Automatic Irrigation System for Vegetable Crops using Internet of Things

M. Marimuthu[1], M. Ajitha[2] and R. Priya Nandhini[3]

[1] Coimbatore Institute of Technology, Coimbatore, mmarimuthu@cit.edu.in

[2] Coimbatore Institute of Technology, Coimbatore, ajithacitizen@gmail.com

[3] Coimbatore Institute of Technology, Coimbatore, priyarnandhini@gmail.com

Corresponding author: Dr.M. Marimuthu, mmarimuthu@cit.edu.in

Abstract

Our country mainly depends upon the agriculture. The present scenario of agriculture and agriculturist is in the tragic position. The main problem lies in agriculture is water scarcity, man power, capital, soil fertility etc. In order to overcome these problems we have developed an automatic irrigation facility. It minimizes human intervention on fields and provide limited amount of water to each crops which minimize water scarcity. Detect the pH value of the soil and provide necessary chemical compounds to each plant. It helps the growth of the plant widely. By adopting this methodology the person, who possess fields in any remote geographic location can also be frequently monitored with the limited cost. Results show the significant improvement in the proposed work.

Keywords: Arduino, GSM module, Humidity sensor, Internet of things, pH sensor, Temperature sensor.

1. Introduction

As India's population increasing drastically may arise a serious problem of food. So focusing towards an agriculture is an essential theme. Advancement in agriculture techniques is essential to bring enormous productivity. Agriculture is a largest freshwater usage and conserving freshwater is a serious challenge. Wireless sensor based system adoption would increase production in the agriculture field [1]. A well grown and healthy plant can transpire lot of water and increase in a humidity values can generate greenhouse effect. Relatively higher humidity can increase diseases and reduce plant transpiration [2]. Systems in agriculture can be automated or semi-automated to utilize water efficiently. The sensor based automatic irrigation can be made i.e. soil sensor can be deployed and measure the varying values and compare with the default values and turn motor on and off [3]. In an automatic irrigation system water level indicators are placed in water reservoirs. Sensors placed in root

zone of the plant and sensors information are sent to a gateway unit which transfers to a microcontroller and turn gateway accordingly [4]. Internet of things allows an integration between physical worlds into computer based systems. It provides results with high speed of accuracy, efficiency and economic benefit [5].

This paper is organized as follows. Part 2 discuss about literature review of the related work. Part 3 describes about our proposed methodology. Part 4 illustrates results and discussion and finally part 5 concludes with conclusion and future work.

2. LITERATURE REVIEW

As author proposed that the irrigation is done based on soil fertility and moisture level [4] different techniques in irrigation would produce higher outgrowth. In this depending upon the water level indicator and soil moisture sensors, motor and solenoid valves are controlled. Which helps to supply water to field. The entire system is monitored and controlled by MQTT server through an internet.

Author [5] described that the system is divided into sensing unit with soil, temperature, humidity sensors and control unit with actuators. Gsm module is employed for a mobile communication over an internet. Zigbee is a wireless communication protocol. The whole system work together in an automatic irrigation module.

As author revised that the advanced water deployment system [6] would optimize crop production and cost effectiveness. Additionally minimize water usage. In this the network is of sensing station and weather station. The communication exists between the sensor nodes and data is received via zigbee protocol. Generally Zigbee protocol is a wireless communication with IEEE802.15.4 protocol.

Drip irrigation is also referred as a micro irrigation [7]. The communication exists in the form of SMS. SMS is generated with the help of a GSM. GSM consist of sim card. The GSM transmits data to an ARM7. It display the data in an LCD. That is whenever it receives an activation command (AT) it checks the field condition another (AT) command, to turn the motor. Motor is made on by a transistorized relay circuit. While the motor is on it frequently checks the soil moisture level, when it reaches the normal value the motor is turned off.

In which irrigation is made by both ARM processor and PIC microprocessor [8]. Pic is programmed to receive and transmit data simultaneously through an RF receiver. In an ARM processor when it receives a valid data from WSU i.e. soil is dry or temperature is high motor is on with an LED glow. It would help to save plenty of water.

