An Efficient Water Optimization for Horticulture Crops using IoT

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***Abstract*—Water scarcity directly affects the future population of India and indirectly influences the economy and ecosystem. The efficient use of water plays a major role in the farming with increasing the productivity and decreasing the cost, while maintaining the environmental sustainability. The adoption of advanced technologies in farming helps in achieving the optimization of water. So here, the Internet of Things (IoT) is the choice for efficient water optimization for the horticulture crops. This paper presents the wireless sensor technology and system deployments for IoT application. Results shows that it is able to provide efficient water optimization for the selected horticulture crops compares to earlier methods.**

***Keywords*—Internet of Things; Wireless Sensor; GSM Module and DC Motor.**

I. INTRODUCTION

Farming consumes around 70% - 90% of fresh water in the world, which marks the biggest consumer of fresh water in the world and makes the case for adoption of advanced technologies using Internet of Things (IoT) in order to water and food security to the world's population. In farming, different approaches of irrigation methods are carried for optimization of water usage for example: under-irrigation, drip-irrigation and so on. Irrigation is most prominent means of farming intensification, which act towards the climatic variability. In order to optimize the irrigation without compromising farming productivity for economic mainstay various approaches have been carried out by researchers with modern technologies [1].

Internet of Things (IoT) is closed loop system of interconnected computing devices with exclusive identifiers and data the ability to transfer data over a network without intervention of human interaction. Wireless sensor refers to spatially dispersed and dedicated sensor to monitor and gather the physical condition of the environmental factors and centralize it. The smart irrigation plays an important role in optimizing the irrigation with proper scheduling of automatic irrigation with consideration of environmental factors of inter and intra farm fields. IoT based sensors helps in determining the right amount of water at appropriate time to the desired place [2].

To produce more nutritious food with less water and to ensure a greener and more sustainable food production optimized water saving solution has to be developed. Development of innovative irrigation systems that efficiently use water is a major priority. Taking into account not only the state of the soil and the plants but also climate information. All these data should be properly interpreted to decide the most suitable actions to carry out. Precision Agriculture (PA) is a set of techniques that provide a suitable solution to optimize field level management with regard to crop science by matching farming practices more closely to crop needs [3]. The main objective of this work is focused on designing a microcontroller based intelligent irrigation system controller which will allow irrigation to take place from remote places where manual inspection is not needed.

Through this project, the drawbacks due to less technological advancements were to be reduced by eliminating the strenuous efforts put in by farmers by saving their time and improving the quality of labor and efficiency. And also optimize the amount of water utilized in irrigation.

II. LITERATURE WORK

Pavankumar Naik et al., [4] developed an automated irrigation system to reduce the usage of water and power loss in agricultural fields. The system consists of a soil moisture sensor, temperature sensor, water availability sensor, level sensor, EB power availability sensor. Once the sensor information is collected, this automated system gives triggering signals to the actuators and also transmits the data to farmers through SMS. A FUZZY based algorithm is developed with set values of temperature and soil moisture and the level of water is programmed into a microcontroller-based controller system to control the water flow. A GSM modem is used to transmit the information about the crop collected from the sensors.

Prachi Patil et al., [5] worked on automating the agricultural environment in real time using IoT. In this paper, they have used PIC16F877A and GSM SIM300 modem for automating the irrigation system for the social welfare of Indian agriculture system. This system is used for monitoring the soil moisture condition of the farm and also for controlling the soil moisture by monitoring the level of moisture content in the soil and accordingly switching the motor ON/OFF for irrigation purposes. The system purposes a soil moisture sensor where the moisture has to be monitored. Once the moisture content in the soil reaches a particular level, the system takes appropriate action to stop the water flow. This system also monitors the water in the water source so that if the water level becomes very low, it switches off the motor to prevent damage. The system also consists of a GSM modem through which the

farmer can easily be notified about the critical conditions in his farm.

Rajeshwari madly et al., [6] worked on system aims at increasing the yield of crops by using an intelligent irrigation controller that makes use of wireless sensors. Sensors are used to monitor primary parameters such as soil moisture, soil pH, temperature and humidity. Irrigation decisions are taken based on the sensed data and the type of crop being grown. The system provides a mobile application in which farmers can remotely monitor and control the irrigation system. Also, the water pump is protected against damages due to voltage variations and dry running.

III. PROPOSED METHODOLOGY

Advancement in technology allowed human beings to ease their work at the same time complete the work with less human force, less time and with better results. The basic idea behind this project is to optimize the water and control the functioning of the agricultural load using wireless technology.

