Aadhunik Krishi - IoT based Smart Farming

Niharika Agrahara, Amit Kushwaha, Saayali Vispute, Arshad Ubare, Siuli Das
Department of Instrumentation Engineering,
RAIT, Nerul, India

Abstract—**Agronomy has a significant contribution in shaping and boosting the economy of the developing nations especially India. The issues faced by the agricultural zones are hampering the growth of these economically developing nations. One technique to solve this problem is to digitize farming and other agricultural activities by replacing the current prediction-based method with smart and analyzed farming. Hence the proffered work aims to automate agriculture using IoT and other wireless technologies. In this paper, an Internet of Things based automatic crop monitoring and watering system, is proposed to modernize agriculture and increasing the yield of the crop. The major benefit of this proposed work is the implementation of precision agriculture with cloud computing, which will control the usage of water and monitor other plant parameters (soil moisture, temperature, humidity and air quality index) thus enhancing the yield of the crops.**

Keywords—Irrigation System; Precision Agriculture; IoT; ThingSpeak.

I. INTRODUCTION

The Smart agriculture monitoring system is the prominent technology through which data from several agricultural fields can be collected using different sensors. The collected data are analyzed by professional operators, workers and farmers to draw the conclusions based on different climatic patterns, soil fertility, nature of crops and the amount of water that needs to be supplied to the field. Smart farming can be further advanced by automating several parameters that are essential for the plant growth. We can apply anticipating algorithms and programs on microcontrollers for the calculation of water that will be required for every agricultural area [1].

IoT has been introduced to the proposed work in order to reduce the physical labor work involved in collecting the crucial agricultural information about soil moisture, humidity, temperature and air quality. If physical labor is involved in the operation, we have to appoint several personnel to different agricultural sites to collect the data and there will be no or limited accuracy in the data since it may be manipulated by human errors which would hinder the conclusion of the professionals and farmers. Using IoT we can send the collected data directly to a centralized server(cloud) through a Wi-Fi Module, NRF Module in real time [2]. Since the collection of data is automated, the data integrity is secured and experts may draw most accurate predictions.

II. RELATED WORKS

The current technique used in the field of agriculture is to manually check the parameters. In this method the farmers themselves compare all the parameters through the data and evaluate the readings. It emphasizes on developing the devices and tools that will be able to display, manage and notify the users. This is done by the application of a wireless sensor network. It focuses on automating the agricultural techniques using wireless communication and IoT technologies. Some of the related works are reported here.

The proposed theory in [3] is intended by taking into account the need of a Sugarcane crop as per the weather conditions in India. The Wireless Sensor Network in agricultural zone is the current evolving technique for the data acquisition and transmission in the field. This is a compact and inexpensive work flow where the data collected is transmitted to a location using a GSM network using a SMS. The concerned person may use the obtained information for monitoring and parametric control in order to increase the quality of crops. This in turn leads to the improved production.

A prototype for automatic controlling and remote accessing of irrigation motor consisting of three things – wireless sensor node, controller node and a smart phone is reported in [4].The node that senses the soil moisture is deployed in the field which has to be irrigated and the controller node receives the data sensed by the sensor node. Once the data is received, this data is compared by the accepted value of soil moisture by the controller node. If soil moisture is less than the prescribed level then the pump is activated to irrigate the field and simultaneously the registered mobile phone receives a SMS.

The GSM based Zigbee Controlled Solenoid Valve used for drip irrigation system is proving to be a real time control system which can observes as well as analyzes the workflow of drip irrigation efficiently [5]. With the use of this system, the manpower, water and power consumption can be saved and reduced by 20% and 30% as to the existing ones. The Drip irrigation system based on the microcontroller being a real time feedback control system can monitor as well as control the workflow of the system efficiently [6]. The current system is a prototype designed in order to modernize the agricultural sectors at a larger scale with minimum expenses. This is done by monitoring the weather conditions (parameters) and thus providing the required data to the concerned person.

The use of WSN over the wired one assists in its decaying in any type of climatic conditions for monitoring, flexible and robust in nature. The usage of FPGA element eases the system for re-configurability and re-programmability in accordance to various climatic conditions [7]. The percentage of potassium, phosphorus, nitrogen are measured by fertility meter and pH meter. Post measuring the fertility of soil, this work implements an automatic wireless DRIP irrigation technique. Some advantages of this wireless sensorbased irrigation are preventing moisture stress of trees, diminishing of excessive water usage, ensuring the rapid growth of weeds, measuring the fertility level of soil [8].

A system with high speed of operation for an advanced agriculture process which includes cultivation based on robotic platform is reported in [9]. The robotic system is an electromechanical and artificial agent which is steered by DC motor which has four wheels. The microcontroller is used to control and monitor the process of system motion of vehicle with the help of DC motor.

