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Farm Automation based on IoT

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Abstract- **The term "Internet of things" refers to a type of network that connects things or objects to the Internet through specific protocols provided by remote sensors, microcontroller, and actuators. So that information and communication are exchanged for intelligent recognition, tracking, positioning, monitoring, management, and control. In smart agriculture, losses of irrigation water and fertilizer are minimized and create a Suitable climate in terms of humidity and temperature to enhance the crops produced on the farm. The objective of this paper, proposing the agricultural field control system using soil moisture, and climate sensors. By observing the changes in these parameters, the irrigation system, temperature, and humidity can be monitoring via the internet and automatically controlled if certain criteria differ from reference values.**

Keywords— IoT, Thingspeak, Soil moisture, DHT11, esp8266

I. INTRODUCTION

While the world is moving towards new technologies and applications, it is necessary to move towards smart agriculture as well. In related work many researchers have been carried out in the field of precision agriculture and most of them have been referred to the use of a wireless sensor network that collects the data of the various sensors deployed in the field in the form of a set of nodes then send it over the wireless protocol [2]. These data from various sensors provide information on the various environmental factors.

The problems in monitoring environmental factors do not represent a complete or optimal solution to increase the productivity of crops. Other factors that are not observed also reduce productivity. To overcome most of these factors and solve these problems, an integrated system should be developed to improve and increase productivity through monitoring, analysis, and automation in agriculture at every moment. However, these integrated systems are not achieved in agriculture due to various problems and issues. Although they have been taken into consideration at the level of scientific research, they are not given to farmers as a product to maximize the use of available resources and thus to increase and improve productivity. The objective of this work discusses the development of smart agriculture using the Internet for things and implement smart system by using some resources available to enhance productivity [5].

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The IoT idea opens up new trends for smart agriculture by connecting remote sensing systems and smart digital systems over the Internet through wireless communication [7]. Modern technology enables low-cost and cost-effective wireless sensor network technology to obtain soil moisture, temperature, and humidity from different locations in the field. Depending on the need of the crop, the irrigation system pumps the appropriate amount of water for the crop to achieve optimal utilization for water. [4]

II. SYSTEM DESIGN

For the automation system to be successfully executed, the system should be able to run a few important tasks automatically and analyze plant growing media according to real-time soil status and plant weather requirements. The delay between collecting data from sensors and sends it to the server for processing to make a decision to convert actuators state must be very short. That means estimating the water, humidity, and temperature needs, pump water into a tank and executing irrigation process by pumping the water into the irrigation line. The system consists of irrigation line, set of pumps and feedback closed loop of soil moisture that measure the soil water saturation level and weather parameters by using the DHT11 sensor to measure humidity and temperature. All the parts of the system divided into a few modules.

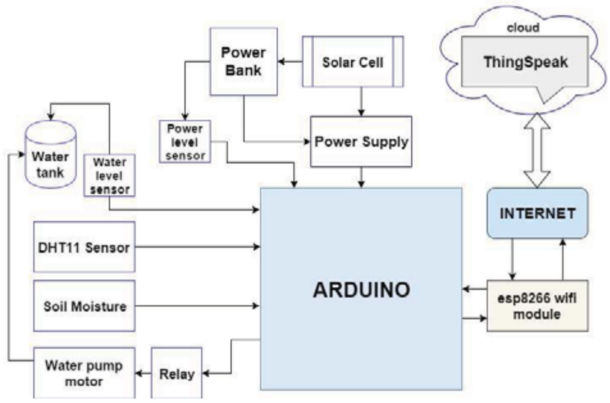

Fig.1. System Design

A. Obtain sensors data

DHT 11 sensor

It's a digital sensor used to measure weather in the field. It gives a digital output value, so we can transfer these outputs directly to Arduino for making a decision to achieve suitable climate by controlling air fans. DHT11 has a capacitive sensor that measures humidity. This sensor has an only real flaw that can get the updated data from it only after every 2 seconds. Its reliability is highly ensured along with an excellent stability.

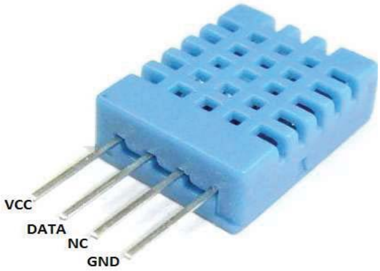

Fig .2.DHT11 sensor

Soil Moisture sensor

This sensor measures the amount of water in the soil using its electrical resistance properties. The relationship between this measured property and the moisture in the soil is analyzed and varies according to different environmental conditions like soil type, temperature or the extent of its connection to the electrification. Here, it is applied to measure moisture in the soil of the field and transfer it to Arduino to make a decision to control the operation or extinguishing of the water pump

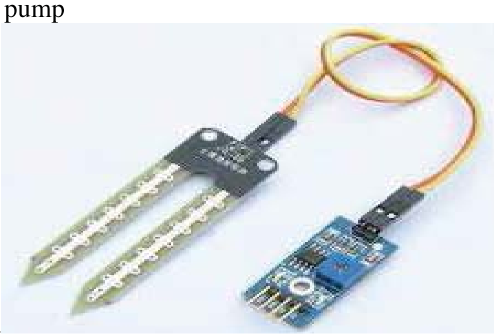

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Fig .3 Soil moisture sensor

HC-SR04 Ultrasonic Sensor

Tank level sensor uses an ultrasound wave to discover the tank water level. An ultrasound is sent from sensor and range to surface of the water discovered by estimating the time needed for the echo return.