This project is a transform from the natural irrigation technique which was followed by the farmers to the automatic irrigation which for sure has benefitted in the less wastage of water and lessens the hard work of the farmers in farms [7]. Controlling of remotely located irrigation water pumps for an agricultural site without going and visiting the site again and again. With this project, the system results in achieving adequate water management due to which there is almost no wastage of water, saves men power, saves time, and is efficient. The block diagram of the proposed model is as shown in Figure 1.

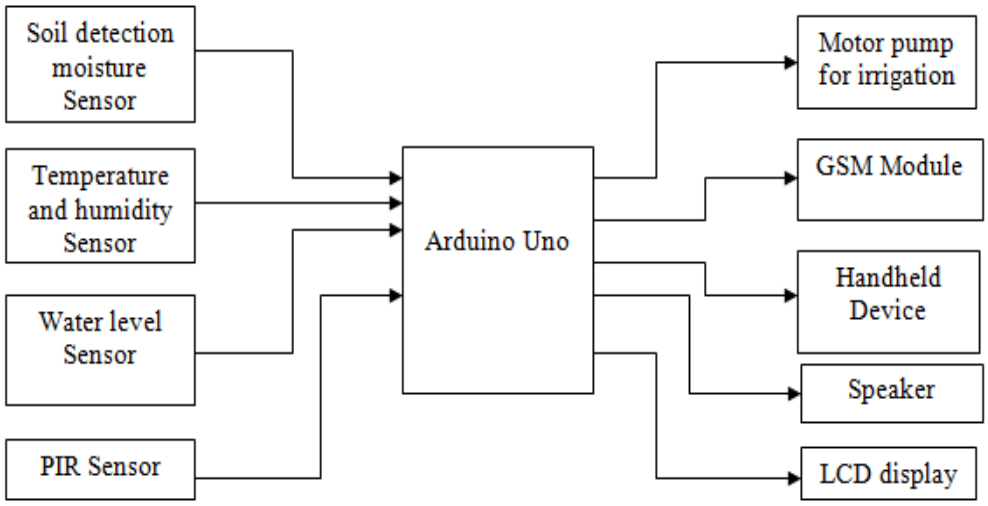

Figure 1: Block diagram for the proposed model.

Soil moisture sensor consists of two electrodes attached to it, where it measures the volume of water in the soil. The electrodes allow the electric current to pass through the soil, by proportionally varying the electricity i.e. conductivity with resistance values. DHT11 sensor used to measures the temperature and relative humidity content in the air, the relative humidity is the measures of actual water vapor content in the air. The DHT11 works on the negative temperature coefficient for reading temperature and substrate mounted back for reading relative humidity [8]. Water level sensor works on the indication point with indicating different levels of water in tank, for experiment purpose considered 5 levels [9]. Here 5 LEDs with buzzer are used to indicate the water level inside the tank. Passive Infra Red (PIR) sensor used to detect the object or obstacle for the security system with a calibration of 10 to 60 Seconds. The circuit diagram for the proposed model is shown in figure 2.

To facilitate effective irrigation of crops and to avoid wastage of water, a soil moisture detection module, a DTH11 module and a water level sensor module has been combined and their values are used to draw the conclusion whether the crop can be watered or not. At first, the soil moisture is taken into account. If the water level in the soil is below the required water level essential for the plant, then temperature and humidity is checked. Temperature and humidity are checked in the view that watering the crops when it is about to rain then the plants will not be watered. When all the aspects do not meet the preconditioned value sufficient for the plant, then the plant has to be irrigated, the water level in the tank or well is to be checked. This is done by considering the necessity of water during inevitable plight. If the water level is low, it is indicated to the farmer and they can take the suitable actions.

Passive Infrared Sensor (PIR) is used to detect animal invasion in the field to protect the crops from the wild animals. If any animal is found then PIR Sensor goes high it will turn on because of the buzzer/speaker sound the animal go away from the field. The GSM module is used to send the message to the farmer in a remote area about the field regarding motor on/off, animal intrusion and water level in the tank or well.

For experimentation purpose considered horticulture crops like Beans and Okra. Where this crops have different growth stages such as germination, seedling, pollination

and fruit-set stages. For each stage, the requirement of irrigation will be different based on soil and crops. The real-time gathered datasets are compared with the intermediate values of specified irrigation based on decision model. The decision model controlled by Arduino Uno decimates the information to farmers and control the flow of water through DC motor.

