International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-9 Issue-3, February 2020

Smart Crop Monitor using Internet of Things, Cloud, Machine Learning and Android App

Yamini U., Taha Sufiyan, Thankam Paul, Suyash Gupta, R. Chinnaiyan

Abstract: ***This paper describes a Smart Crop Monitoring system implemented using Internet of Things (IoT) for sensing environmental conditions and forwarding the data, Machine Learning to generate decisions for crop management based on the data, Cloud for storage and an Android application interface for operation of the system.***

Keywords: Smart Crop Monitoring, IoT, Machine Learning, Cloud, Android.

I. INTRODUCTION

Agriculture plays a vital role in an agro-based country like India where 70% of the population depends on farming and agriculture is responsible for one-third of the country's capital. Moreover, it is extremely important for us as an active part of humanity to be sensitized to the harrowing plight of farmers in our country. The Smart Crop Monitor yearns to alleviate this by providing an easy, automated system that monitors crops in regular periods and based on the observations for temperature, humidity, soil moisture and light, and may perform certain actions such as switching on an artificial light source in case of low light, or a motor for water if the soil moisture level is low. It also provides a transparent means of communication between the farmer and the device via an android app that keeps the farmer updated about the conditions. The external sources are switched off as soon as the required levels for a crop are matched. This is a major advantage of the system because one of the main problems in agriculture is the wastage of resources, and with this system, only the exact amount of resource required is utilized. Minimizing wastage means maximizing produce and profit.

II. EASE OF USE

A. Android Application

The user-friendly android app is used to select the crop, check the required conditions for it and control the external devices for resource management.

Any action taken by the device is communicated to the farmer via the app.

B. No Manual Intervention Required

The sensing and analysis of the conditions, comparison with the required conditions and resource provision on requirement is done automatically by the system and does not require any manual intervention.

III. MOTIVATION

As a result of global warming and the mammoth increase in population, it is imperative that resource utilization is maximally optimized to prevent wastage. A Smart Monitor largely depends on automatic sensing of the environmental conditions and analysis of the large amounts of data generated, for which IoT and Machine learning are used. Sensor knowledge has also been innovative and several kinds of sensors like environmental sensors, gas sensors are developed and used in applications as per the need. Cloud-Computing and Mobile-Computing interface are established technologies and use cases exists in practically each field using the foresaid technologies. With the help of the foresaid technologies in agriculture and the respective tools and technologies used for improvement in this domain.

A. Sensors and Devices

This layer consists of Temperature and Humidity sensor, Light sensor, soil moisture sensor, relay switches, water pump, and greenhouse lights. The devices and sensors are connected to the Arduino.

The sensors are used to collect data from plants and the atmosphere while devices like water pump and the greenhouse lights turn on and off according to the actual conditions of the environment. The relay switches are used to control the water pump and the greenhouse lights.

- Soil moisture sensor measures the volumetric content of water inside the soil and gives the moisture level as output.
- Temperature and humidity sensor measures the real-time weather conditions.
- Light sensor provides the real-time light conditions.

Revised Manuscript Received on February 05, 2020.
* Correspondence Author
Yamini U., Department of Information Science and Engineering, CMR Institute of Technology, Bengaluru, Karnataka, India.
E-mail: uyamini1996@gmail.com
Taha Sufiyan, Department of Information Science and Engineering, CMR Institute of Technology, Bengaluru, Karnataka, India.
E-mail: tahasufiyan@gmail.com
Suyash Gupta, Department of Information Science and Engineering, CMR Institute of Technology, Bengaluru, Karnataka, India.
E-mail: gupta.suyash25@gmail.com
Thankam Paul, Department of Information Science and Engineering, CMR Institute of Technology, Bengaluru, Karnataka, India.
E-mail:thankamp20@gmail.com
Dr. R. Chinnaiyan, Associate Professor, Department of Information Science and Engineering, CMR Institute of Technology, Bengaluru, India.
E-mail: vijayachinns@gmail.com

IV. SYSTEM ARCHITECTURE

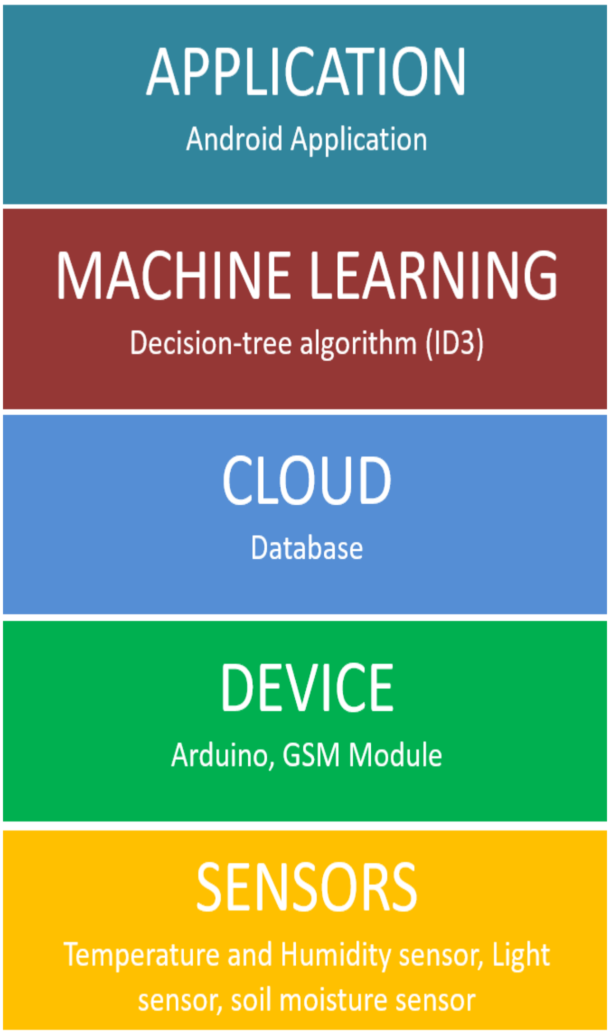

Fig. 1. System Architecture

A. Controllers and Network

This layer consists of Arduino as the microcontroller and a sim800A GSM module as the networking module. Arduino sits at the heart of the system; it accepts the data from the sensors as input and performs actions accordingly. GSM module enables the Arduino to connect to the internet and is instrumental in keeping the farmer in the know using the SMS capabilities of the module.

