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Predictive Analysis of Crops Cultivation for a Smart Green Environment Using Azure Services

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Abstract*: Internet of Things is a pervasive field and can be efficiently implemented in the agriculture sector. Internet of things can revolutionize the world today making it more efficient and smart. Agriculture is very essential in a country and integrating it with Internet of things (IoT) technology can take automation in agriculture to a whole another level. Ever increasing population brings with an increase in demand for food and to sustain the farming must be made more productive. IoT enhances the agricultural productivity by providing the farmer with information about soil moisture, temperature, humidity and acidity of the soil. This research work implements a practical system which deals with monitoring the crop field through a wireless network of sensors (light, humidity, temperature, soil moisture, water level indicator etc.) along with automating the irrigation system based on several field constraints. The farmers can monitor the farm conditions through a web app from anywhere, anytime and receive timely notification about the changes in the farm. This makes IoT based farming highly efficient when compared with the conventional cultivation approach. IoT technology and predictive data analytics can be used to enhance the agricultural productivity by providing the farmer, information about soil moisture, temperature, humidity and acidity of the soil. In IoT-based farming, the crops are monitored with the help of light, humidity, temperature, soil moisture and Ultrasonic sensors along with automating the irrigation system. Even in case of environmental issues, IoT based farming provides great benefits like more efficient water usage and optimization of fertilizers and plant treatments. The article aims in making use of IoT technology for smart agriculture. ThingSpeak Math works IoT platform is used for analyzing and presenting agriculture fields sensor data. The major objective of this paper is to collect real-time sensor data of a green environment and make predictions on crops cultivation pattern based on the weather condition through MS Azure IFTTT services.

Index Terms: Internet of Things, Smart agriculture, Cloud Computing, IFTTT, Wireless Sensor area network, Thing Speak cloud, Azure Web App

I. INTRODUCTION

Internet of things can revolutionize the world today making it more efficient and smart.

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When agricultural is integrated with IoT technology, it can take the agricultural production to a whole new level [7]. Due to lack of proper technology and monitoring, farmers suffer a great loss which not only leads to a decrease in productivity but also weakens the economy. Ever increasing population brings with it an increase in demand for food and to sustain this demand, the farming must be made more productive. The agricultural productivity can be enhanced by acquiring basic parameters like soil moisture, temperature, humidity, the acidity of the soil, air quality. The traditional methods of irrigation can be replaced by modern ways which support organic cultivation of crops and judicial use of water and enhance the quality of crops. Detecting the soil moisture through sensors can help save water by up to 53%. This combined with the Internet of things can reform the agriculture system as we can monitor the various factors related to the farm and alert the farmer accordingly.

II. LITERATURE SURVEY

IoT infrastructure can provide numerous solutions to everyday problems [9]. Various methods have been proposed by numerous researches and projects have been implemented to enhance the agricultural productivity and to ease the irrigation system by various methods [10]. An interdisciplinary model deploying cloud computing and big data analysis along with a sensor module to measure soil and weather parameters was implemented in [1]. The farmer was provided with valuable information like which crop to grow next for better yield and what nutrients the soil requires. The concept of precision agriculture through the use of wireless sensor networks is deployed in [2]. This provides assistance to the farmer to make the right decisions by setting up links between the agronomists and farms. An expert system helping the farmer to save his crops at an early stage from pests, insects, and diseases is built in [3]. Various modules in monitoring interface like irrigation planner, crop growth monitoring and calculating the water need through evapotranspiration method are implemented in [4]. Management of the farm through AI or the farmer's commands is achieved in [5]. All the data collected like humidity, water level are sent to an Android Automated device (AAD) which then sends it to the data center. A low power consumption IoT network for agriculture is realized in [6].

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It utilizes solar power and optimizes sleep time of sensor nodes for an enhanced lifetime, at the same time being cost friendly.

