

Smart Watering System with IoT

Irrigators

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Project Overview

To promote sustainable gardening and demonstrate utility of MathWorks tooling in this problem space, we are developing an **IoT**-enabled, **state-machine** based watering system

Features: live monitoring of grow conditions, automatic watering decisions, and ThingSpeak integration

Limitations: time, weather, scalability

Assumptions: uncontaminated water, room temperature, reliable internet connection and power supply

Project Requirements

Hardware Deployment

- Integration of sensors, a microcontroller, and other necessary hardware components.
- Establish communication between microcontroller and ThingSpeak.

State Machine

- Determines when and how to water a plant based on sensor data.
- Written in MATLAB.

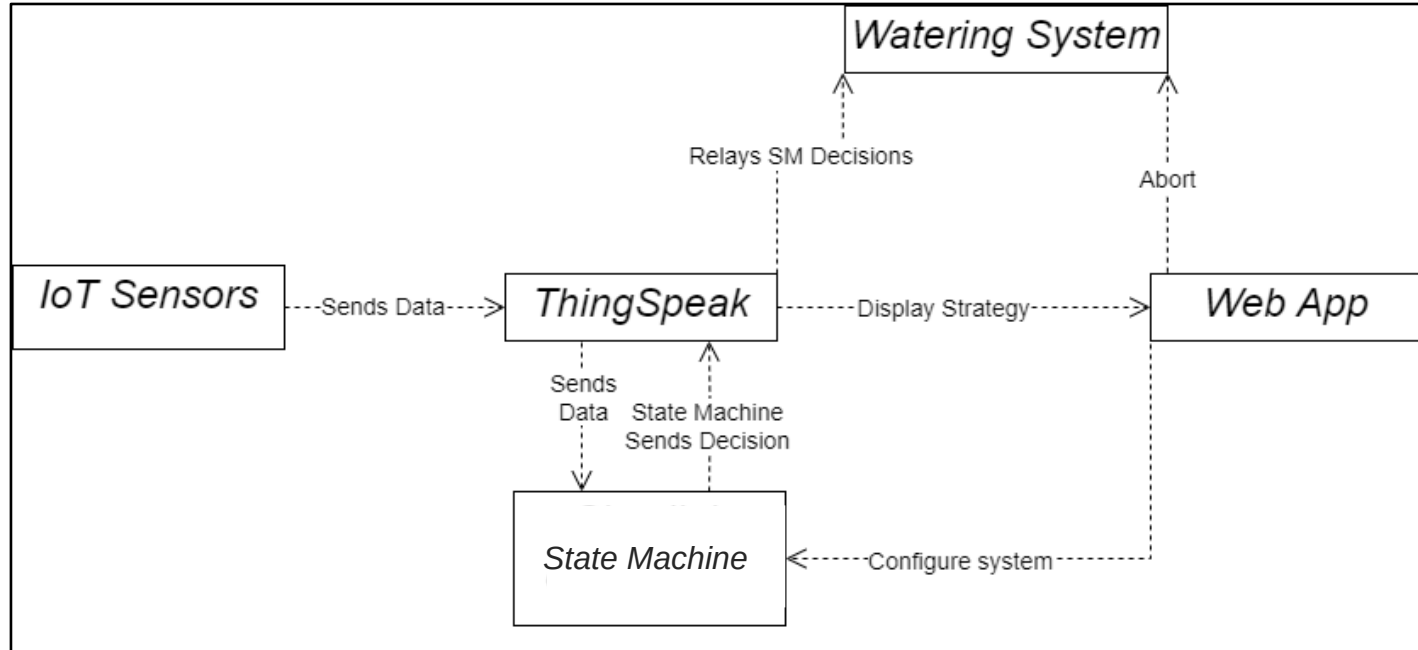
Hardware Solution

All data communications are facilitated by the microcontroller, which processes sensor data (soil moisture, temperature, humidity) and sends commands (water plant, turn off light) according to programmed instructions.