The implementation of automated agricultural system [10] uses WEB and GSM technologies. This embedded work is to design a low cost system and to develop in such a way which is based on embedded platform for agricultural automation. This project uses soil moisture sensor and temperature sensor and level sensor. GSM and WEB technologies are used to monitor the running status of the sensors.

III.PROPOSED WORK

This work is based on the principle of recognition and transmission of data from sensors to the user. The sensors which are the primary sensing sources produce data information and transmit it to the user through an interconnected Wi-Fi module. This will enable the kit to compare statistics with the standard values and allows the processing unit to analyze and alter the changes in the farming sector.

A. Hardware

The orthodox method of monitoring the agricultural environment requires personnel to go and manually take measurement and check them at regular intervals. To eradicate and avoid such circumstances, this work has been developed which will help the farmers in such situations where they are unable to reach and monitor the agricultural land regularly. Sometimes, the crops in agricultural areas may run out of moisture content due to sudden climatic change, during these times this work will help to provide water to the crops at stringent time and in specific quantity even in the absence of the farmers. The sensor will acquire and transfer the data to the system to which the system will respond by testing out specific amount of water in the field according to the crop requirement. The tank from which the water will be drawn is taken into account using a level sensor to ensure the availability of water during the process.

The other parametric measure includes the air quality, temperature and humidity measurements. This work acquires such data through the MQ135 (air quality) and DHT11 (humidity and temperature) sensors which are encased in the system. This sensed data is sent and stored in the cloud for the farmers to access it for further operations during farming. The entire process is depicted in Fig1.

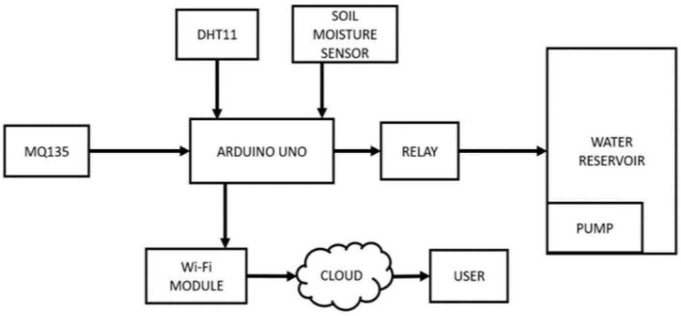

Fig 1. Block Diagram

This operation will be done using a Wi-Fi module for data transmission and a dedicated local cloud platform i.e. ThingSpeak where one can view the graphical representation of data flow and use it for further analytical operations. The prototype is as shown in Fig 2.

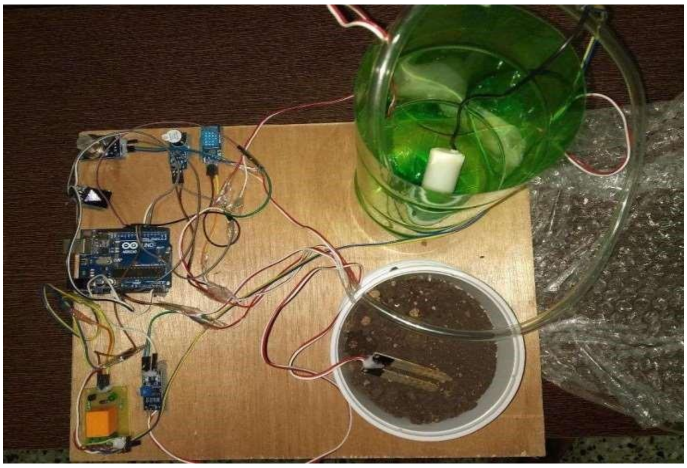

Fig 2. Prototype

B. Software

The first thing in ThingSpeak is to sign up by entering the email address and other required credentials asked as shown in Fig 3. By doing so, the channel will be ready, but certain changes are needed to receive the data from the sensors. In ThingSpeak, the data will be stored as private by default but this channel can also be made public in order to share data among people, Once the data is on ThingSpeak, one can analyze it, create new data from it and send the data to other devices [11].

The API key is a private key consisting of letters and numbers and it is used to identify and write values to the particular channel. This is written in the given space, shown in Fig 4. The API key is kept confidential to prevent other users from using the same channel. This API key will be written in the program code of the project.

