Automated Farm Watering System

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***Abstract*— The modern era requires smart solution for the traditional farming which will help to save resources and decrease the chances of human error. Automated Farm watering can be defined as system which uses IoT technology. This modern system increases the quantity and quality of agricultural products. IoT devices provide information about condition of the field and then take action depending in the farmer input. In this paper, an IoT based advanced solution for monitoring the soil condition and atmosphere for efficient crop growth is presented. The developed system is capable of monitoring temperature, soil moisture level using the ESP8266 Wi-Fi module and several sensors connected to it. Also, the system will notify the user in the form of SMS and mail about the environmental condition on the field. The user can also view the soil condition and water pump status using a mobile application connected to the internet.**

***Keywords*— Automated Farm watering, IoT Technology, IoT devices, ESP8266 Wi-Fi, SMS**

I. Introduction

India is a country that is driven by manual irrigation system. Considering the growing population and its effects there is a need of automation in the field of agriculture. In the traditional method of farming, a farmer has to check the water level and then turn on/off the water pump manually due to which sometimes the crops are irrigated even though the soil is moist, this leads to wastage of water and crops. Therefore, it is time to switch to efficient, cost effective and smart automated farm watering system.

The term Internet of Things (IoT) was coined by Kevin Ashton and Gamble in 1999. It is a system of interrelated computing devices with ability to transfer data over network without any human intervention. Agriculture is the major source of income for the large population in India and is a major contributor to Indian economy. Based on the survey it is observed that on average agriculture contributed 27 percent to GDP and provides employment to 70 percent of Indian population based upon 1960-2019 data. IoT has a major impact on the agriculture field by empowering farmers to fight with the difficulties they face.

Nowadays one of the greatest problems faced by the world is water scarcity and agricultural activities require water. Therefore, we need a system which will use water efficiently. Automated farm watering will take into account the moisture content of the soil and maintain the threshold moisture content in the soil without any manual intervention. Thus, the system will save time, money, water and the plant will stay healthy.

This paper proposes an intelligent, fully automated farm watering system. It concentrates on efficient utilization of water using the Arduino Uno. Arduino Programming is used to automate the pump. The system consists of ESP8266 Wi-Fi module, soil moisture sensor, temperature sensor (LM-35), motor driver board, pump. Arduino board is powered by a laptop using USB or an external power source. Messages will be sent to the user via an email whenever moisture level drops below the threshold on real time basis. All the recent data related to pump and soil data can be monitored by anyone having an internet connection. The system is well equipped with modern and accurate equipment which can withstand different environmental conditions.

The proposed automated farm watering system is designed to manage water efficiently by measuring the soil moisture and deciding if water is needed or not. The system also decreases the manual intervention in farming and helps remote monitoring of data thus saving time and energy. Finally, the system is also requiring low maintenance and is easy to use.

II. Literature Review

S.R. Kumbhar and Arjun P. Ghatule (2013) [1] proposed a Microcontroller based controlled remote irrigation system for agricultural plantation. The developed system is placed at the remote location and required water provides for plantation. Whenever the humidity of the soil goes below the set-point value. Humidity sensor provides proportional amount of output with change in humidity, which is compared, to the set-point data is high, then after motor is turned ON, which provides water to the plant till the humidity goes above set-point value. After reaching the humidity above set-point value motor is turned OFF and scans the next channel. This provides right amount of water at right time. The required software program is developed as assembly level language.

Prof C.H. Chavan and P.V. Karnade (2014) [2] proposed a smart wireless sensor network for monitoring environmental parameters using Zigbee. These nodes send data wirelessly to a central server, which collects data, stores it and allows it to be analysed then displayed as needed and also be sent to the client mobile. Weather forecasting and nutrient content is not determined in this system.

Karan Kansara (2015) [3] proposed an automated irrigation system where the humidity and temperature sensors are used to sense the soil conditions and based on that microcontroller will control the water flow. Farmers will be intimated through GSM. This system doesn't monitor the nutrient in the soil.

