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A Hybrid Method for Smart Irrigation System

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Abstract*: Internet of Things (IoT) is a boon to the technological developments during the past decade. Though the adoption of this technology in agriculture has gone up immensely in recent years, the implementation of the smart irrigation system remains its initial stage in this agricultural setup. The sprinkler or dripper irrigation methods are widely used in the smart irrigation environment. In this paper a hybrid method is proposed to select the irrigation method automatically based on the climate changes and soil moisture level. By enhancing this method using the rapid growing technologies and IoT enabled smart irrigation controllers, the agriculture sector will be improved over the foreseeable future.

***Keywords*: Smart Irrigation, Sprinkler, Dripper, Hybrid Method.**

I. INTRODUCTION

Agriculture plays a vital role in countries like India. As Mahatma Gandhi said, the development of our country depends on the economic status of the villages which are mainly depending upon agriculture. Water is the core element for agriculture [1]. Figure 1 explains the need of water resource for agriculture. In India 80% of water resource is used for agriculture. Nowadays, climate changes reflect in the time and duration of monsoons which are the main water source.

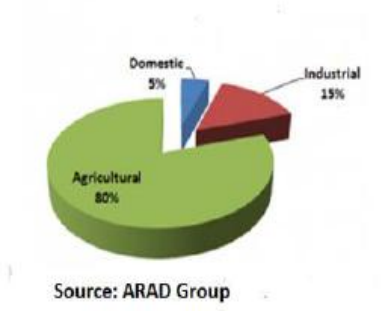

Figure 1: Water usage in India

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To overcome this water scarcity issue, the smart irrigation system is deployed in agriculture field. The smart irrigation system monitors the weather, soil type and its moisture level, evaporation and water usage of the plants and automatically adjusts the watering schedule [2]. It helps the farmers to optimize the water usage, enrich the quality of crop growth and quantity of yields in their fields. Smart irrigation systems are easy to implement and it has a straight forward approach [3]. In this paper, the background study related to smart irrigation, the issues and challenges in implementing the smart irrigation and IoT-based smart irrigation methods are discussed. A hybrid irrigation framework is proposed and some research issues in the smart irrigation systems are also highlighted

II. RELATED WORKS

Yuthika et. al [4] proposed an Intelligent IoT based irrigation system. For analysing and predicting KNN (K-Nearest Neighbour) classification machine learning algorithm was used in this approach. Machine to Machine (M2M) technology was implemented for communication among the devices and a prototype model was developed to test the efficiency. The security and water source issues were ignored in their work. Alauddin et al [5] proposed a Cloud based IoT for Smart Garden Watering System using Arduino Uno which was used to monitor and to maintain the soil moisture and light intensity. The monitored data was sent to ThingSpeak IoT cloud. The data gathered in the cloud was analysed and when it reached the threshold value, an action was sent accordingly from the cloud to the irrigation system. It needs further refinement like including temperature sensor and controlling the system using smart phone. Harishankar et al [6] suggested an automatic sprinkler irrigation system using solar power for automating the irrigation process using solar power and to optimize the use of water. When implemented for bore holes, the system was found to be successful. Solar pumps also offered clean solutions with no danger of borehole contamination. Maroufpoor et al [7] recommended three artificial intelligence methods such as Artificial Neural Network (ANN), Adaptive Neuro-fuzzy Inference Systems (ANFIS) and Gene Expression Programming (GEP) for estimating wind drift and evaporation losses from sprinkler irrigation systems. According to the authors, Gene Expression Programming method provided the best result. Fabrizio et al [8] explained a machine learning technique to manage heterogeneous datasets which include physical, biological and sensory values collected from real-time agricultural sector. Weather, humidity, wind speed and soil types were the factors considered in their approach.

The supervised machine learning algorithms such as decision tree, K-nearest neighbours, Neural Network and polynomial predictive models were used in this research. According to the authors, effective implementation of their work will increase productivity and will save the environmental resources and will pursue economic profits.

III. ISSUES AND CHALLENGES

To adopt and implement the technologies in agricultural sector, the developing countries like India have to face many issues and challenges.

- Lack of knowledge and fear of implementing and upgrading the technology in higher levels among large number of farmers in the country.
- The solution must have the customization facilities for different languages, so that it could be easy to understand for the ordinary people.
- Interoperability is another issue, due to lot of platforms and vendors for IoT tools and techniques.
- The farms own by the farmers are varying in its size. Hence, the solution related to smart irrigation should be scalable and flexible.
- Security is another big issue. If one of the sensors is hacked it will collapse the entire system. The security tools have to be updated frequently and it leads to additional headache to the poor farmers.

To find out a solution having all these requirement is not easy. These challenges and issues lead to further research and developments in the smart irrigation field.

IV. IOT BASED IRRIGATION METHODS

IoT based smart irrigation system is capable of automating the irrigation process by analyzing the moisture of soil and the climate condition. When the power supply is given to the microcontroller, it will check the soil moisture content [9]. If the moisture content is not up to the threshold then it makes the motor to get on automatically and turns off automatically if it reaches to the threshold level. The need of water for any crop is also reduced drastically. Remote monitoring is also possible in IoT based smart irrigation system.

A. Smart Irrigation System Requirements:

The core components for deploying the smart irrigation system are: Node MCU, Soil moisture sensor, temperature sensor, humidity sensor, 5v Relay, Sprinkler, Dripper, Solenoid valve and Water tank [10]. There are two types of irrigation methods such as dripper and sprinkler can be used according to the season. Dripper irrigation method can be used in the windy season, whereas sprinkler irrigation method can be adopted in the summer season.