A pipe with rain gun is irrigation mechanism is adopted [9]. It is attached to the reservoir. When the sensor values are sent to a microcontroller based on the signal generated. Water is pumped out drop by drop through a rain gun. When it reaches a saturated value turns off. GSM and microcontroller are connected via MAX232. Gsm signals through a buzzer.

Irrigating the plant alone doesn't fetch a good yield [10]. It also includes factors to be noticed that is attack of pests, attack of animals and birds when crop grown, theft occurs at the stage of harvesting, and also for the farmers to store after harvesting. To all of these problem solutions are provided in a single module includes a GPS based remote controlled robots for weeding and spraying and then an smart irrigation and also includes warehouse management that is maintaining a temperature, moisture, humidity etc. all of these can be connected to an internet with a ZIGBEE ,cameras ,GSM, raspberry pi micro controller.

Authors designed with an Arduino-Uno as an embedded Linux board [11] which helps to communicate with the soil sensor and ultrasonic sensor. The node MCU monitors the physical conditions such as temperature, humidity with the help of DHT11 sensors. Using these values signal is sent to motors.

A wireless irrigation for smart home garden can be combined with a smart home control system [12]. Proposed system can consist of both Arduino and raspberry pi. It can be a master and slave. Master is raspberry pi and slave is an Arduino. The sensor values are converted from analog to digital in ARDUINO micro controller, and the digital values sent to a raspberry pi through Zigbee module.

The five important factors for drip irrigation are temperature, humidity, ground water, carbon dioxide, light intensity [13]. In which an advanced microcontroller LM3S5T36 which is 32 bit ARM CORTEX. It has a flash memory, ram, Analog to digital convertor, timers. Timer is set for water flow according to the temperature and soil sensors water flows manually. It deals with the sensors that are placed on the root zone of the plant [14]. It sends the data to a microcontroller and the two mobiles are connected via a GSM. The GSM and microcontroller are connected with an MAX232. When it reaches signal from microcontroller the mobile phone generates a buzzer. And the rain gun flow drop by drop till it reaches a destined value.

Zigbee and GPRS wireless system is suitable for connecting to a microcontroller [15]. The data of sensor nodes and data receiver is sent to a zigbee. The receiving unit possess a duplex communication it sends the data globally via GPRS through a GSM module.

3. Proposed Methodology

The demand for higher productivity is increasing day to day life. The urge to facilitate the food production. With a limited cost, limited man power etc. we would like to irrigate the crops whenever necessary. This would avoid overflowing of water. Not only has the proper irrigation fetched us better results in productivity. So we would like to place the pH sensors and detect pH values of the soil which discriminates the acidity and basicity and provide necessary amount of fertilizers. This system remains active from the growing stage of the crop to harvesting period, which stage needs considered amount of water flow. This would also help to grow in a healthy manner and provide larger food production. Figure 3.1 depicts the proposed prototype of automatic irrigation. This would irrigate the plant crop periodically depending upon the sensor values and it helps to conserve water and avoid Human Intervention.