In [4] the system uses Arduino technology to control watering and roofing of the green house. It uses statistical data acquired from sensors (like temperature, humidity, moisture and light intensity sensors) compared with the weather forecast for decision making. Kalman filter is used to eliminate noise from the sensors. Agriculture System (AgriSys) [5] uses temperature, pH, humidity sensors and the fuzzy inference to input the data from sensors. The system monitors the sensors information on LCD and PC. In [6] Wireless sensing Network with ZigBee technology helps to control air humidity, soil moisture and temperature. System is implemented with components as soil moisture sensor, humidity sensor, temperature sensor, ZigBee, 18F458 PIC Microcontroller, water pump, fan, relay and buzzer. In paper [7], wireless sensor network is integrated with ZigBee to transmit soil moisture level and temperature values. The data is transmitted to a web server using GPRS through cellular network. The data monitoring can be achieved via internet using graphical application. In [8] the paper explains wireless sensor network for sensing soil moisture level, temperature and relative humidity values. Network lifetime of the node is increased by using sleep - wake up plan. The system in this paper implements clustering of nodes. Graphical user interface (GUI) is designed in MATLAB for data handling. The paper [9] defines automation for remote agriculture having sensors and actuators connected to IoT gateway running OPC UA server. Cloud services (installing or configuring process controller) are used to change the control rules without updating firmware of remote sensors/actuators. In [10] WSNs integration with Cloud Computing is described. It provides performance comparison guideline for integrating WSN with Cloud Computing to improve performance and to overcome storage and energy constraints of WSN.
R. Subalakshmi (2016) [11] proposed a paper to make irrigation system simpler, complexities involved in irrigation is tackled with automation system using microcontroller and GSM. Based on the sensed values from soil moisture, temperature and humidity sensors, the GSM sends message to the farmer when these parameters exceed the threshold value set in the program. The soil condition cannot be monitored by the user.
K.K. Namala and Krishna Kanth Prabhu (2016) [12] proposed a paper on prototype of smart irrigation system using Raspberry Pi. The system uses the value of soil moisture sensor to control the water level. The system doesn't provide any means to store the data for future or analytic purpose.
Wenju Zhao and Shrngwei (2017) [13] proposed a LoRa- based smart irrigation system. In this system, the irrigation node is mainly composed of LoRa communication module, solenoid valve and hydroelectric generator. The irrigation node sends data to cloud through LoRa gateways via wireless transmission. The system lacks the notification about the soil condition to the user.
Shweta and Dhanashri (2017) [14] proposed an IoT based solution. The system uses Zigbee for communication between sensor nodes and base station. The farmer can monitor the readings on the mobile applications. The system uses Zigbee whose radio signal ranges ten to hundred meters only.
Ravi Kishor Kodali and Borade Samar Sarjerao (2017) [15] proposed a paper that tries to design a simple water pump controller by using a soil moisture sensor and NodeMCU-12E. A MQTT protocol is used for transmitting and receiving sensor information. Depending on a status of soil moisture content NodeMCU-12E controls a water pump action and displays the soil moisture sensor data and water pump status on a web page.
Raikar, Padmashree, Namita and Sachin (2018) [16] proposed a paper which uses CloudIoT solutions for the irrigation system. The model uses Amazon cloud for collecting temperature and moisture sensor data. MQTT (Message Queue Telemetry Transport) is used for communication, Dynamo DB is used to collect the data. This system does not tell pump and field status on real time basis.

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III. METHODOLOGY

A. *Block Diagram of Automated Farm Watering System*

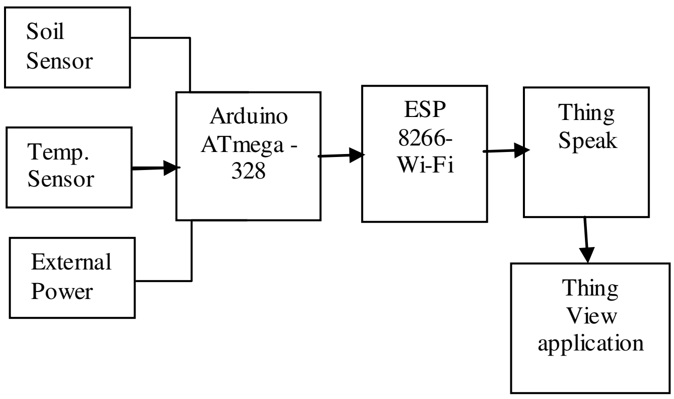

Figure 1: Block Diagram of the Automated Farm Watering System

The Figure 1 shows the block diagram of the system which consists of two sensors that are connected to the microcontroller and sensed values are sent to the mobile application.

Farmers can utilize the monitoring system in order to increase the yield and using the water in controlled manner. This proposed work includes an embedded system for automatic control of irrigation. It contains wired sensors (moisture and temperature sensor) for real time sensing. The system provides uniform and appropriate amount of water required by the soil thus avoiding water wastage. When moisture level in the soil reaches below threshold level the pump is automatically switched ON and once it reaches threshold level it is turned OFF. The sensed parameter (Soil moisture sensor reading and temperature reading) and current status of the water pump will eb displayed on the user application.

