MEC – Programming

Irrigation Control System

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Table of Contents

Introduction

This paper will serve to illustrate the form and function of the developed programming solution, designated the Irrigation Control System, henceforth referred to as the ICS. The ICS is meant to serve as an assistive tool for farmers that have an irrigation system. The ICS will allow farmers to more efficiently control water flow and general property irrigation through utilization of moisture and water flow sensors.

Problem Analysis

The problem that the ICS is meant to address is irrigation control of a plantation. The problem as the ICS seeks to address it is that it is difficult to accurately and consistently maintain the proper amount of water flow and soil moisture without being wasteful in some capacity. The goal of the ICS is to minimize water waste while still maintaining ideal growth conditions for the crops being grown in the irrigated plantation.

Scope

The scope of the project is a farm that consists of a system of irrigation nodes. Each of these nodes will be able to water an area around it in metres squared. The ICS utilizes weather data, water flow, and moisture sensors to deliver an optimal amount of water to each node or alert the farmer in the case that the system undergoes a failure.

Assumptions

1. The crop is the same throughout the node.
2. Water is equally distributed within each node.
3. Nodes are independent from one another.
4. All water units are millimeters of rain equivalent in each node.

5. Each node represents a single sprinkler.
6. All nodes start at midnight.

System Inputs

1. A node profile, containing:
    - A minimum moisture level as a float.
    - A maximum moisture level as a float.
    - A minimum amount of water per unit time as a float.
    - A maximum flow per unit time as a float.
    - A start of the day time as a float.
    - A crop name as a string.
2. Number of nodes in the server.

Internal Machine States

The machine inputs both come from the sensors. There are two sensors, one to measure moisture and one to measure water flow. The system receives these inputs once per update cycle. The system outputs a desired flow value to the PID controller that oversees flow control in each node individually. As a user output, it displays both a current moisture level as well as a general diagnostic. The transition mechanisms for the system are entirely included within the usage of the PID controllers. Each PID controller takes their desired flow value output on a node to node basis and proceeds to attempt to change the current flow value to the desired one. The internal functions of the program can be further compartmentalized. Communication from server to nodes takes two forms. Firstly, the server sends proper crop profiles and information to the nodes. In the case of an error, however, the node will return the error message to the

server. The server generates a thread per node which interacts with the node-specific PID controller which controls the water flow value. The simulator is used to simulate real-world sensory inputs to properly test the reactions of the ICS. The simulator generates a variety of inputs in order to accurately test the ICS.

Error Messages

Error	Error Message
Actual flow is not equal to flow requested.	Flow requested not output.
The moisture is higher than the inputted maximum moisture level.	Max moisture exceeded.
The water level is higher than the maximum water level allowed.	Max water exceeded.

Conclusion

The Irrigation Control System (ICS) is a system that is designed to assist a farmer in the irrigation of their fields. The ICS allows for easier, more fluid control of crop irrigation and will allow farmers to more accurately control water flow and soil moisture of their fields in a node-by-node basis. The ICS will maintain both a minimum amount of soil moisture and a minimum amount of water given to each crop per day, preventing both underwatering and overwatering. The ICS also takes weather into account, as rainfall will change water outflow and therefore be accounted for before water is added to the system.