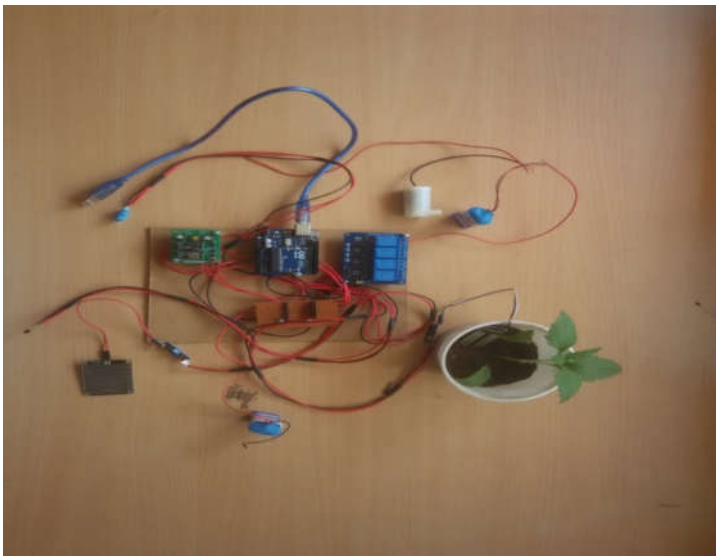

Figure 3.1: Prototype of Automatic Irrigation System

Figure 3.2 describes the block diagram of how Arduino ATmega 328 is connected to temperature sensor, humidity sensor, pH sensor, soil sensor, and Rain drop sensor connected which reads the values from soil. The code is generated to turn motor ON and OFF depending on the threshold values and the reading is updated on web server.

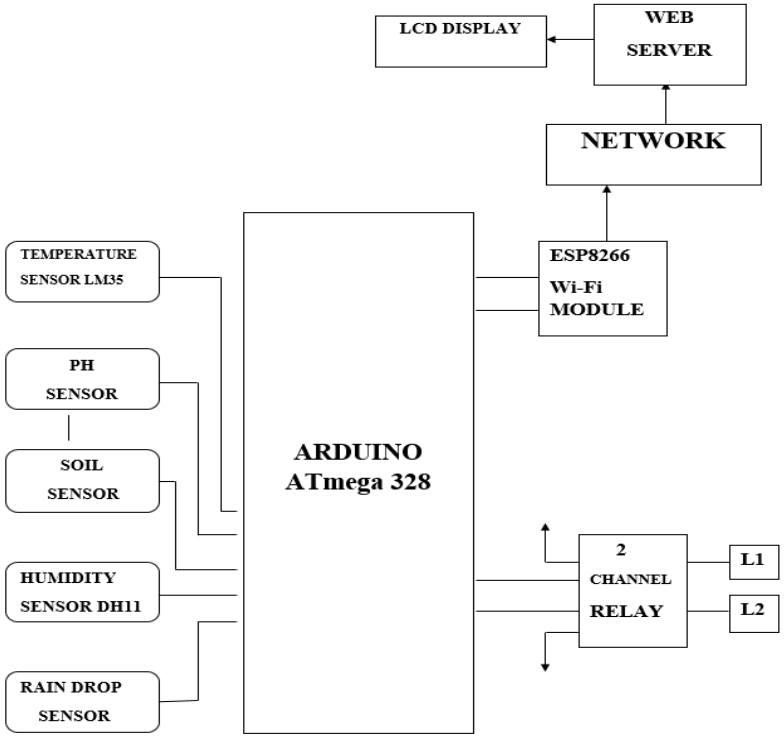

Figure 3.2: Circuit Diagram of ARDUINO ATmega 328

Figure 3.3 illustrates the working model and sensors are connected to ESP8266 module. The analog value is converted to digital value while the temperature reaches the value motor is switched on .When pH value is less than 0.7 millimetre range chemical is supplied and the soil value is less than 500 loam motor is on. Humidity value reac motor is switched on while rain drop sensor reaches 6 millimetre motor is turned on.

