INTELLIGENT IoT BASED IRRIGATION SYSTEM FOR AGRICULTURE

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Abstract—*This paper primarily describes about the IoT based intelligent irrigation system that provides smart access of soil moisture and relative agricultural parameters such as temperature, pH, Methane content and surrounding air quality using varioussensors connected to the microcontroller ATmega328 and transfers data to cloud for remote access using the ESP8266 Wi-Fi module, all the data are monitored in the cloud. There threshold values were found to be (550-600) for moisture, (0.0017%) for methane, (<65°F) for temperature, (<1000ppm) for air quality and (7.5-8.5) for pH in small scale agricultural field for the proper plant growth and depending upon the moisture content the switch that we have designed in IoT platform can be made ON or OFF and the corresponding notifications and alert messages are received in the farmer's mobile phone using GSM800C. The entire power needed for the system is provided by solar pumping module consisting of solar panel of 36 cells that provides power of 10W and a lead acid rechargeable battery of 12V. The objective of the project is to monitor the agricultural parameters and to provide an eco-friendly and efficient solar powered irrigation system.*

Keywords—IoT, ATmega328p, Smart irrigation, solar energy

I. INTRODUCTION

India is an agricultural country. Agriculture and its related activities act as major source of income and subsistence for more than 80% population of rural India. It provides employment to approximately 41.4% of labour. Its contribution to Gross Domestic product (GDP) is between 18 to 19.9%. There are huge problems encountered by the farmers such as poor irrigation, high labour force, lack of easy credit to agriculture and over reliance on money lenders.

One of the best way to lessen the problems faced by the farmers is to choose smart irrigation system where the various types of sensors are used to monitor and the data is sent and processed and finally the appropriate action is taken automatically and the notification is sent [1] and also solar module is used for the entire power consumption. Installing the solar panels [2]in the farm can cost more but it increases efficiency. The research is ongoing on to grow the plants under the solar panels and this can improve the solar cell efficiency as it creates the cooling microclimate. The farmers get a new experience and they can even monitor the condition directly from smart phones.

II. PROPOSED SYSTEM

Soil Moisture level is periodically checked and maintained using moisture sensor(FC -28) and the air quality of surrounding field is also checked using the MQ-series sensors. Soil fertility is checked and monitored using temperature sensor LM35 and analog pH sensor.

Solar pumping module is used for irrigating the entire agricultural field. Depending on weather condition the irrigation is changed, if it is raining then the irrigation is not needed for one day.To store the information in the cloud and to send the notifications to the user and GSM800C is used to send the alert messages[4]. Solar pumping module consist of solar panel, converter, battery and DC stepper motor[2] .The farmers can monitor the condition directly from smart phones.The data are updated for every second and is accurate. Shade tolerant crops are grown under the shadow of solar panel.

III. METHODOLOGY

The Figure 1 shows the block diagram of smart irrigation system. It consists of sensors namely LM35(Temperature sensor), Moisture sensor, pH sensor, air quality and methane sensor connected to the analog pins of Arduino. The Arduino

A. Block diagram of IoT based irrigation system

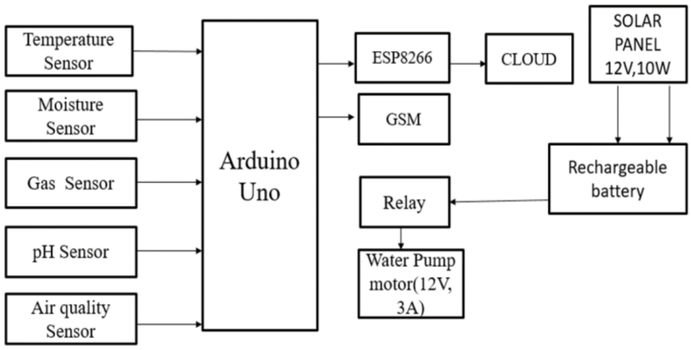


Figure 1: Block diagram of IoT based irrigation system

UNO is programmed using the Arduino Software (IDE), an Integrated Development Environment. The next block is the ESP8266 Wi-Fi Module which consist of 16 GPIO Pins, which can be used both under normal operation and programming mode [8]. The ESP8266 is capable of providing an application or offloading all Wi-Fi networking functions from another application processor.

