi Flora** wireless sensor. Initially, the PASCO sensor posed serious limitations: lack of accessible documentation restricted the system's automation, forcing us to operate semi-automatically. In contrast, the Mi Flora sensor offered seamless integration and enabled full automation, aligning perfectly with our original vision. From a cost perspective, the Mi Flora (€21) was also significantly more affordable than the PASCO (€240) - approximately **11 times cheaper** - while providing **richer environmental data**, including temperature, light intensity, and soil fertility. This switch not only enhanced functionality but also reduced our prototype's total cost by around **€150**, making it more accessible and scalable for real-world applications.

Testing and Data Validation: During implementation, we encountered initial issues with data parsing and incorrect readings. Early versions of our program produced values that differed from those shown in the **Xiaomi FlowerCare app**. After debugging and refinement, our output matched the app's readings precisely. To improve consistency and accuracy, we deployed **three Mi Flora sensors**, significantly enhancing data reliability and system performance.

Conclusion: This sensor replacement was one of the most impactful changes in AquaWise's evolution. It transformed the system into a fully automated, affordable, and scalable smart irrigation solution. By integrating AI-driven automation and real-time environmental monitoring, AquaWise delivers precision irrigation, water conservation, and lower operational costs - addressing water scarcity through practical innovation.

Comparison to Agrinexus Hub (Eratosthenes)

The **Agrinexus Hub**, developed by the Eratosthenes Centre of Excellence, is a decision-support platform that combines satellite imagery, field sensors, and weather data to assist farmers in making informed irrigation and fertilization decisions.

How AquaWise Differs

- **Direct Action vs. Advisory Support**: While Agrinexus offers guidance, AquaWise autonomously executes irrigation decisions based on live data.
- **Fully Automated Irrigation**: AquaWise adjusts watering schedules in real time without requiring manual input, ensuring efficient water use.
- **On-Site Deployment**: It utilizes soil moisture sensors and Raspberry Pi-controlled valves for localized precision.
- **Cost-Efficiency**: Designed for affordability, AquaWise is ideal for small- and medium-scale users, whereas Agrinexus targets larger agricultural operations.

Summary of Impact: While Agrinexus empowers farmers with valuable data insights, **AquaWise goes a step further—automating irrigation entirely**, demonstrating that smart, real-time systems can actively promote water conservation and sustainable agriculture.

- **Alignment with Objectives**

AquaWise fully aligns with the goals of the **Stockholm Junior Water Prize (SJWP)** by demonstrating:

1. **Novel Techniques** – Real-time data, sensor automation, and AI enhance irrigation precision.
2. **Innovative Use of Technology** – Combines affordable sensors and weather data with automated control to reduce water waste.

3. **Practical Impact** – Scalable from school gardens to commercial farms, with testing confirming measurable water savings and sustainability benefits.

Final Thoughts: AquaWise exemplifies how intelligent, low-cost irrigation solutions can contribute to global water conservation through smart, adaptable, and sustainable practices.

(ix) Conclusion

AquaWise has proven to be an efficient, scalable irrigation system by combining real-time environmental data, sensor automation, and AI-based decision-making. By adjusting irrigation based on soil and weather conditions, it minimizes water waste and ensures plants receive precisely the amount of water they need - supporting sustainable agriculture and climate resilience.

Importance to Water Management and Conservation

AquaWise contributes meaningfully to modern water management through smart, sustainable practices:

- **Addresses Water Scarcity** – Reduces unnecessary irrigation, making it ideal for regions vulnerable to drought and climate stress.
- **Enhances Resource Efficiency** – Automates irrigation to eliminate the inefficiencies of manual watering, ensuring optimal water use.
- **Supports Sustainable Agriculture** – Helps conserve resources while maintaining healthy crop yields and long-term productivity.

Alignment with the UN Sustainable Development Goals (SDGs):

- **SDG 6 – Clean Water and Sanitation**: Promotes efficient use and conservation of water through smart irrigation.
- **SDG 12 – Responsible Consumption and Production**: Reduces water waste through automation and real-time monitoring.
- **SDG 13 – Climate Action**: Builds resilience by adapting irrigation schedules to shifting climate patterns and weather extremes.

Recommendations and Future Steps

To further strengthen AquaWise and broaden its impact, future developments will focus on:

- **Improve Automation** – Refining AI algorithms to minimize or eliminate human intervention.
- **Advanced Sensor Integration** – Improving data accuracy and expanding environmental monitoring capabilities.
- **Expanded Testing** – Deploying the system across diverse climates, soil types, and agricultural settings to validate its adaptability.

These steps aim to position AquaWise as a fully autonomous, intelligent irrigation solution ready for widespread, real-world application.