Fig.4 Ultrasonic Sensors

B. Wireless Data Transfer and communication

ESP8266 Wi-Fi module

It is a low-cost independent device used for the wireless connection that can be applied to develop the end-point Internet of things. It enables internet connections to integrated applications. ESP8266 use TCP/UDP communication protocol to connect with server/client. Microcontroller use set of an AT commands and specified Baud rate (Default 115200) to communicate with ESP8266 [6].

Fig .5 ESP8266 Wi-Fi module

C. Data collection and cloud database

ThingSpeak

ThingSpeak is an open-source program of the Internet of things launched as a service to support the IOT applications. It allows the creation of logging applications of different sensors and applications tracking websites and social network of things with continuous updates of the status. It stores and recovers collected data from sensors or objects using the HTTP protocol over the Internet or LAN. It has co-operated with programming software such as MATLAB from Mathworks. In order to analyze data and visualization, no need to buy MATLAB in MathWorks. Thingspeak preserves cordial connections with Math Work. It does not need to have valid login ID for ThingSpeak web if the user is a client of MathWorks.

At the core of Thingspeak is a Thingspeak Channel. The received data from sensors stored in the channel. Any channel contains 8 fields for several types of data, 8 fields for data, and 1 field for status. To publish data on Thingspeak server we must have a channel on Thingspeak, data processing, and then have application retrieve the data [3]. The collected data which stored in Thingspeak channel database can be easily recovered as excel file.

D. Data Processing and Real-time Decision making

Arduino

Arduino Uno will be used as the main system's controller for operating the proposed automation system. It's commonly used in many applications as it gives an excellent processing. Also for running the system smoothly, the tasks should be executed one after another and repeated the entire task after the specific time gap.

III. EXPLAINING THE SYSTEM DESIGN

The sensors are connected Arduino and power supply is given. The Arduino reads the values from Sensors and posts the information to the cloud server (Thingspeak server). If the values are less than the already set threshold values, then the relay switches ON the actuators (pumps or fan). The actuators stay in ON condition till the factor that is less than the threshold value reaches the threshold value. When the threshold value is reached, the relay automatically switches off the actuators.

IV. Automation of Irrigation System

The proposed automated irrigation system will be designed by dividing the system into several tasks which were hardware implementation, software implementation, and prototype testing. The hardware is a major part of executing the automated weather and irrigation system that makes it possible to run all the specific tasks. All the physical processes involving the system only can be accessed by the hardware after instructions were executed by the microcontroller.

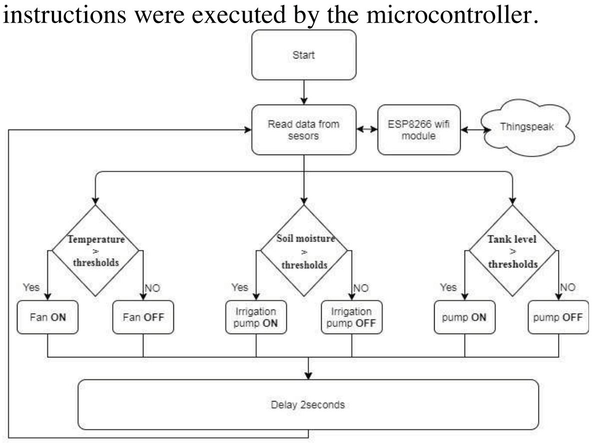

Fig. 6 The process flow for automation system

V. RESULTS AND DISCUSSION

The automation system is implemented and tested under different conditions. The soil moisture is tested in all soil cases and results are translated successfully. The temperature reading was taken under various climate conditions. all actuators ran smoothly and automatically when thresholds conditions variated.

The wireless communication was achieved using ESP8266 wifi module.The data was stored in Thingspeak channel database using PHP script.The data was recovered successfully from channel database which is used for monitoring purpose. The input voltage resistance values for different soil cases obtained are described in Table I.

Table I Soil resistance value in different cases of soil from sensor

parameter	Soil case	Minimum Value	Maximum value
Operating voltage	--	3.3V	5V
Result value	saturate	0 Ω	550 Ω
	humid	551 Ω	885 Ω
	Dry	986 Ω	1023 Ω

The result of a monitored system on Thingspeak channel shown in figures below.