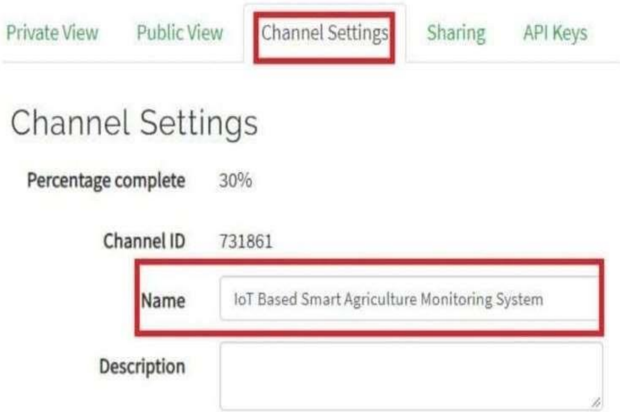

Fig.3.Creation of channel

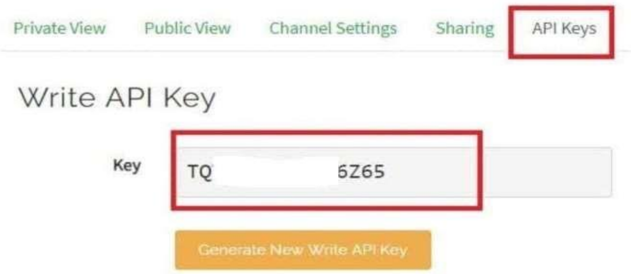

Fig 4. API Key

IV. RESULT AND DISCUSSION

Creation of channel and fields in ThingSpeak shows the present time status of six parameters that can be seen graphically as laid out in the figures This proposed work will keep an eye on the workflow of the entire agricultural system constantly and reflects the same via digital platform.

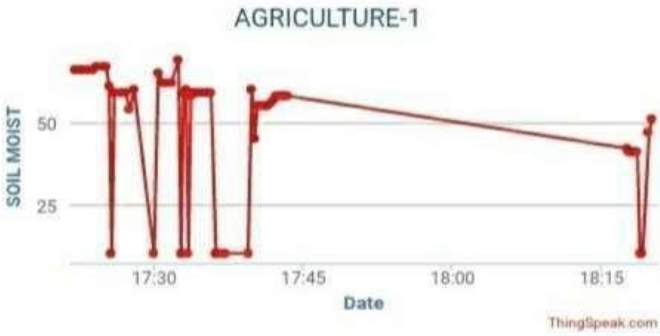

Fig 5. Soil Moisture

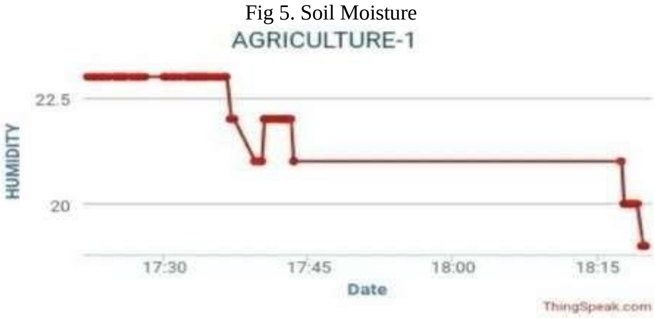

Fig 6. Humidity

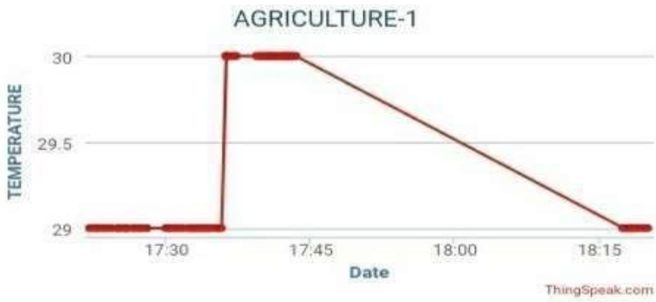

Fig 7. Temperature

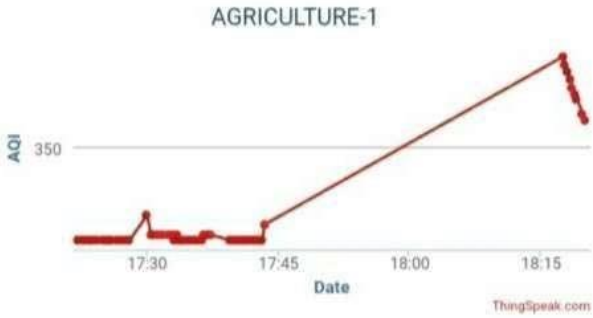

Fig 8. Air Quality Index

Fig 9. Pump Status

Fig 10. Tank Status

When immersed in different types of soil, the variation in the level of soil moisture is shown in Fig 5.

The variation of humidity due to temperature and surrounding conditions is shown in Fig 6. Humidity requirement of various crops is different so according to the humidity range shown graphically the farmers can choose a particular crop that fits the range.