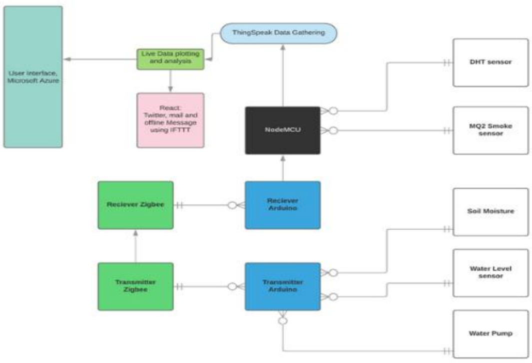

Fig.1 Precision Agriculture UML Diagram

III. WORKING

This research work collects data from different types of sensors over the local wireless network to cover every corner of the farm. A wireless network is necessary to cover the entire farm [11]. The collection and analysis of the data are done at the edge and then sent to the cloud for further analysis and notifications. Cloud computing provides an efficient way to work on the data produced [8]. The farmer gets alerts by notifications in his/her mobile through an app, email and text message. The system for the farm also provides information about the condition of the soil moisture content, pump etc. through tweets in regular intervals. Visualization of the collected data is done via Microsoft Azure Web App services and ThingSpeak cloud environment so that the farmer can monitor the crop condition just by entering the URL in his browser.

Precision Agriculture Hardware Module:

A. Xbee S2C RF communication module

DIGIKEY Xbee S2C transceiver module is used to provide the wireless communication between the two nodes of the system. It is a low power (1mW) RF module with the ability to form a mesh network which works on the DIGI-mesh network protocol and supports the range of 1.6km.

B. Arduino microcontroller development board

Arduino microcontroller board has an Atmel Atmega328 MCU on-chip with 16 MHz crystal operator and 32KB flash memory with 2KB SRAM. It is a low-cost microcontroller board which several digital and analog I/O pins for data acquisition and transferring with inbuilt ADC unit.

C. ESP8266 NodeMCU

NodeMCU is used as a gateway to send the data to the Thing speak cloud environment. NodeMCU is based on ESP-12 module and the processor ESP8266. It has a flash memory of 4MB.

D. DHT-22 sensor

It is a low-cost, low-power consuming temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the temperature of the air and gives a corresponding digital signal which can be read by the microcontroller. DHT-22 can read temperatures from -80o C to 55o C and humidity from 0 - 100% with 2-5% accuracy.

E. Soil Moisture sensor

The soil moisture sensor is used to measure the moisture content of the soil by inserting the two probes of the sensor in the soil and measuring the conductance of the soil between the two probes which is directly proportional to the amount of moisture present in the soil and thus generate a corresponding analog or digital signal.

(i) Physical Layer

The physical layer consists of all the hardware including the sensors, like temperature sensor, ultrasonic sensor for water level detection, a soil moisture sensor, Arduino Uno development board for data acquisition and manipulation, ZigBee modules for wireless communication, an ESP8266 module which is used as a gateway to the cloud and a pump actuation unit.

The physical layer is further divided into

a) Transmitter: The transmitter side sends the water level, soil moisture content, temperature and humidity of the field to the receiving unit. Transmitting Arduino is interfaced to a Zigbee router. This router sends it to a Zigbee coordinator which is interfaced to the receiving Arduino.

b) Receiver: After receiving the data through the Zigbee coordinator, the Arduino board is programmed to control the pumping unit on the basis of the content of moisture in the soil and amount of water in the reservoir. When the soil moisture level is below a threshold value and if the water in the reservoir is sufficient then the pump is switched on. For example, the water level status can be defined in three ways that are- very low, half-filled and full represented by 0, 1 and 2 respectively. The Arduino board serially transmits all the data it received to the NodeMCU which is the gateway to the cloud.