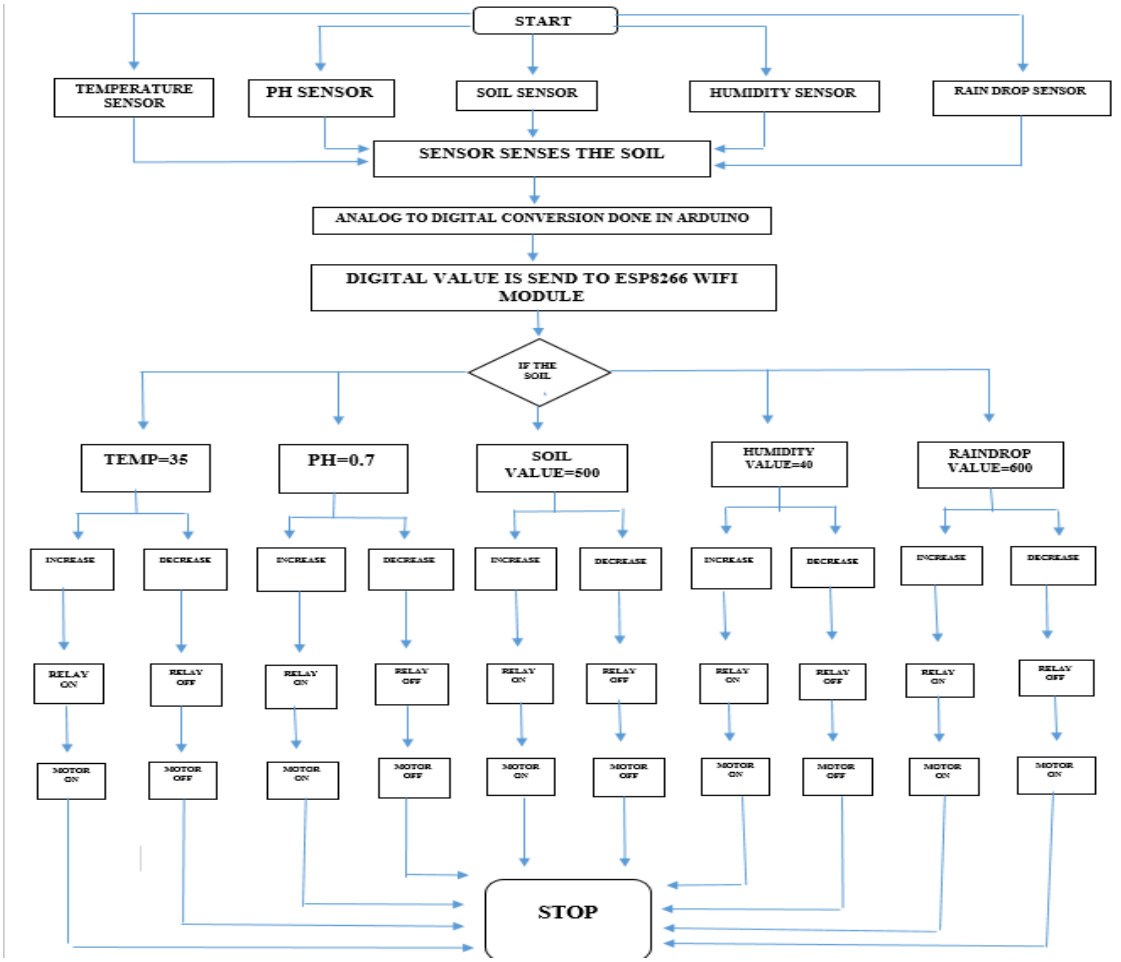

Figure 3.3: Working Model of Automated Irrigation System

Below Table 3.1 depicts the maximum and minimum Threshold values for Temperature sensor, Humidity sensor and Soil sensor.

S.No.	Threshold	Threshold values
1	Lower threshold for Soil Moisture	**25%**
2	Upper threshold for Soil Moisture	**40%**
3	Threshold value for Temperature	**40□**
4	Threshold value for Humidity	**40□**

Table 3.1: Threshold values for Sensors

4. Results and Discussion

The automated irrigation system runs successfully by providing sufficient amount of fresh water when ever needed that would drastically saves fresh water and increase the crop production. Results are stored ThingSpeak website [16]. ThingSpeak is an open source Internet of Things (IoT) application and API used to store and retrieve data for processing. Figure 4.1 Soil Sensor reading and display the oscillating values in a graphical representation. Figure 4.2 represents the Humidity values in a graphical format. Figure 4.3 varying Temperature values in a graphical format and finally figure 4.4 represents the Rain Drop readings in a graphical representation.

