Embedded Systems Project

Supervised by

Prof. Belal Sababha

at

PRINCESS SUMAYA UNIVERSITY FOR TECHNOLOGY

Amman, Jordan

Fall 2024/2025

Project Report:

Automated Plant-Care System

Student Name	*Student ID*	*Major*	*Email*
Katrin Zagha	20210858	NIS Engineering	kat20210858@std.psut.edu.jo
Lujain Amro	20210738	IoT Engineering	luj20210738@std.psut.edu.jo
Rama Al-Bishawi	20210559	IoT Engineering	ram20210559@std.psut.edu.jo

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Abstract

The Automated Plant-Care System (APCS) is designed to address common challenges in plant care, such as a busy lifestyle and inefficient resource usage. By integrating mechanical, electrical, and software components, the system provides automated watering, light management, and environmental monitoring. This report outlines the system's design, implementation, challenges encountered, and recommendations for improvement.

Introduction and Background

Plant care is an essential activity for ensuring the health and growth of plants. However, many individuals struggle to maintain proper care due to time constraints or lack of knowledge. Common issues include overwatering, insufficient watering, and exposure to harmful environmental conditions.

The APCS was developed to automate essential tasks, reduce human intervention, and ensure resource efficiency. Using a combination of sensors, actuators, and microcontrollers, the system optimizes water usage, manages light exposure, and monitors environmental conditions to provide a reliable solution for plant care.

Design

Mechanical Design:

- **Water Pump:** Facilitates automated watering by delivering water based on soil moisture levels.
- **Servo Motor:** Adjusts a shading mechanism to protect plants from intense sunlight.
- **Shading Mechanism:** Activated by the servo motor to shield plants from harmful light intensity.
- **Plant Container:** Houses the plant and provides the base for soil moisture measurements.
- **Water Tank:** Supplies water for irrigation.
- **Tubing and Connectors:** Direct water flow from the tank to the plant.

- **Sensors:**
  - Soil moisture sensor to measure soil hydration.
  - LDR (Light Dependent Resistor) for detecting light intensity.
  - Ultrasonic sensor to monitor the water tank level.
  - Temperature sensor to track environmental conditions.
- **Actuators:**
  - Water pump for irrigation.
  - Servo motor for shading control.
- **Indicators:**
  - LCD for displaying sensor readings and system messages.
  - LEDs to indicate operational modes (Green for automatic, Red for manual).
  - Buzzer for low water level alerts.

The system operates using a microcontroller-based program with the following features:

1. **Sensor Integration:** Reads data from the soil moisture sensor, temperature sensor, ultrasonic sensor, and LDR.
2. **Decision-Making Logic:** Executes actions based on predefined thresholds:
    - Activates the water pump if soil moisture is below a set threshold.
    - Triggers the shading mechanism when light intensity is high or temperature exceeds 34°C.
    - Displays a "TANK IS EMPTY" warning and activates the buzzer if the water level is low.
3. **Dual Operation Modes:** Supports automatic and manual control modes:
    - Automatic mode performs all actions based on sensor inputs.
    - Manual mode allows user intervention via buttons.
4. **Interrupt Handling:** Manages events like light intensity changes or mode switching.
5. **Servo Motor Control:** Adjusts the angle to operate the shading mechanism using pulse width modulation (PWM).