Then the real time agricultural data is stored in IoT platform that allows us to build interfaces for controlling and monitoring our hardware using smart phones [5].

As Shown in the figure 1 we have a solar pumping module consisting of rechargeable battery (lead acid battery), DC stepper motor of 3Amps and 12V. This solar module is eco-friendly, efficient and under the solar panel farmers can grow shade tolerant plants, so that they can diversify the crop selection. GSM800C provides the alert messages to the farmer's mobile phone and in order to have a serial communication between the microcontroller and GSM we connect the Tx pin and Rx pin of GSM to PWM enabled pins of microcontroller [4].

We are using a single channel relay to control the output of the motor.

B. Flowchart for the proposed system

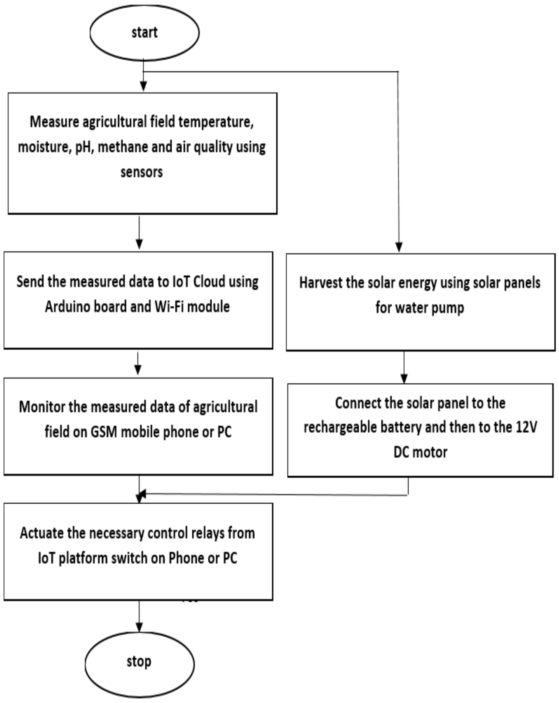


Figure 2: Flow chart for agricultural parameters

The various agricultural parameters such as moisture level, temperature for the crop growth, pH level of the soil and water along with the air quality sensor to sense ammonia, sulphide and other hazardous gases are sent[6] through wireless transmission to the IoT Cloud using ESP8266 Wi-Fi module and then the corresponding actions such as switching on the motor takes place in the IoT platform .Depending upon the monitored and stored data in Wi-Fi logs, we are going to take the necessary actions like activating the motors and relays.

C. Flowchart for moisture sensor

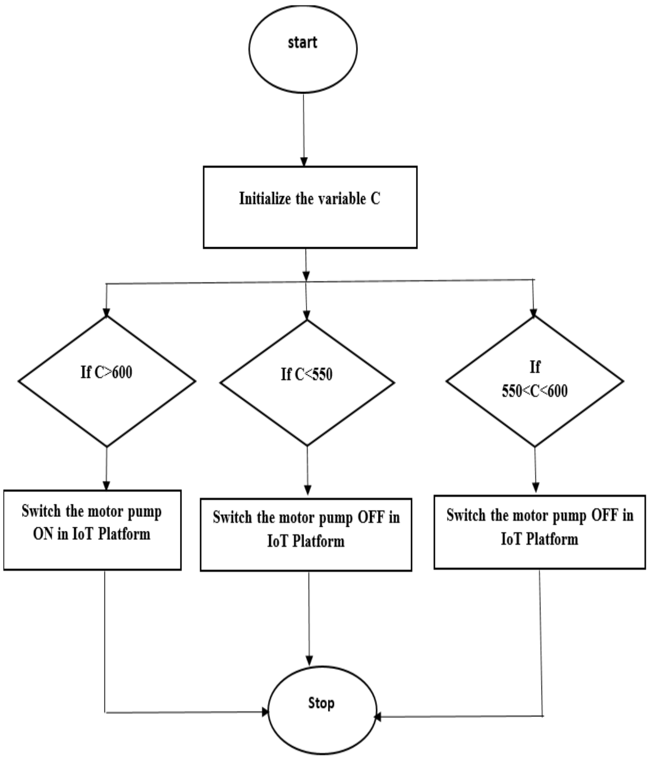


Figure 3: Flowchart for moisture sensor

Figure 3 shows the flowchart for moisture content of the soil. The moisture sensor act as a variable resistor and the resistance value is inversely proportional to the moisture level[3]. If the resistance value is above 600, then the pump is made on and when the resistance value is below 550 the moisture content of the soil is more, so the motor pump is switched off and when the value is between 550 and 600 , the soil is neutral hence no action should be taken. The alert messages will be received in the farmers mobile phone [4].