(x) Business Aspect: Feasibility and Cost Analysis

1. Feasibility of AquaWise Implementation

AquaWise has been evaluated as a **cost-effective**, **scalable**, and **energy-efficient** irrigation solution. Its affordability and automation make it suitable for small-scale farmers, educational use, and scalable deployment in broader agricultural contexts.

Key Advantages:

- **Low Operational Costs** – Smart water usage reduces both waste and expenses.
- **Scalability** – The system can easily adapt to various field sizes and environments.
- **Automation** – Minimizes the need for manual operation, enhancing precision and efficiency.

2. Purchased Items Summary and Cost Breakdown

The following table summarizes the key components and associated costs required to build the AquaWise prototype:

Purchased Items Summary

Item	Description	Quantity	Unit Price (€)	Total (€)
MI Flora Soil Moisture Sensor	Wireless Soil Moisture Sensor	3	€21.00	€63.00
Raspberry Pi 4 Model B (4GB)	Central Processing Unit	1	€88.00	€88.00
Micro HDMI to VGA Adapter	Converts Raspberry Pi Video Output	1	€17.50	€17.50
64GB Micro SD Card	Storage for software and data processing	1	€12.50	€12.50
Grand Total				**€181.00**

The total cost of the AquaWise prototype is approximately **€181.00**, making it a **highly affordable investment** for smart irrigation. Compared to commercial alternatives, this prototype achieves similar functionality at a fraction of the cost, highlighting its **feasibility for widespread adoption**.

3. Use of Components in AquaWise

Each component in AquaWise has been carefully selected to ensure functionality, affordability, and ease of integration:

- **Wireless Soil Moisture Sensor (Mi Flora)** – Monitors real-time soil moisture levels, enabling automated irrigation responses.
- **Raspberry Pi 4 Model B (4GB)** – Acts as the central processor, executing irrigation algorithms and retrieving meteorological data.
- **64GB Micro SD Card** – Hosts the system's software, stores environmental data, and supports remote monitoring functionalities.

Category	Analysis
Cost of Main Components	3 MI Flora Soil Moisture Sensors (€63)
Microcontroller Choice	The Raspberry Pi 4 (€88) offers a balance between cost and performance, ideal for IoT applications.
Total Project Cost	€180.23 is a reasonable investment for a high-quality smart irrigation prototype

4. Potential Savings & Cost Optimization

To further reduce costs and improve scalability, AquaWise can incorporate several strategic adjustments:

- **Sensor Alternatives** – Replacing costly sensors (e.g., PASCO PS-3228) with affordable alternatives like Mi Flora maintains reliability while reducing hardware expenses.
- **Alternative Microcontrollers** – Switching from Raspberry Pi to lower-cost options like **ESP32** or **Arduino** can significantly reduce unit cost, especially in large-scale deployments.
- **Bulk Purchasing** – Buying components in larger quantities can lead to notable discounts and lower production costs.

These adjustments preserve AquaWise's efficiency and functionality, making it an even more **affordable and scalable** solution for smart irrigation and sustainable water management.

Final Conclusion: AquaWise is a cost-effective, scalable, and sustainable solution for precision irrigation. By combining real-time soil monitoring, automated decision-making, and adaptable system architecture, it optimizes water use while supporting environmentally responsible agriculture.

Future Improvements

- **Affordable Sensor Alternatives** – Further reduce costs with lower-priced moisture sensors.
- **Energy-Efficient Microcontrollers** – Integrate low-power hardware for improved sustainability.
- **Scalability & Commercialization** – Expand the system's reach to larger agricultural operations.

Through continuous refinement in both technology and cost, AquaWise stands as a practical and innovative tool, advancing sustainable irrigation practices and addressing global water challenges.

Data Collection and Processing

Smart Irrigation Logic

AquaWise uses a decision-making algorithm that activates irrigation based on two main criteria:

- **Critical Condition**: If soil moisture ≤ 10%, irrigation starts immediately.
- **Smart Conditions**: Irrigation is also triggered when:
  - Soil moisture < 30%
  - Rainfall ≤ 0.2 mm
  - Temperature > 20°C
  - Relative humidity < 50%

💧 This rule-based system ensures precision irrigation tailored to Mediterranean climates like Cyprus.

Example Dataset & Decision Table

AquaWise collects daily weather and soil data. The table below shows how decisions are made based on real conditions:

Parameter	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Soil Moisture	5%	33%	3%	14%	5%	27%
Wind Speed (km/h)	5.0	2.0	5.0	5.5	4.0	2.5
Wind Direction	SE	SW	N	E	S	E
Expected Temperature (°C)	33	14	41	38	35	21
Expected Relative Humidity	30%	50%	69%	32%	22%	74%
Expected Rainfall Rate	0.1	0.2	0.0	0.1	0.4	1.2
Water The Plants?	Yes	No	Yes	Yes	Yes	No

Data Processing and Decision Making

Data Monitoring & AI Integration

- **Real-Time Monitoring**: Data is stored online and updated continuously.
- **User Access**: A web dashboard displays soil, weather, and irrigation logs.
- **AI Optimization**: The system refines decisions over time by analyzing past data.