Similarly, the temperature requirement also varies .The graph shown in Fig 7 depicts the temperature variation with surrounding environment. If the crop selected by farmer meets the temperature and humidity values of the surrounding, the farmer can go ahead with that crop else the crop needs to be changed with another that meets the

The changes in Air Quality Index (AQI) is shown in Fig 8. If any gas is present in excess quantity, the graph will show an increase in AQI value indicating the farmers not to grow crop in this particular environment. The operational condition (on-off control) of the pump is indicated by graph shown in Fig 9.
Once the moisture content in soil decreases, the pump starts to supply water through the tank whose status is shown by graph in Fig 10. These graphs can be analyzed for further predictions regarding plant yield.

In this way, this proposed work will help the farmers to access data and ensure the better yield of crops by differentiating between several variety according to its growth in such conditions.

V. CONCLUSION AND FUTURE SCOPE

Thus, this entire system establishes field automation in agriculture that makes easier for the farmers in certain farm related operations. The present condition of the field can be analyzed by Several Analytical Graphs and can help in taking specific measures for the betterment of crops. The Temperature and Humidity data sensed by the sensor can be used for statistical analysis of data regarding the climatic conditions in the past and predict the future for proper growth of crops. In future, the data collected from the sensors can be compared with the standard values of the crops that needs to be entered in the database. After the comparison, the controller will get to know which crop is suitable for a particular climatic condition and will accordingly grow that crop to get better yield. This will help in increasing the agricultural production and reducing the time and cash expenses of the farmers. Thus, over a period of time, smart farming will revolutionize the ancient means of farming in this fast-growing world.

ACKNOWLEDGEMENT

We are highly indebted to Dr. Siuli Das for her guidance and constant supervision as well as for providing necessary information and ideas regarding the project. Without her help it would have been be a tough job for us to accomplish this task. It was the consistent guidance, encouragement, dedication and rich knowledge of our guide that motivated us from beginning till the end of our project. We also thank our Head of the Department (Instrumentation) Dr. Sharad. Jadhav for providing us all the support and the necessary facilities regarding the project.

REFERENCES

[1] N. Rajeshkumar, B. Vaishnavi, K. Saranya and C. Surabhi, "Smart crop-field monitoring and automation irrigation system using IoT", International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue:03, Mar 2019.
[2] Bhagyashree A. Tapakire and Manasi M. Patil, " IoT based Smart Agriculture using ThingSpeak" , International Journal of Engineering Research & Technology (IJERT) , Vol. 8 Issue 12, December-2019.
[3] Anjum Awasthi and S.R.N Reddy, "Monitoring for Precision Agriculture using Wireless Sensor Network", Global Journal of Computer Science and Technology Network, Web & Security, Volume 13, Issue 7, Version 1.0, 2013.
[4] R. Jaichandran, A. Anthony Irudhayaraj, Surabhi, Rajkumar Kuila and Trisha Sinha, "Prototype for Automatic Controlling and Remote Accessing of Irrigation Motor", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 1, Issue 4, June 2013.
[5] Jyothipriya.A.N. and T.P.Saravanabava, "Design of Embedded Systems for Drip Irrigation Automation", International Journal of Engineering Science Invention ISSN, Volume 2, Issue 4, PP.34-37,April 2013.
[6] Prathyusha.K, G. Sowmya Bala and K. Sreenivasa, Ravi, "A Real Time Irrigation Control System for Precision Agriculture Using WSN in Indian Agricultural Sectors", International Journal of Computer Science, Engineering and Applications (IJCSEA), Vol.3, No.4, August 2013.
[7] Swarup S. Mathurkar and D. S. Chaudhari, "A Review on Smart Sensors Based Monitoring System for Agriculture", International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-2, Issue-4, March, 2013.
[8] Rashid Hussain, JL Sahgal, Anshulgangwar and Md.Riyaj, "Control of Irrigation Automatically By Using Wireless Sensor Network", International Journal of Soft Computing and Engineering (IJSCE), ISSN: 2231-2307, Volume-3, Issue-1, March 2013.
[9] Dattatraya Gholap Dipak, Mhatardev More Vaibhav, Shrihari Lokhande Manojkumar and Joshi S.G, "Robotic Agriculture Machine", International Journal of Innovative Research in Science, Engineering and Technology, April 2014.
[10] Vidadala Srija and P. Bala Murali Krishna, "Implementation of Agricultural Automation System using WEB and GSM Technologies", International Journal of Engineering & Science Research, ISSN 2277-2685, Vol-5, Issue-9, September 2015.
[11] Sharmad Pasha, "Thingspeak Based Sensing and Monitoring System for IoT with Matlab Analysis", International Journal of New Technology and Research (IJNTR), ISSN: 2454-4116, Volume-2, Issue-6, June 2016.