D. GSM Output for moisture sensor

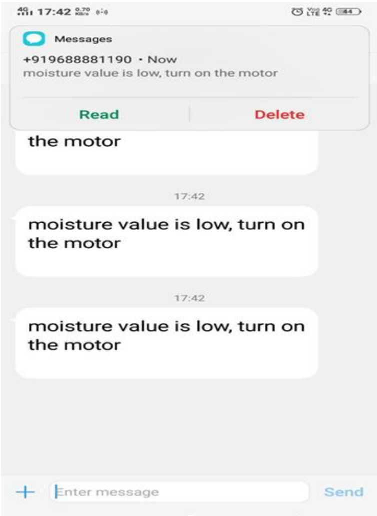


Figure 4: Output for moisture sensor

Flowchart for Air quality sensor

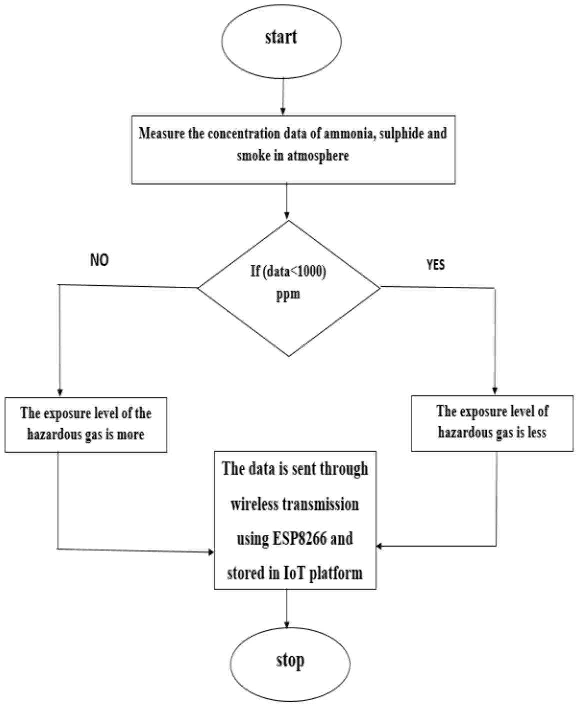


Figure 5: Flowchart for air quality sensor

The air quality sensor MQ135 senses the hazardous gases such as ammonia ,sulphide and smoke[7] .The preheater inside the gas sensor gets heated and then when the sensing layer interacts with such gases,the load resistance is varied according to the concentration of the gas .As shown in figure 5,the concentration range must be less than 1000ppm in agricultural field.

E. Flowchart for pH sensor

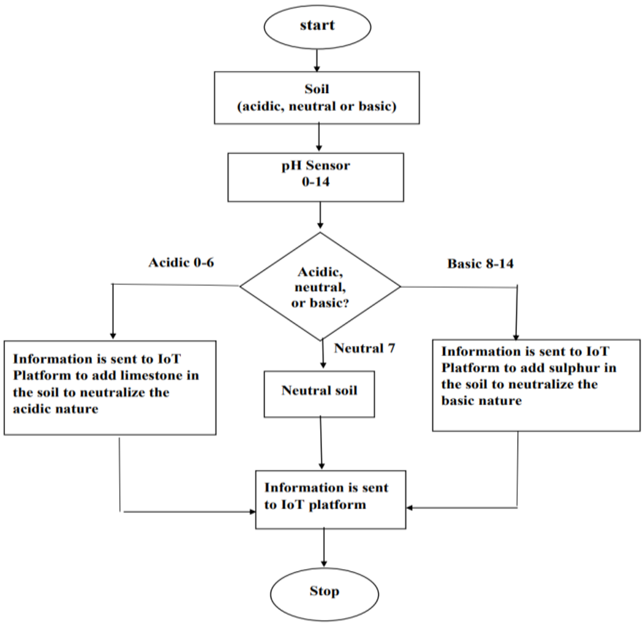


Figure 6:Flowchart for pH sensor

As shown in figure 6, we have to find the soil and water nature using this sensor,certain crops can only grow in acidic nature ,and few crops can grow in basic nature.In such cases if we have more basic soil we can add sulphur to the soil to neutralize the alkalinity .Similarly to neutralize the acidic nature we can use limestone.Generally for water we should have an thresold value of 7.5-8.5.