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B. Algorithm and flowchart

The algorithm for the overall process can be divided into following steps-

Step 1: Start the process.
Step 2: Connect to Wi-Fi.
Step 3: Read temperature and moisture.
Step 4: Get the temperature and moisture sensor value from Analog Pins.
Step 5: Send data to ThingSpeak API and IFTTT API.
Step 6: Delay to 10 seconds.
Step 7: Repeat Step 4,5 and 6 until the process ends.
Step 8: END.

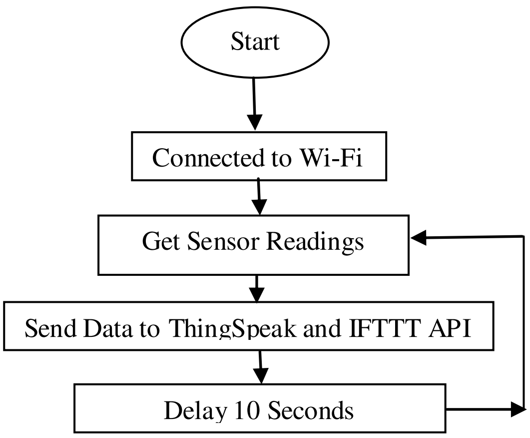

Figure 2: Flowchart of the used Algorithm

C. Results and Discussions

We recorded the process of manual irrigation of three types of plants (rose, snake plant and cactus) for two weeks. The project has given positive results for all the inputs. The expected and actual behaviour has been close enough as was the idea before developing the project.
We set the moisture readings for the rose, snake plant and cactus as 40%, 30% and 15% respectively by hit and trial method.

The test results have been summarized below:

Table 1: Results of Different test cases

Name of Plant	Moisture % set	Test Results
Rose	**30**	The plant dried up a bit on sunny days
Rose	**40**	Plant remained in perfect condition.
Snake Plant	**40**	Over watering of plant happened
Snake Plant	**30**	Perfect water level maintained.
Cactus	**20**	Overwatering of Plant.
Cactus	**15**	Perfect water level

Through the evaluated result from the above table 1 it can be seen that once the correct moisture threshold is set for the sensor, it maintains he required amount of water need by plant without any manual intervention and keeps the health of the plant in good position. Each plant requires a different amount of water which needs to be figured out and calibrated in the sensor post which the process is automated.

IV. Conclusions

The use of Internet of Things for the automation of the irrigation has a wide scope as it analyses the moisture content of the field and accordingly changes the state of the water pump. The created system utilizes the concepts of IoT and empowers the farmer to reduce the man power for the cost optimization and improves the productivity which leads to maximation of the profits.
The discussed model and IoT system design explored in this project can not only be implemented in large fields but also in small settings like a backyard garden, in-door. All the components and designs can be scaled to meet the user’s needs. However, it should be noted that smart farming (as an IoT technology) has not been given much attention. This is because

many of the farming operations usually occurs in remote areas. But given more attention this application has the potential to revolutionize the way farms operate.

This project provided the opportunity to acknowledge the existing systems along with their advantages and drawbacks. The proposed system is used to turn on/off the water pump as per the moisture content of the soil and thereby reducing one of the most time-consuming activity in the agriculture. The system used the information from the soil moisture sensor to irrigate the farm, uses a relay to power the water pump and a temperature sensor to read the surrounding temperature of the field. The system connects with the ThingSpeak cloud in order to store the history of the data and display the real-time readings of the temperature sensor, moisture sensor and water pump. Various operations can be performed on the collected data in order to gain the valuable insights. The ThingSpeak cloud also connects with the IFTTT applet in order to send the notification to the user.

User gets notified whenever the moisture in the field drops below the threshold over SMS and Email. Everything happens in real-time with a minimal latency. The system uses information from the soil in order to prevent the condition of over irrigation or under irrigation of soil and thereby minimizing any chance of water damage. The end user can also monitor the readings using a mobile app which is configured for this project. The app provides the way to user to monitor the field without logging into the ThingSpeak cloud again and again. This project concludes that there can be considerable development in the field of farming with the use of IoT and automation. The proposed system provides a solution to the problems faced in the existing manual process of irrigation by enabling efficient utilization of water and maximizes the profit and provides an intelligent watering method that conserves water through the precise management of the time and amount of watering. In future, information regarding the optimal amount and time of watering may be collected and analysed through the use of big data, which would contribute greatly in increasing the productivity of agriculture and sustainable development.

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