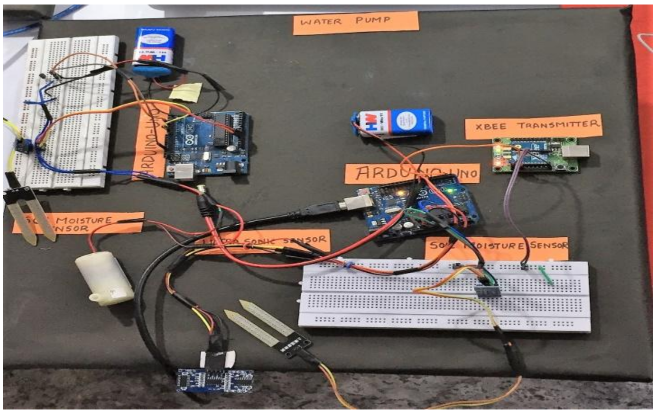

Fig. 2(a) Prototype -Transmitter section

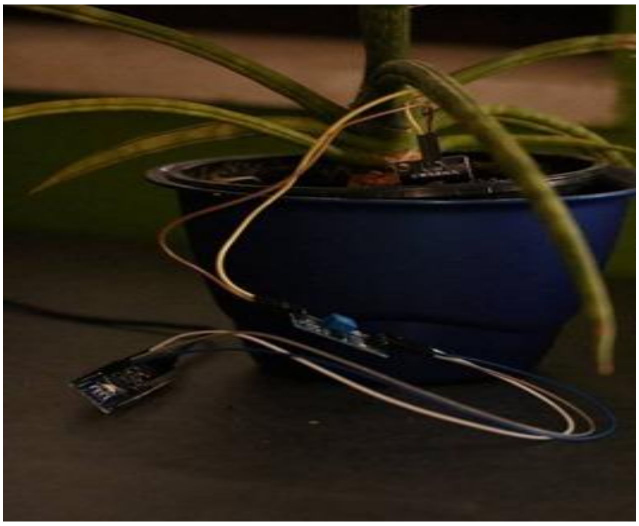

Fig. 2(b) Soil with connected sensors illustration

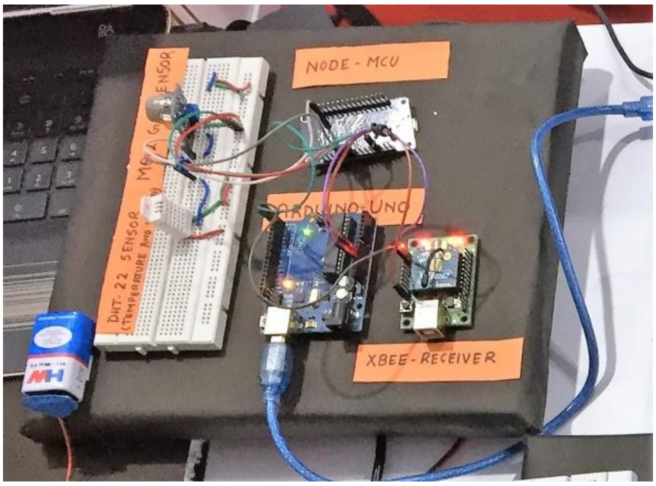

Fig. 2(c) Prototype -Receiver section

(ii) Cloud Layer

The sensor data is pushed to ThingSpeak for further analysis. The data is posted at regular intervals of 30 seconds to the cloud and a real-time graph is plotted for the incoming data. For predictive analytics of the sensor data ThingSpeak MATLAB analysis tools are used to make predictions on the crop field status. The data is stored and maintained in the ThingSpeak cloud. The average temperature, humidity, soil moisture content, the minimum and maximum temperature for the day and various other parameters are visualized using MS Azure data visualization console.

(iii) Alert/React System

When any of the field parameters crosses a certain value, the farmer is notified by three ways - notification in mobile, an email or an offline message. A Twitter account has also been set up to regularly to tweet about the condition of the farm.

To trigger a reaction, we are using if this then that (IFTTT) services, which contains Webhooks services. An applet is created to send a notification, mail and a message by using Webhooks application, which runs whenever the URL of the applet is pinged. The applet is pinged whenever the threshold value of the field parameter is reached. To Tweet, Twilio service by ThingSpeak cloud is utilized.

