

# MEC Programming

## Irrigation Control Systems

By: Purav Chheda

Marwan Mekhemer

Juwon Adeola

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**Problem Overview:**

The purpose of this program is to help farmers control the irrigation systems based on factors affecting their crops in order to maximize their harvest. This program works as an early detection system and provides information on the level of moisture in the soil as well as the amount of rainfall expected to fall in the coming days. Based on this information gathered from online databases and sensors in the soil, the irrigation control systems allow farmers to anticipate the factors affecting their crops and the potential effect it can have on their overall harvest.

**Scope/Assumptions:**

Based on restrictions, the scope of this irrigation control system would include multiple farmlands with a prebuilt irrigation system that grow a variety of different crops in the summer season when there is significant rainfall and fairly moderate to high temperatures. External effects such as humidity, erosion, natural disasters are excluded from the scope of this system.

**Problem Analysis:**

This system relies on information obtained from various online databases on certain parameters and input from sensors to make accurate decisions on how when and how much to water certain crops in order to maintain a fixed level of moisture in the soil.

The Sensors used in this system include the Soil Moisture sensor and the Precipitation sensor:

- The Soil Moisture Sensor indicates the average amount of moisture present in the soil, and depending upon that level, the system will irrigate water accordingly via sprinklers.
- The Precipitation sensor indicates whether or not rainfall is actually occurring, and if so how much occurred on the targeted farmlands. Precipitation data is obtained from the online databases, however that data only covers how likely it is precipitation will occur and the likely amount of rainfall to occur.

These sensors then relay information back to the irrigation control system where after considering several factors, chooses to release water to irrigate the crops. These factors include

1. Crop types: There are many different crop types that farmers grow, and some need more water than others to grow. This tells the system what type of crop is about to be watered.
2. Crop requirements: This includes the information the system needs to accurately know which crops need more or less water.
3. Future Weather Patterns: Consisting of weather information such as temperature and chances of rainfall, this information is obtained from online databases that determine whether the crops need water to be watered if there is going to be rainfall later in the day. Depending on the temperature, the hotter the day the more water the crops need.

4. Crop Maturity: Based on the age of the crops, some crops need more water. A newly planted crop needs more water to grow than a crop that is ready to be harvested.
5. Soil Water level: Based upon a set constant moisture level that the farmers require to have in the soil, the crops are irrigated accordingly to make sure that the crops have enough water to grow.
6. Water Level Offset: Based on if the moisture in the soil is within an acceptable range of the soil water level, the system can choose to water the crops more or not at all.

These various factors would thus become the inputs to this program as the farmers input the various data into the system and the system also incorporates the data from the online databases. The system then processes this information and advises the farmer on what to do to ensure crops always have water available in the soil. This is essentially a feedback loop, as the soil moisture level leads to water being outputted by the irrigation control system.

The primary function of the irrigation control system is to output water through the sprinklers when the soil water level is falling below the standard soil water level. After that the system checks after 12 hours unless excess rainfall occurs. The second feedback loop present in the system consists of the rate of the change of the soil moisture between each cycle. When weather patterns cause the rate of change of soil moisture to increase, less water is detected in between each cycle, resulting in the control system increasing the time between cycles to keep up with the fluctuating temperatures to ensure that at no point in time is there less water available in the soil.

Otherwise, without any anonymous fluctuations between measurement of soil water level between cycles, the system constantly runs in 12 hour cycles to detect inputs from sensors and databases and logs them as well sending an error message to farmers in case there is excess water flow or system failure due to power outage. In the event of a power outage, the system automatically stops irrigating the crops and upon reboot to a back generator runs an emergency cycle to detect any changes in the soil moisture, then outputs water via sprinklers if necessary. An emergency cycle can be run by the irrigation control system if the farmer feels that the soil is drying up rather quickly.

## **Project Technicals**

The primary functions used in control system are:

- Functions to find the water levels and temperature via the sensor and return the values back to the control system to process
- Functions to automatically water the crops. Once the water levels have dropped within the soil, the function receives this information from the sensor and in turn tells the control system to start targeting specific crop objects to be watered.

In conclusion, this irrigation control system helps farmers grow their crops by outputting water via sprinkler system. Based on the information gathered from online databases and sensors in the soil, the irrigation control systems allow farmers to anticipate the factors affecting their crops and the potential effect it can have on their overall harvest.

## References

[1]U. Howard Perlman, "Irrigation: How farmers irrigate fields", *Water.usgs.gov*, 2017. [Online]. Available: <https://water.usgs.gov/edu/irquicklook.html>. [Accessed: 22- Oct- 2017].

[2]"Factors to Consider in Selecting a Farm Irrigation System | UGA Cooperative Extension", *Extension.uga.edu*, 2017. [Online]. Available: <http://extension.uga.edu/publications/detail.html?number=B882>. [Accessed: 22- Oct- 2017].