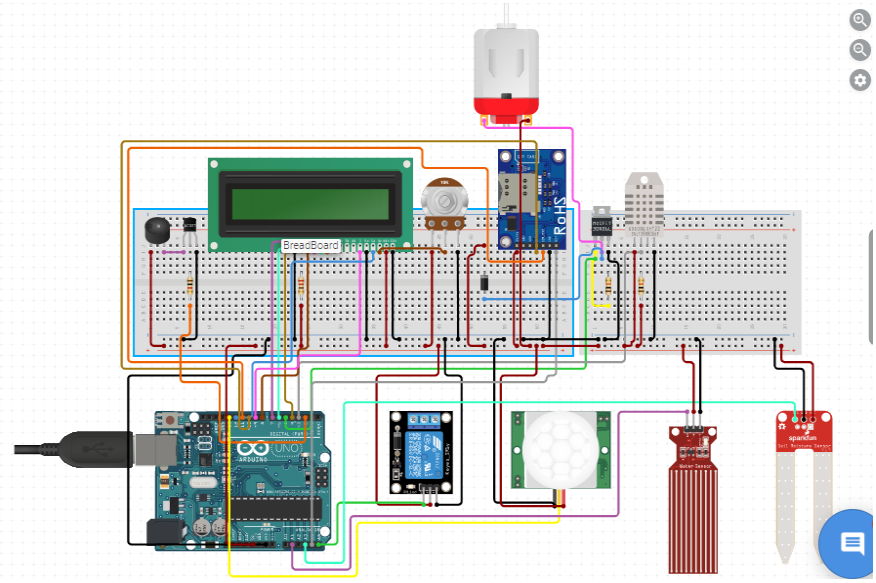

Figure 2: Circuit diagram for the proposed model.

IV.RESULTS

If the soil moisture value is less than 1000, an alert message is sent ”MOTOR ON” to the mobile then water will be supplied till the plants reach the moisture level. If the soil moisture value is less than 250, an alert message is sent ”MOTOR OFF” to the mobile then water supply will be stopped. The GSM module is used for message transform. The result of LCD display that has been interfaced with Arduino Uno. The LCD display acts as an output system that displays the status of system. The LCD display provides the message about both irrigation need and field protection. The snapshot of working model is shown in figure 3.

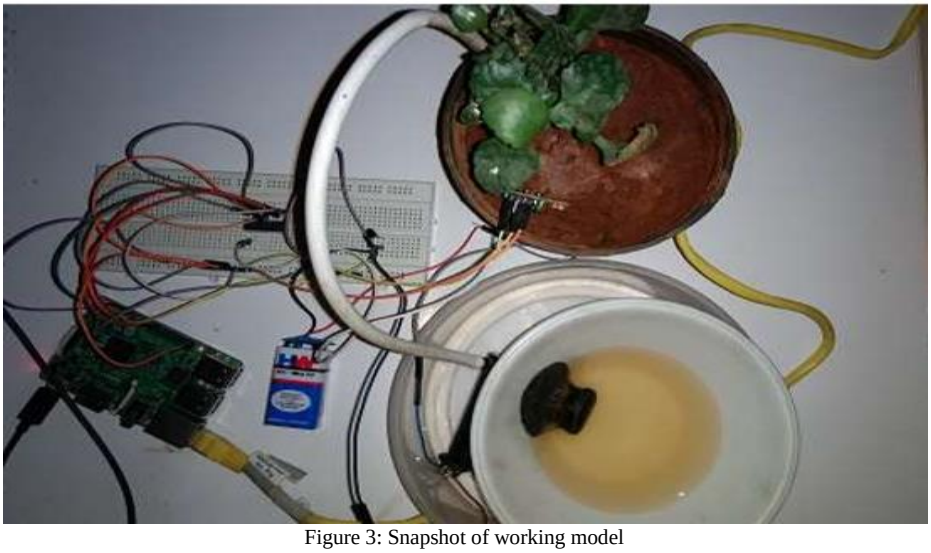

Figure 3: Snapshot of working model

V. CONCLUSION

The proposed system provides an attractive user interface with the most efficient way of controlling the irrigation system. It gives the idea to monitor the soil moisture content and temperature in a farming area and the user can control watering system using the IoT based sensors with decision support system. The result shows that by adopting the advanced technologies in the farming, one can save water around 50 – 60 percentage compared to normal irrigation method carried nowadays.

VI. ACKNOWLEDGEMENT

We are grateful to Maharaja Institute of Technology, Mysore for continuous encouragement to continue this research work. We would like to thank our family

members, Staffs of department ECE and friends for their continuous support to present the paper.

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