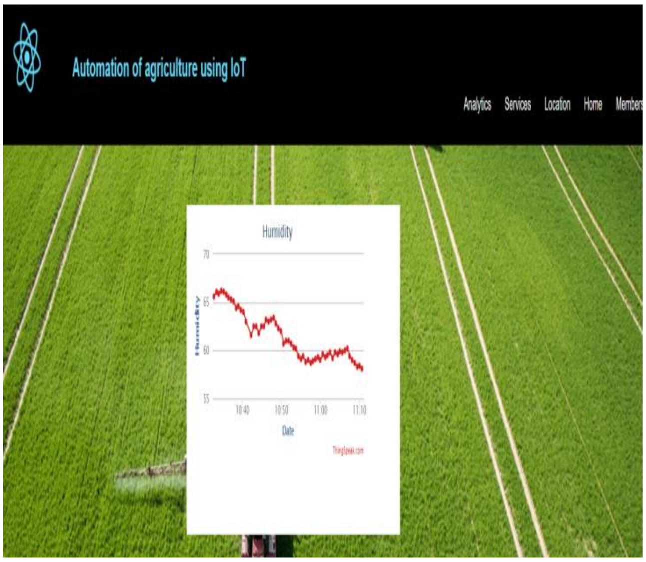

Fig. 3 Field wise data Visualization

IV. CONCLUSION

In this paper, a successful model to tackle the common challenges faced by the farmer and to make predictions about the crops yield are presented using Sensors, ThingSpeak cloud environment, and MS Azure services. The data is acquired from different parts of the farm through wireless communication between different sensor nodes and this data is then sent to the cloud. The analysis is done at the edge before it is placed in the cloud. The farmer is notified via email, text message and through a notification in his smartphone taskbar. It enables the farmer to monitor the field in real time using a custom-created web application. Implementing this system, we can make the farm more productive and ensure improvement in the quality of organic crops and its yield.

V. FUTURE SCOPE

An initial framework is built here to improve the overall working of the farming process. The system keeps the farmer well informed about his farm condition. Many areas in agriculture that can be made smart are yet untapped. We aim to help the farmer in selecting the suitable crop in accordance with the type of soil in his field and determine the right time for the crop rotation by monitoring various parameters like the acidity of the soil, nutrients in the soil, temperature of the soil through various sensors. The system can be improved to reduce the pesticides used based on the predictions we make using machine learning algorithms in the cloud.We also plan to create a database for the essential requirements of soil parameters for different types of crops for regions like Israel where soil fertility is very worse to advise the farmer on which
soil what type of crops can be cultivated. A major threat to the farm is pests that cause damage due to plants, which we also consume.

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In the future, research can be carried out to cultivate organic crops by applying Deep learning principles for the data that we collect from the fields.

REFERENCES

1. Hemlata Channe, Sukhesh Kothari, Dipali Kadam, "Multidisciplinary Model for Smart Agriculture using Internet-of-Things (IoT), Sensors, Cloud-Computing, Mobile-Computing & Big-Data Analysis," Int.J.Computer Technology & Applications, Vol 6 (3),374-382.
   Ojas Savale, Anup Managave, Deepika Ambekar, Sushmita Sathe, "Internet of Things in Precision Agriculture using Wireless Sensor Networks," International Journal Of Advanced Engineering & Innovative Technology (IJAEIT).
2. Raheela Shahzadi, Muhammad Tausif, Javed Ferzund, Muhammad Asif Suryani, "Internet of Things based Expert System for Smart Agriculture," (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 7, No. 9, 2016.
3. Domain Mohanraj I, Kirthika Ashokumar, Naren J, "Field Monitoring and Automation using IOT in Agriculture," 6th International Conference On Advances In Computing & Communications, ICACC 2016, 6-8 September 2016.
4. A V L N Sujith, K Chandra Sekha," Automated Agriculture as a Service Using IoT," International Journal of Advanced Research in Computer Science and Software Engineering, Volume 7, Issue 5, May 2017.
5. Heble, S., Kumar, A., Prasad, K. V. V. D., Samirana, S., Rajalakshmi, P., & Desai, "A low power IoT network for smart agriculture," 2018 IEEE 4th World Forum on Internet of Things (WF-IoT),2018.
6. Andreas Kamilaris, Feng Gaoy, Francesc X. Prenafeta-Bold´u and Muhammad Intizar Aliy, "Agri-IoT: A Semantic Framework for Internet of Things-enabled Smart Farming Applications," 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT).
7. Jayavardhana Gubbia, Rajkumar Buyyab, Slaven Marusic, Marimuthu Palaniswami , "Internet of Things (IoT): A vision, architectural elements, and future directions," Future Generation Computer Systems 29 (2013) 1645–1660
8. Georgakopoulos, D., & Jayaraman, P. P. (2016), "Internet of things: from internet scale sensing to smart services," Computing,98(10),1041–1058.,doi:10.1007/s00607-016-0510-0
9. Partha Pratim Ray, "Internet of things for smart agriculture: Technologies, practices and future direction," Journal of Ambient Intelligence and Smart Environments 9 (2017) 395–420
10. Li Li, Hu Xiaoguang, Chen Ke, He Ketai, "The Applications Of WiFi-based Wireless Sensor Network In Internet Of Things And Smart Grid," 2011 6th IEEE Conference on Industrial Electronics and Applications.