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Smart cultivation system for better farming practices

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ABSTRACT

A smart cultivation system for better farming practices is intended to create an automated IOT based system that helps ease the process of cultivating plants. This is a low-cost method and an effective solution to determine various factors such as moisture, temperature, and humidity which influence the growth of plants. For the agricultural sector, the use of proper methods of cultivation and irrigation plays a significant role in determining the quality of the crops. The main aim is to maximize the benefits of proper cultivation methods whilst reducing spoilage of crops and wastage of water. This system brings into play the Arduino UNO boards, MCU units, two low-cost sensors connected over a common server to collect the necessary data.

Keywords— *Soil Moisture, Irrigation, IoT, Temperature, Arduino, Humidity*

1. INTRODUCTION

Agriculture is the largest source of livelihood for the Indian population, employing 59% of the country's total workforce in 2016. 70 percent of its rural households still depend primarily on agriculture for their livelihood. The agriculture sector is the largest employer in India's economy. India ranks second worldwide in farm output. With the ever-increasing population, the demand for the agricultural industry is much higher than anticipated. For example, latest estimations on demand for food grains reveal that with an anticipated rise in the growth rate of per capita income in India from the current trend of 3.5 to 5.5 percent, total demand for cereals will increase by around 140 percent over 1990. Agricultural management technology has to become highly efficient in order to suffice the expanding production. A continuous decline in land area, ineffective irrigation practices, and systems, falling growth in productivity has led to a concern for the future for the agricultural sector of India. The yields of major crops in India are far less than many developing countries. The wastage of agricultural produce after harvesting, poor management of food grains which result in spoilage are two of the downsides of Indian agriculture.

Irrigation plays the most important role for the proper production of crops. Several studies have shown that the performance of irrigation practices is still low. 60% of India's population does not have access to modern, up to date technology. Therefore, it is not only necessary to improve irrigation scheduling, but also the design of the systems to maximize the benefits. In irrigation practices like Surface Irrigation and Sprinkler system, the biggest limitation is that sometimes the soil absorbs more water than it needs. This results in moistening of most of the top layers of the soil. This results in waterlogging and appearance of weeds and fungus. The most effective method of irrigation is drip irrigation. Water is allowed to drip onto the plant, either the roots or on the surface thereby minimizing water wastage and waterlogging. Drip irrigation wets only 30% of the soil, compared to other irrigation methods. It is an effective method to keep the moisture levels in check because rows between plants usually remain dry.

In addition to this, everything in the environment affects how crops grow. Humidity affects when and the plant opens or closes its stomata. When humidity levels are too high or there is a lack of air circulation, a plant cannot make water evaporate or draw more nutrients from the soil, which eventually causes the plant to rot. When the conditions are too humid, causing diseases and fungi. In addition to this, measuring soil moisture levels enables highly efficient irrigation systems, providing water when required and eliminating the excessive use of water.

2. PROPOSED METHOD

The system involves two sensors, an Arduino board, and a microcontroller and the necessary watering system. The sensors are the key components to measure the conditions of the environment. The Soil moisture sensor uses analog I/O signals to communicate with the Arduino board. The Temperature and Humidity sensor uses DHT Sensor library. This setup is connected to the Microcontroller Unit/ Raspberry Pi along with network module, which helps in performing complex computational analysis. A Gateway is set up if the MCU board does not communicate with the server directly without changing the format of the protocol.

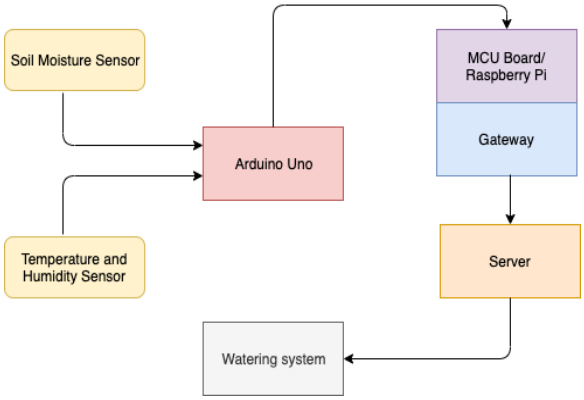

Fig. 1: Setup of the system

The Proportional-Integral Derivative (PID) is the control mechanism used in the system. The function of this to read a sensor, compute the desired output by calculating proportional, integral and derivative results. The PID Control is advantageous over the On/off Control system. With ON-OFF controller, only two operations are possible which results in limited operations. The PID controller uses loop mechanisms along with feedback system to analyze operations. The feedback system involves changing output based on the feedback the controller gets from the process. A python application can be built to implement the PID Controller by the general formula using numpy, scipy, pandas, matplotlib and patsy libraries.