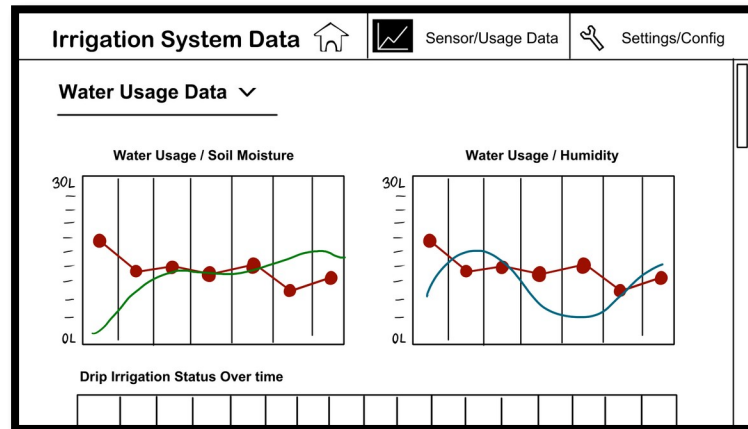
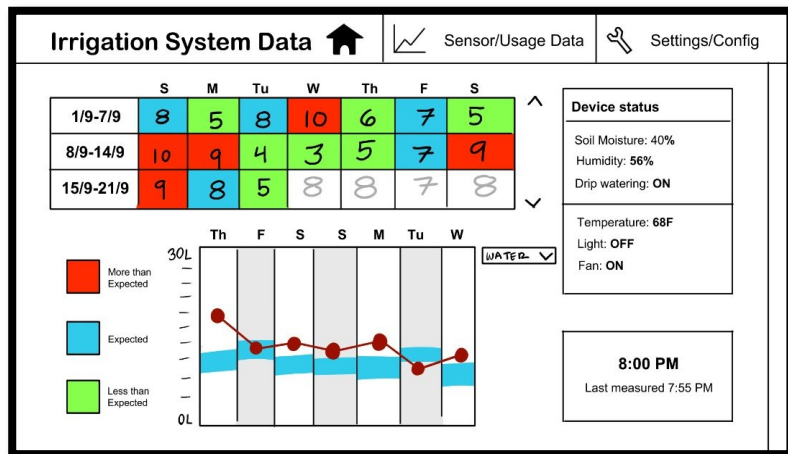
Components:

- Arduino Uno Rev3
Microcontroller
- Moisture Sensor
- Temperature/Humidity Sensor
- Arduino Relay (2)
- Breadboard + Jumper Wires

Software Architecture



UI Design



Irrigation System Data

Sensor/Usage Data
Settings/Config

Soil Moisture:

Target:

Minimum:

Maximum:

Environment:

Temperature:

Light hours:

Humidity:

Save Configuration

Testing, Validation, and Acceptance Plan

Testing

- Write unit tests for the individual components as they are built.
- Once each subunit is fully functional we will spend time integrating and testing the integration.
- When each subunit is deemed to be fully integrated we will switch to hardware.
- The full system will be put through comprehensive tests to ensure it is behaving as expected.

Acceptance

- Our project will be deemed deliverable once testing has been completed and the stakeholders approve of the system demonstration.

Major Work Accomplished

- Established key milestones with corresponding deadlines.
- Held weekly meetings to review progress and assign tasks.
- Developed proficiency with essential tools: ThingSpeak, MATLAB, Arduino, and nginx.
- Conducted initial integration tests for system components.
- Assigned specific project tasks to individual team members.

Timeline

Milestones	2024					2025				
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Setup: project plan, initial research, and simple prototyping										
System Simulation: mocked sensors, state machine, and ThingSpeak integration										
System Analysis: “dashboard” web app with system controls										
Hardware: arduino, sensors, drip irrigation, and agriculture supplies										
Documentation: comprehensive user guide and developer reference										

Maintenance Considerations

Packaged as a mix of software and hardware components:

1. Software available through GitHub
2. Hardware can be assembled based on provided documentation.

Project **delivery** & **deployment** comes in two phases:

3. Simulation
4. Hardware

Maintenance will be exclusive to the team for the duration of the project.

After completion:

- Software will require minimal post-deployment maintenance.
- Users expected to handle hardware upkeep.

Project Risks and Strategies

Hardware risks

- Sensor malfunction
- Hardware failure
- System tampering

Solution, emphasis on system design with mocked data/response.

Software risks

- Lose connection between components
- Faulty code
- Mocked data is an inaccurate representation

Solution, have default state if connection is lost. Spend significant time testing and understanding problem.

Project Management Considerations

- **Weekly scrums**
 - Informal Wednesday Standups
- **Using GitHub to host our project**
- **Internship experience**
- **We plan to code separately initially**
 - Integration and large steps like initial hardware setup will be done together.

Ownership Breakdown

- **IoT device and sensor hardware,** Arvand Marandi
- **Arduino development,** Matt Nguyen
- **ThingSpeak Channels,** Caleb Lefcort
- **State machine,** Caleb Lefcort
- **Water usage prediction,** Arvand Marandi
- **Front-end webserver and website,** Madison Spink

Budget Plans

All software services, notably ThingSpeak, are provided and supported by MathWorks.

Hardware needs amount to a \$144 budget request.

Thank you for listening!

Questions?