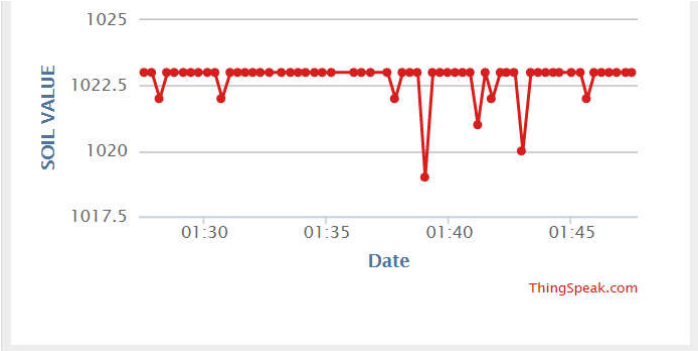

Figure 4.1: Soil Sensor value

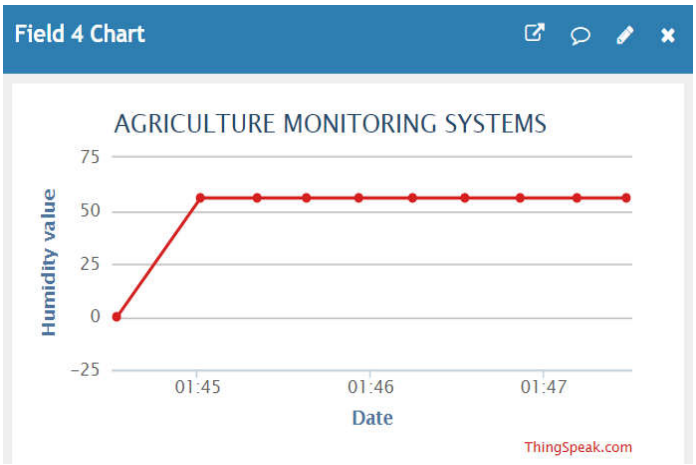

Figure 4.2: Humidity Sensor value

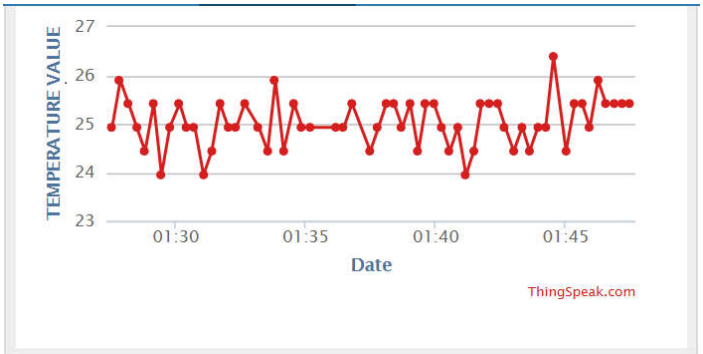

Figure 4.3: Temperature Sensor value

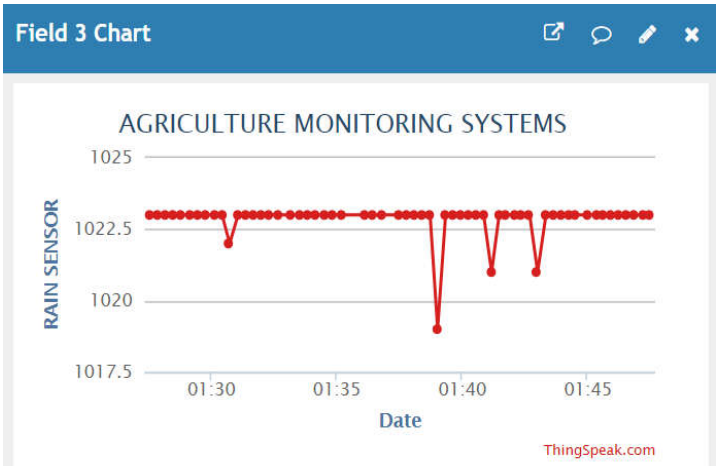

Figure 4.4: Rain Drop Sensor value

5. CONCLUSION

The Automated irrigation system is an important aspect to our upcoming generation where water scarcity, labour short comes, capital problem would occur. To overcome these entire crises, this will increase our food productivity. Limited amount of manure to soil would enhance the soil fertility and fresh water conservation is considered drastically. In future it can be enhanced by visualizing the type of soil and irrigate accordingly would fetch an accuracy.