F. Flowchart for Methane sensor

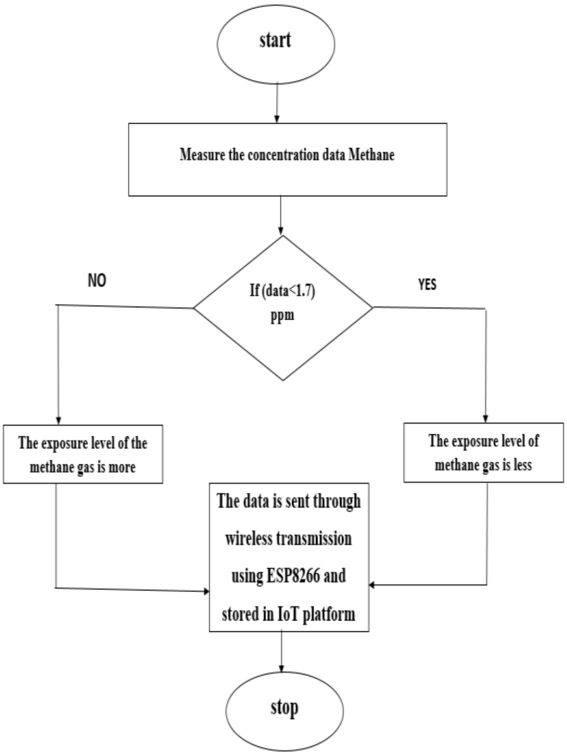


Figure 7: Flowchart for methane gas sensor (MQ-4)

Initially we have to measure the methane concentration in atmosphere. The methane gas content must not be more than 1.7ppm or 0.00017 percentage in atmosphere. If it is more than the normal concentration then there is a possibility of methane gas leakage.

G. Flowchart for temperature sensor(LM35)

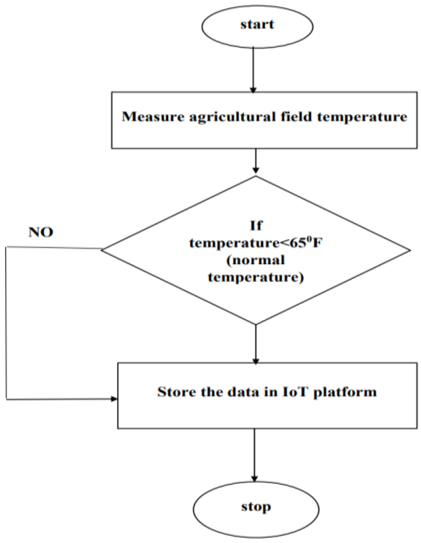
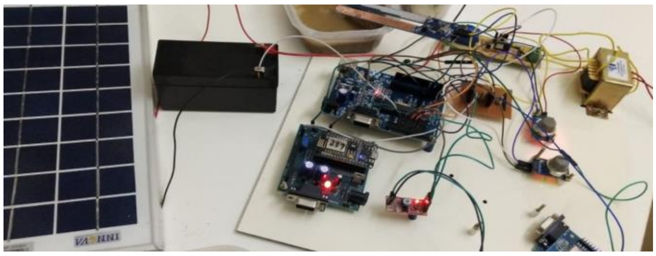


Figure 8: Flowchart for LM35

As shown in figure 8, the normal temperature of the atmosphere is found. The temperature must be less than 65^0F. The crop also requires this temperature for the proper growth.

IV. HARDWARE IMPLEMENTATION



Solar energy is harvested using solar panel [2] of 10W and it consist of 36 cells and a dimension of 355 x 255.All the analog output pins of the sensors are connected to the analog pins of the microcontroller (ATmega328p). Then the microcontroller is connected to ESP8266 Wi-Fi module to provide access to the webpages. Then the GSM is connected to the external adapter of 12V. The one channel relay is used to control the output of the motor. The common is connected to the 12V Rechargeable battery and the normally open terminal is connected to the positive of the DC motor.