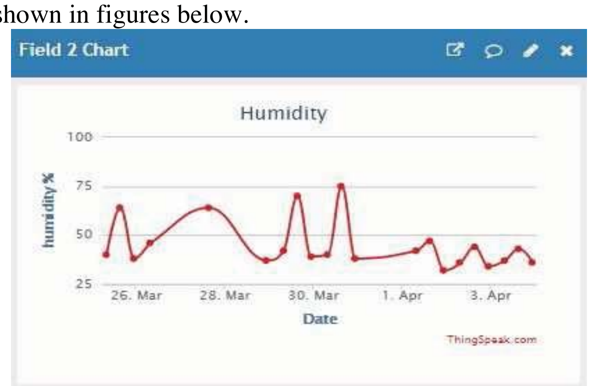

Fig.7 Humidity vs date

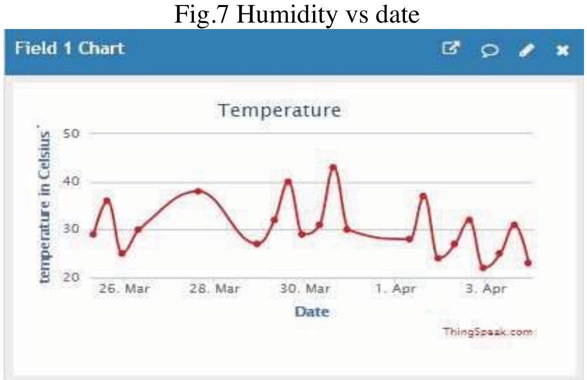

Fig.8 Temperature vs date

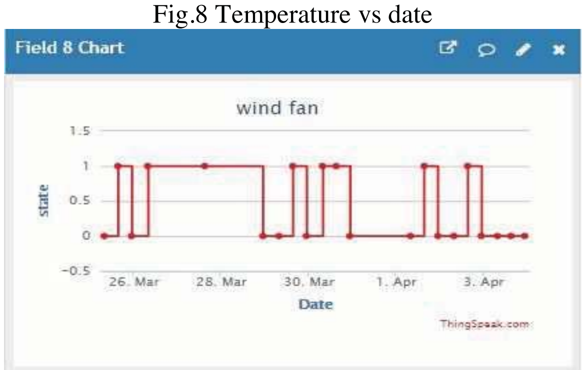

Fig.9. Wind fan state vs date

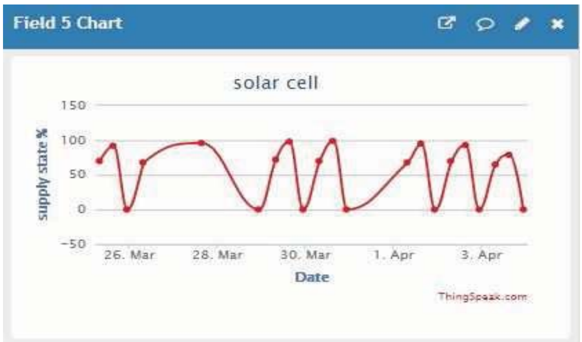

Fig.10 Solar supply state vs date

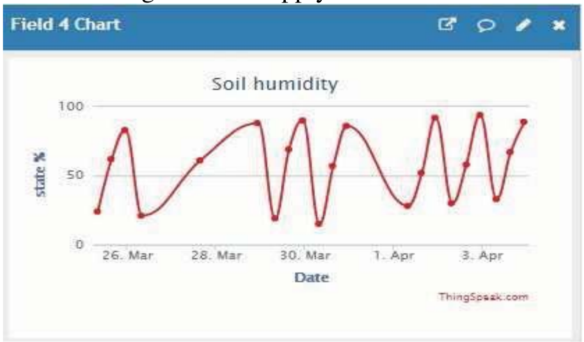

Fig.11 Soil humidity vs date

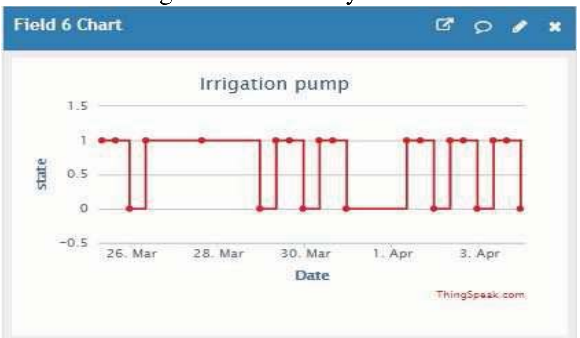

Fig.12 Irrigation pump state vs date

Fig.13 Tank water level vs date

Fig 14 Tank pump state vs date

VI. CONCLUSION

The automatic irrigation system has been designed and implemented in this paper. The system improved is useful and works in a cost-effective practice. It decreases the water loss to a greater range. It needs minimum maintenance the power waste has been reduced very much by using solar cells. The system is applied in greenhouses. The System is very useful in fields where water deficiency is a major problem. The crop's productivity improved and the wastage of crops are very much decreased using this irrigation system. The automated system is more effective and gives more achievable results. The extension work is the prediction of crop water needs using data mining algorithms in which we are currently progressing. The prediction helps to supply the right quantity of irrigation to the crops.

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