REFERENCES

1. Nagare Brushalim,M. Agarkar, B.S. and . Kapale, N.B. (2015). Automated irrigation system using WSN and GPRS/GSM, *International Journal of Advance Research and Innovative Ideas in Education* , Vol (1), 83-92.

2. .Devika, S.V , Khamuruddeen, S.K. Jayanth Thota and Khalesha, Shaik. (2014). Arduino based automatic plant watering system. *International Journal of Advanced Research in Computer Science and Software Engineering*, Vol.4, 449-456.

3. Sanjay Kumawat, Mayur Bhamare, Apurva Nagare and Ashwini Kapadnis. (2017). Sensor based automatic irrigation system and soil ph detection using image processing. *International Research Journal of Engineering and Technology*, Vol. (4), 3673-3675.

4. Babanna, Kumbar, Basavaraj Galagi, Bheemashankar and Naveen Honnalli. (2016).Smart irrigation system using internet of things. *Bonfring International Journal of Research and Communication Engineering*, Vol. (6), 4-9.

5. Azim khan Shubham Singh, Shiva Shukla, Atul Pandey. (2017). Automatic irrigation system using internet of things. *International Journal of Advance Research, Ideas and Innovations in Technology*, Vol. (3), 526-529.

6. Nilesh, D.Kuchekar and Pagare. R.A. (2015). Advances water deployment system for irrigation using WSN&GSM Module. *International Engineering Research Journal.* Vol. (1), 243-247.

7. Pavithra D. And Srinath, S.M. (2014). GSM based automatic irrigation control system for efficient use of resources and crop planning using an android mobile. *IOSR Journal of Mechanical and Civil Engineering,* Vol. (11), 49-55.

8. Nagare Vrushali, M. Agarkar, B.S.and Kapale, N.D. (2015) Automatic irrigation system using wireless sensor network and remodule. *International Journal of Engineering Sciences and Research Technology,*Vol.4*,* 606-611.

9. Karan Kansara, Vishal Zaveri, Shreyans Shah, Sandip Delwadkar and Kaushal Jani. (2015). Sensor based automated irrigation system with IOT, *International Journal of Computer Science and Information Technologies*, Vol. (6), 5331-5333.

10. Nikesh Gondchawar and .R.S.Kawitkar. (2016). Iot based smart agriculture. *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. (5), 838-842.

11. Shweta Bopshetty, Mrunali Yadhav, Rithvika Rai, Sheril Silvister, and Parth Sagar. (2014). Monitoring and controlling of drip irrigation using iot with embedded linux board. International Journal of Advanced Research in Computer and Communication Engineering, Vol. (6), 893-898.

12. Sneha Angel.(2015). Raspberry pi .Arduino Based automated Irrigation System.

International Journal of Science and Research, Vol.5, 1145-1148.

13. Praphyusha,K. and Chaitanya Suman, M.. (2012). Design of embedded system for automation of drip irrigation system. *International Journal of Application or Innovation in Engineering and Management*, Vol. (1), 254-258.

14. Suresh,R, Gopinath, S,Govindaraju,K ,Devika,T,.Suthanathira and Vanitha, N. (2014). GSM based automated irrigation control using Rain gun irrigation. *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. (3), 5654-5657.

15. Karthikeswari, M.and Mithradevi,P.(2014).Automated irrigation system in agriculture using wireless sensor technology. *International Journal of Advanced Research in Electrical, Electronics And Instrumentation Engineering*. Vol. (3), 13622-13627.

16. Website URL "https://thingspeak.com".