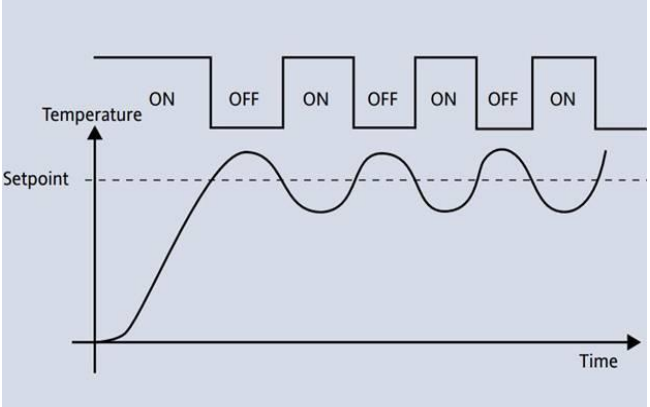

Fig. 2: Comparison between on/off controller and PID controller

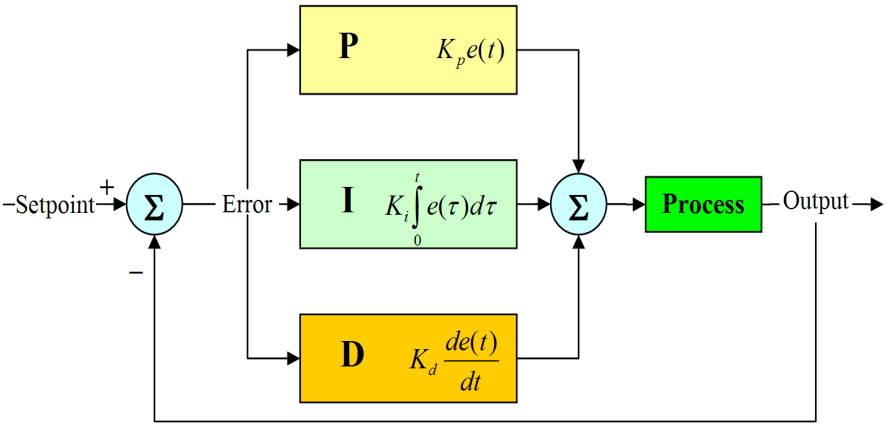

Fig. 3: Outline of the PID controller and formula

The entire field can be first divided into smaller sections such that each section should contain at least one soil moisture sensor. The sensors are buried into the ground at an appropriate depth. Once the soil has reached an appropriate moisture level the sensor can detect the moisture and send the information to the microcontroller.

The temperature and humidity of the atmosphere is displayed on the LCD Display by the Arduino. The Arduino board is connected over a wireless network to communicate with the server using HTTP or MQT Protocols. The soil moisture sensor output determines whether to pump water or not. The output of the measurement by soil moisture sensor is used as a feedback value for the PID Controller. If PID output is a positive value, it signals the motor to pump water. Soil moisture data is obtained through Arduino through a wireless network.

The water system consists of a typical drip irrigation setup: Pump Unit, Control Head, Main and Sub Main Lines, Laterals, Emitters or drippers. Automation equipment can reduce runoff over plants and avoid irrigating at the wrong time. Operation cost is usually reduced once it is set up.

3. RESULT

Wastage of water is reduced and crop yields are increased. The following idea can be implemented across the agriculture sector to maximize output and production. Temperature, Humidity and Soil moisture are determined. These factors directly affect the growth of the crops.

4. CONCLUSION

The main objective of this project was to provide a sustainable method for farmers to supervise their crops along with preventing wastage of water. If combined with rain water harvesting methods and effective ground water saving schemes, the project could help save water and replenish the water levels to a large extent. The principal of the project can be extended to create large systems for equipping fully automated lands.

5. REFERENCES

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