V. OUTPUT

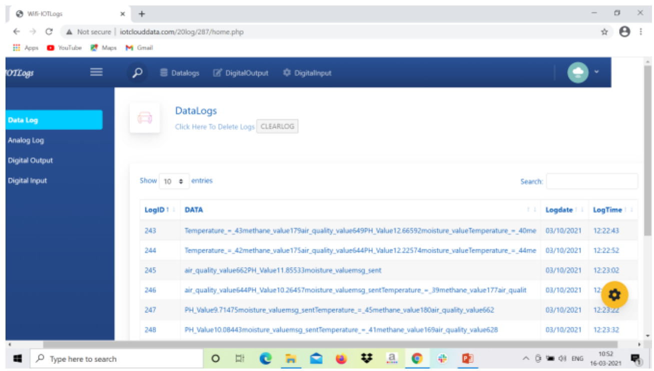


Figure 9: Data logs of the agricultural parameters

We have created our cloud webpage [5]to store the sensor data. As shown in the figure 9 we have different sensor information such as temperature, air quality, methane content, moisture level and pH information.

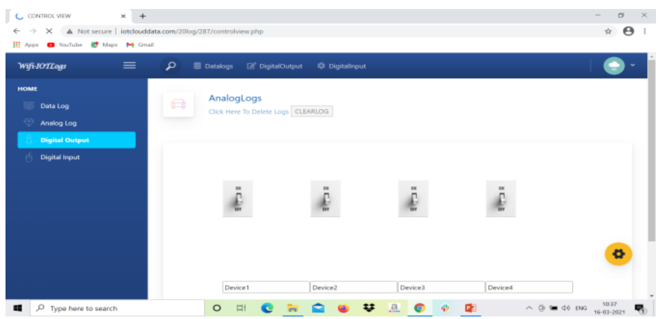


Figure 10: switch to be on or off in IoT platform

The figure 10 depicts the switch that is to be made ON manually in IoT platform whenever we get GSM output notification message in mobile phone regarding the moisture level of the soil.

VI. CONCLUSION

In this research paper, we have achieved our goal of creating IoT based intelligent irrigation system powered by solar panel of 10W and rechargeable battery of 12V. Agricultural parameters such as temperature, pH, methane and other toxic gases concentration are measured and monitored using IoT platform. There threshold values were found to be (550-600) for moisture, (0.0017%) for methane, (<65°F) for temperature, (<1000ppm) for air quality and (7.5-8.5) for pH in small scale agricultural field for the proper plant growth. Moisture level is both monitored and controlled with the help of switch in IoT platform. Finally, GSM alert messages is sent to the farmer's mobile phone.

VII. REFERENCES

[1] Nor Adni Mat Leh, Muhammad Syazwan Ariffuddin Mohd Kamaldin; Zuraida Muhammad; Nur Atharah Kamarzaman, "Smart Irrigation System Using Internet of Things" IEEE 9th International Conference on System Engineering and Technology (ICSET),2019.

[2] Patil,S.S., & Zende, R.M."Solar powered water pumping system". Third International Conference on Sensing, Signal Processing and Security (ICSSS), 2017

[3] Srishti Rawal, "IOT based Smart Irrigation System,"International journal of Computer applications, vol. 159, no. 8, pp. 1–5, February 2017.

[4] Kranthi K. Kumar; Sriya Rachamalla; S. Vijaya Laxmi; Pamireddy Sindhu "Most Economical - IOT based SmartIrrigation Using GSM" 3rd International Conference on Communication and Electronics Systems (ICCES),2018

[5] B. Khelifa, D. Amel, B. Amel, C. Mohamed, and B. Tarek, "Smart irrigation using internet of things," 2015 4th Int. Conf. Futur. Gener. Commun. Technol. FGCT 2015, no. Fgct, pp. 91–96, 2015.

[6] Rahul Dagar; Subhranil Som; Sunil Kumar Khatri "Smart Farming – IoT in Agriculture", International Conference on Inventive Research in Computing Applications (ICIRCA),2018.

[7] Ahmed Abdullah Ibrahim "Carbon Dioxide and Carbon Monoxide Level Detector" 21st International Conference of Computer and Information Technology (ICCIT),2018.

[8] Prakhar Srivastava; Mohit Bajaj; Ankur Singh Rana, "Overview of ESP8266 Wi-Fi module based Smart Irrigation System using IOT" Fourth International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB),febraury 2018