The AquaWise Threshold System

This advanced subsystem enables **automated adjustment of irrigation thresholds** based on crop production. Key features include:

- **Scheduled Threshold Activation**: Triggered based on time or new data.
- **Dynamic Adjustments**: Thresholds vary based on yield levels (very low → increase irrigation; very high → reduce irrigation).
- **Logging & Notifications**: Threshold changes are recorded (CSV/HTML), and updates are emailed to users via secure Gmail SMTP.
- **User Validation**: Inputs like production and plant type are verified for accuracy.
- **Machine Learning Elements**: The system learns from historical trends to improve its logic without manual reprogramming.

Future Add-ons: Python-based ML models for local climate adaptation and plant recognition via camera for personalized irrigation and email alerts

Key Benefits of Data Processing

- ✅ **Water Conservation** – Avoids unnecessary irrigation
- ✅ **AI Accuracy** – Learns and adapts over time
- ✅ **Climate Responsiveness** – Responds dynamically to changing environmental conditions

Our Team

Broader Impact

AquaWise is a scalable, intelligent irrigation solution that promotes global water conservation by combining real-time weather data, automation, and AI.

Scalability & Applications

- Adapts easily across regions using global APIs (e.g., OpenWeatherMap, NOAA).
- Suitable for public parks, farms, and large-scale agriculture.
- Learns from weather and crop data to optimize irrigation under diverse conditions.

Pilot Implementation: In collaboration with the **Municipality of Lakatamia**, AquaWise is being tested in public parks, demonstrating its value in urban water management.

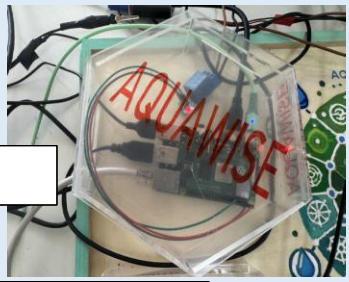
Future Partnerships: Potential collaborations include environmental NGOs, government agencies, cooperatives, and universities to support large-scale rollout and AI refinement.

Impact Overview

- 💧 **Water Efficiency** – Minimizes waste, vital for drought-prone areas.
- 💰 **Economic Gains** – Reduces water costs and manual labor for farmers.
- 🌱 **Environmental Benefits** – Prevents overwatering, erosion, and energy waste.

Next Steps: Full AI Integration
Future versions will feature self-learning AI that predicts water needs based on crop yield history, recognizes plant types and local climates and executes site-specific irrigation autonomously.

Conclusion: More than a system, **AquaWise** is a smart, eco-friendly model for sustainable water use—adaptable, affordable, and globally impactful.

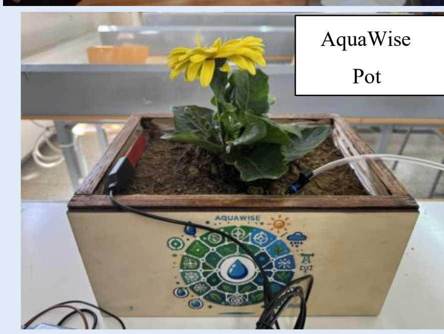


Raspberry Pi

Appendix A: Comparative Table of Irrigation Methods

Feature	AquaWise	Agrinexus Hub	Manual Irrigation
Automation	Fully automated (decision & action)	Advisory only – user takes final action	None – relies entirely on human decisions
Sensor Integration	Soil moisture sensors + weather data	Field sensors + satellite + weather data	No sensor integration
Real-Time Response	Yes – instant reaction to changing conditions	No – user-dependent action delay	No – fixed or delayed human action
Hardware	Raspberry Pi, relay, sensors, hydraulic valve	High-end servers, sensors, satellite feeds	Basic equipment (e.g., hose, valves)
Data Use	On-site sensor data + live weather via API	Remote sensing, data modeling, and satellite imagery	Subjective (farmer's experience)
Scalability	Ideal for small-to-medium scale	Designed for large-scale farming	Small-scale only
Cost	Low (approx. €100–120 total)	High (requires subscription/infrastructure)	Low, but inefficient over time
Energy Use	Minimal (gravity-assisted, no pump needed)	Moderate–high (depending on tech infrastructure)	Low (manual), but labor-intensive
Water Efficiency	High – avoids over/under irrigation	Moderate – depends on user implementation	Low – often inefficient
Environmental Impact	Supports sustainability, reduces waste	Promotes data-informed practices	Often leads to overwatering or water loss


Department of Meteorology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