B. Sprinkler Irrigation System:

Sprinkler irrigation system allows application of water under high pressure with the help of a pump. Small diameter nozzle is placed in the pipes, it releases rainfall like water through the distributed system of pipes and sprays into air and irrigates [11]. Thus, it is not suitable for the windy season. Figure 4.1 depicts the sprinkler irrigation system with solenoid valve and other required components

In summer, the leaves of the plants easily wither; since this sprinkler irrigation method sprays water like rainfall, it is suitable for the summer season

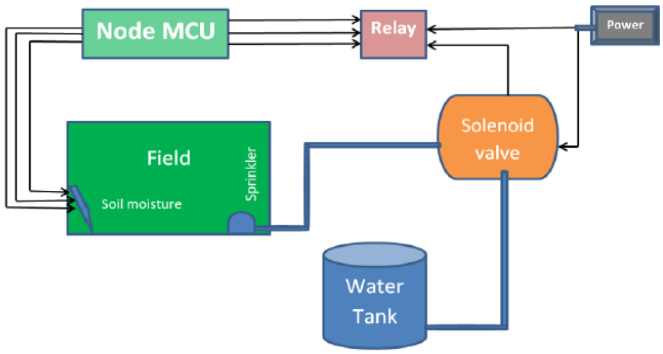

Figure 4.1 Design of Sprinkler Irrigation Method

C. Dripper Irrigation System:

Drip irrigation systems distribute water through a network of valves, pipes, tubing and emitters. Depending on how well designed, installed, maintained, and operated it is, a drip irrigation system can be more efficient than sprinkler irrigation. This system with dripper component is explained in figure 4.2.

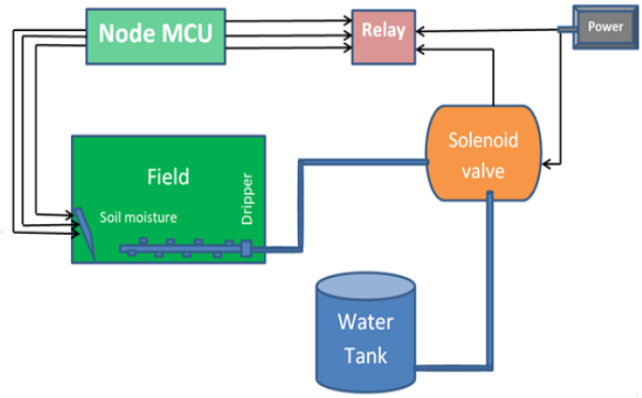

Figure 4.2 Design of Dripper Irrigation Method

This method is useful for all seasons, but sprinkler outperforms this drip system during summer season. There is a need for a better irrigation method which adapts all weather.

V. PROPOSED HYBRID METHOD FOR SMART IRRIGATION

In some situation both sprinkler and dripper irrigation methods can be used when the crop is needed to spray water on leaves of the crop as well as to be fed water to the root of the crop. According to the weather and climate condition either sprinkler or dripper method can be adopted. It is called hybrid irrigation method. This system can be controlled from anywhere through the User Interfaces such as mobile phone or laptop. The sensor data sent by different sensors are stored into the Cloud like ThingSpeak through the border router.

The working environment with the combination of sprinkler and dripper is shown in the figure 5.1 and the various functionalities of the smart hybrid irrigation system framework are explained below:

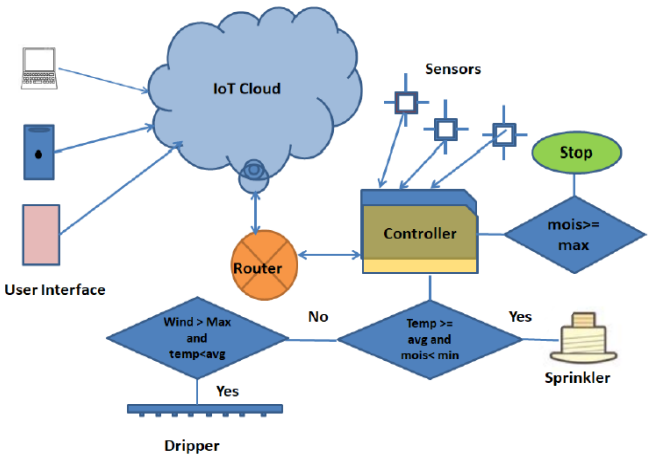

Figure 5.1. Hybrid Smart Irrigation Framework

Step1: The soil moisture sensor and weather sensors will give the details of moisture level of the soil, temperature, rainfall, wind speed and humidity information to node MCU (Microcontroller) whether water is needed to the crop or not.

Step 2: If watering is needed, the Microcontroller will trigger the relay to be switched on the power.

Step 3: Once the relay is switched on then the solenoid valve will be opened which is already connected with water tank and water is poured using sprinkler/dripper to the crop. If the temperature is high and the soil moisture level is very low then the sprinkler system is enabled to water the plants. If the wind speed is very high and also the moisture level of the soil is below the average level then the drip irrigation method is triggered.

Step 4: After irrigation process, the information will be sent to the microcontroller and the relay will be triggered to switch off the power.

Step 5: If water is not needed the irrigation system remains idle.

Mobility of the system helps the farmers to monitor the irrigation process from anywhere. Thus, by using this hybrid smart irrigation strategy, protection of the crops against various climate conditions is very easy.

VI. CONCLUSION

The Smart hybrid irrigation system is recommended to provide a valuable tool for conserving water planning and irrigation scheduling. The dripper or sprinkler method is selected automatically according to the moisture level of the soil, surrounding temperature and climate condition. This system can be used in large agricultural area where human effort needs to be minimized and the farmers can monitor and control the irrigation process from anywhere. Many aspects of the system can be customized and fine-tuned according to the requirement of a particular plant.

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