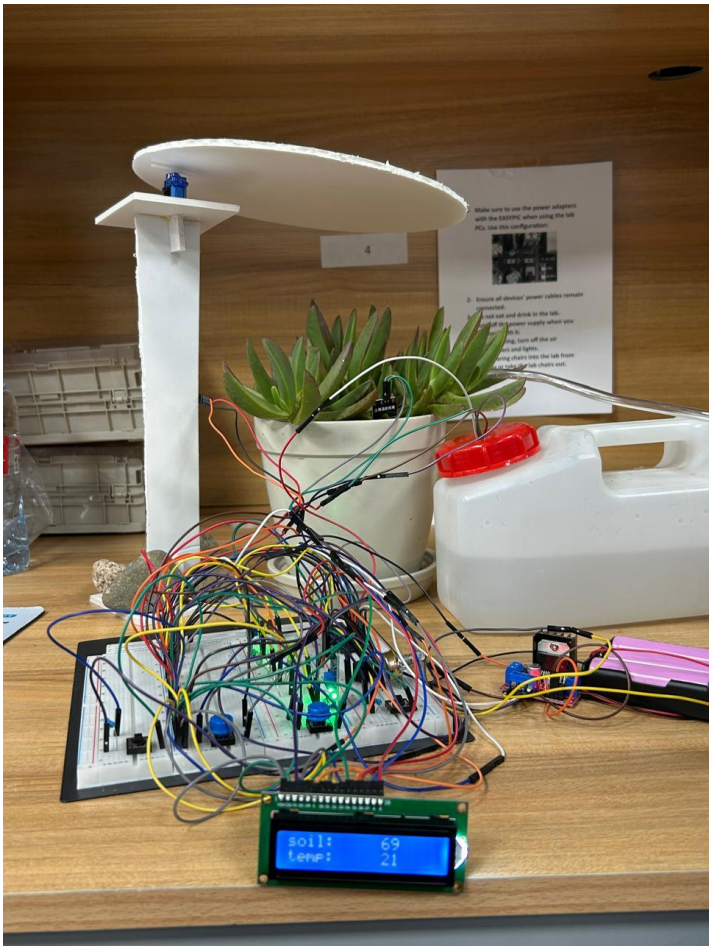

Figure 1: Mechanical Design (1)

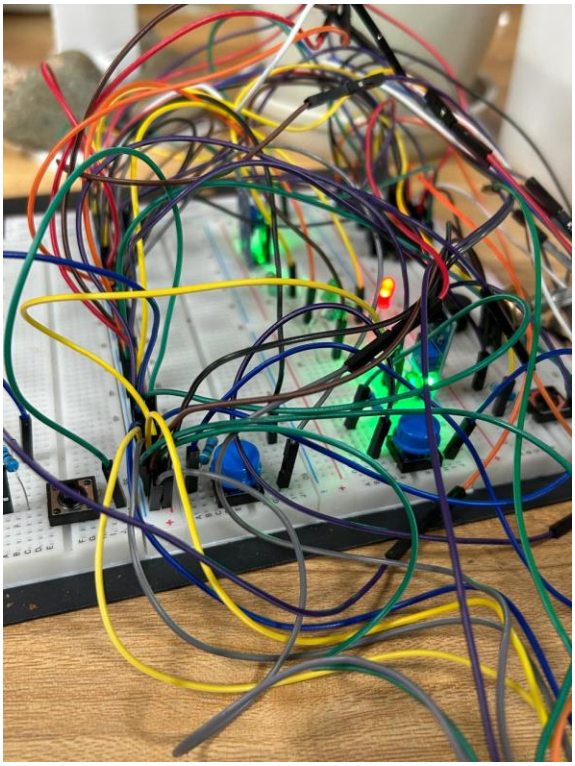

Figure 2: Mechanical Design (2)

Electrical Design:

This is a detailed illustration of the electrical connections in our circuit using the PIC16F877A in Proteus:

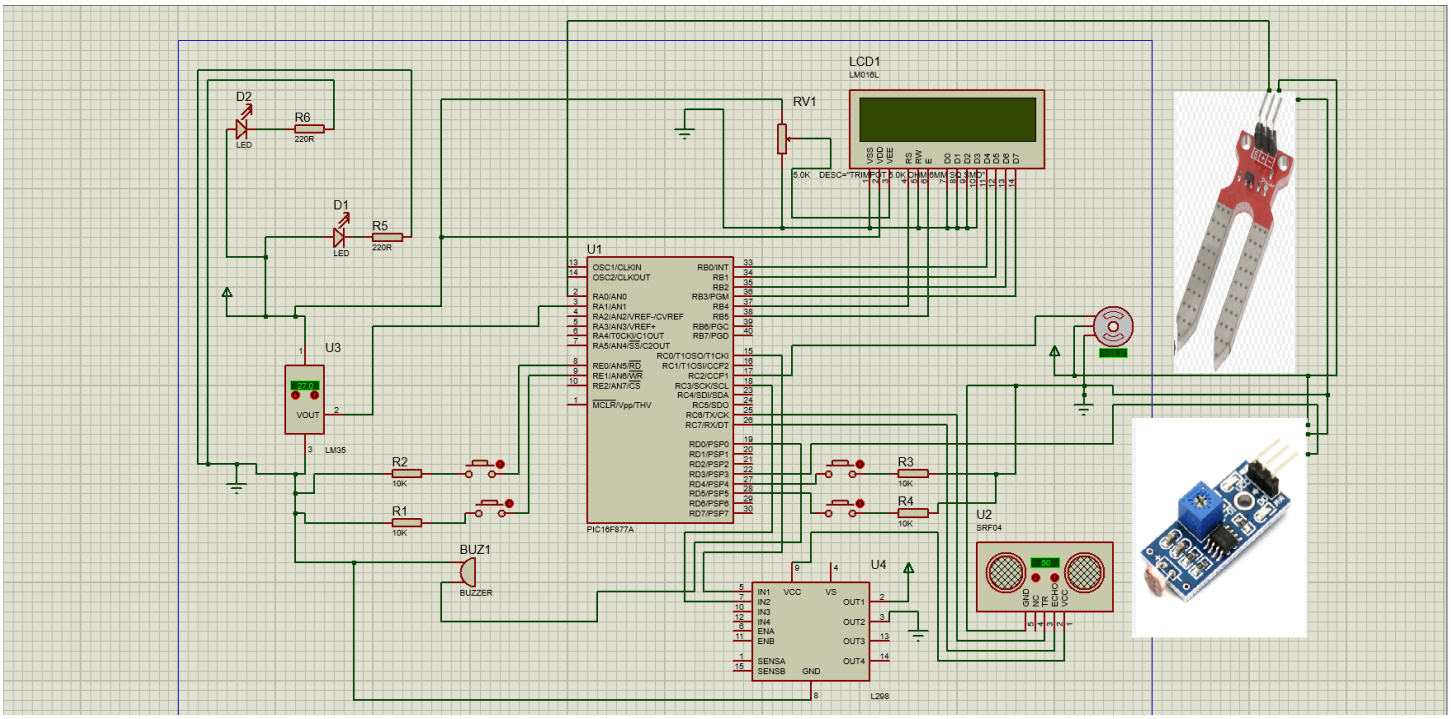

Figure 3: Circuit Design

Software Design:

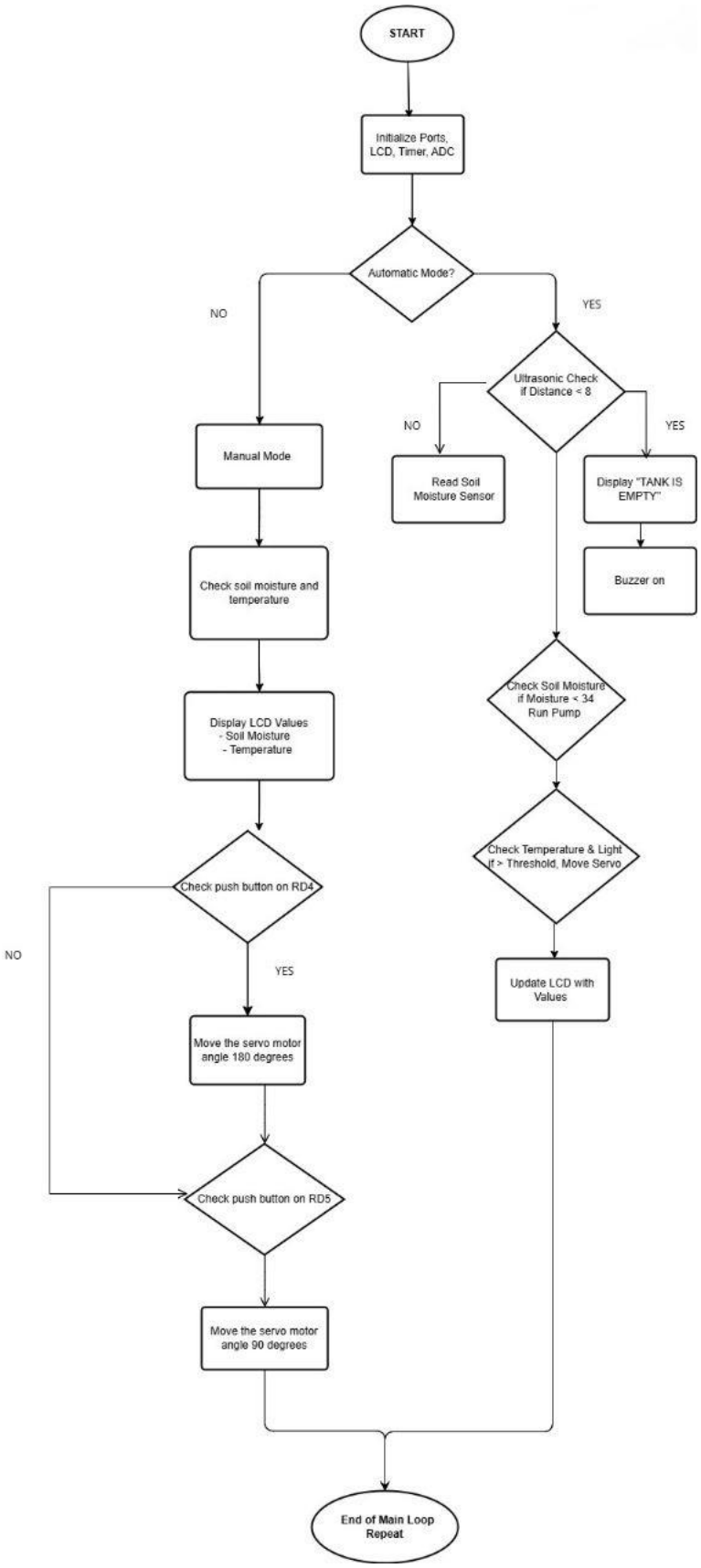

Figure 4: Software Design

Problems and Recommendations

Problems

1. **Sensor Interference Due to Delays:** During implementation, it was observed that the temperature and soil moisture values displayed on the LCD were sometimes identical. This issue was traced back to insufficient delays in the ADC (Analog-to-Digital Conversion) process, causing overlapping readings and incorrect data display.
2. **Power Inefficiency:** Continuous data collection may lead to unnecessary power consumption.
3. **Limited Functionality:** The system does not currently incorporate features like fertilizer management or data storage.
4. **Connectivity Gaps:** Lack of connectivity limits real-time monitoring and remote control capabilities.

Recommendations

1. **Enable Watchdog Timer (WDT):** Periodic data collection can conserve energy without compromising functionality.
2. **Fertilizer Management:** Incorporate NPK soil sensors and a fertilizer dispenser to provide nutrients as needed.
3. **AI Integration:** Collect and store data to implement AI algorithms for predictive plant care.
4. **Connectivity Enhancements:** Add serial communication with a PC for data logging and remote monitoring.

Conclusion

The Automated Plant-Care System is a significant step towards efficient and user-friendly plant care. By automating essential tasks, it addresses key challenges and ensures better resource utilization. Future enhancements, including connectivity, AI integration, and extended functionalities, will further improve its performance and applicability.