B. Cloud

This layer consists of the database. Arduino sends the data to the database over the internet. This data is then stored in the cloud for further processing and/or referencing purposes. The data file gets continually updated as the new data is retrieved from the Arduino every 5 minutes.

C. Machine Learning

This layer is for generating the decision, based on the decision tree using ID3 algorithm. ID3 creates a decision tree which branches out to check whether the conditions one by one to decide if it is optimal to grow the crop based on the required conditions for the selected crop. If not, the tree branches out to control the external devices which regulate the resource quantity. It classifies the conditions into optimal and not optimal, and sends the label value to the farmer in case any action is taken.

D. Application

This is the top-most layer and consists of the Android application and the SMS. It serves the purpose of letting the users monitor the data in real-time so they can take actions accordingly. Or to just let them know the current atmospheric and plant conditions.

V. PROPOSED SYSTEM ARCHITECTURE

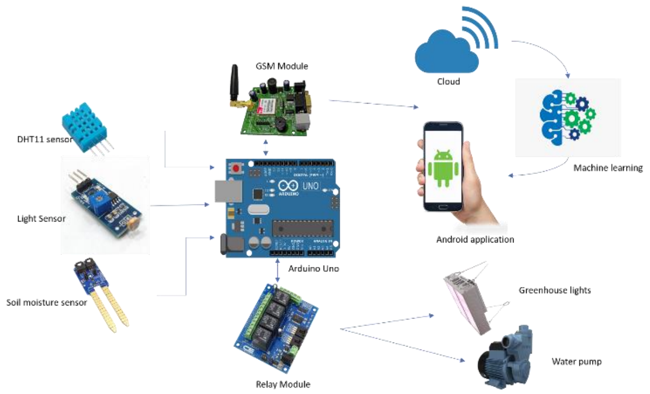

Fig. 2. Proposed System

Fig. 2 displays basic system function diagram for smart crop monitoring system including temperature, humidity, light intensity and soil moisture sensing capability.

In the proposed smart crop monitoring system, Arduino is connected to all the sensors, GSM module and the relay switches. Arduino is connected to the mobile network and the internet via GSM module. The module plays an important role as it adds a network layer which is responsible for transferring data from Arduino to the cloud and to the user's mobile device. The proposed system is capable of performing various functions such as monitoring soil and atmosphere conditions, switching the water pump and greenhouse lights on and off as per the real-time sensor data.

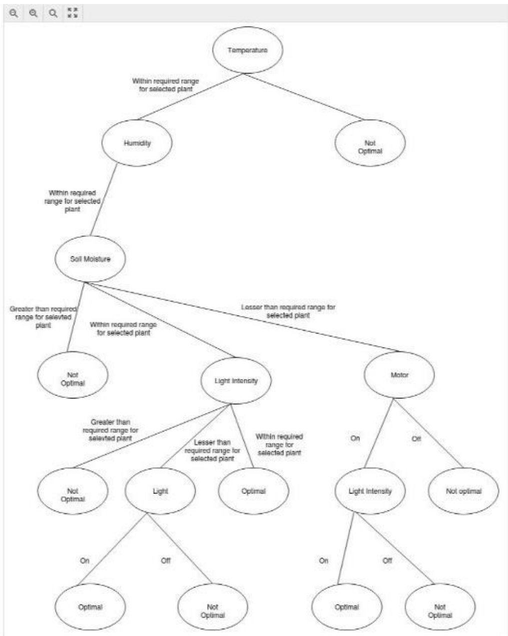

Fig. 2. ID3 Decision Tree

Light sensor – Used for providing real-time light conditions.

Fig. 3. Light Sensor

Soil moisture sensor – Used for measuring the volumetric content of water.

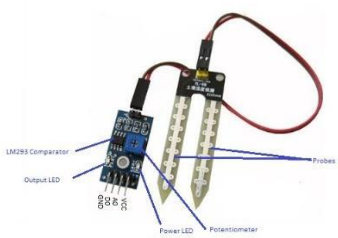

Fig. 4. Soil Moisture Sensor

Temperature and Humidity sensor – Used for measuring the atmospheric conditions.

Fig. 5. Temperature & Humidity Sensor

Arduino – It is a microcontroller. it accepts the data from the sensors as input and performs actions accordingly.

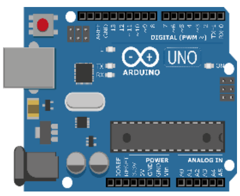

Fig. 6. Arduino

GSM Module - GSM module enables the Arduino to connect to the internet.

Fig. 7. GSM Module

Cloud – Database is stored in cloud and data can be retrieved for future references.

Fig. 8. Cloud

Machine Learning – Used for generating decisions by analysing the data. Uses ID3 Algorithm to carry out the process.

Fig. 9. Machine Learning

Android Application – Used to show user the current conditions of soil and atmosphere and also enables the user to carry out some functions manually.

Fig. 10. Android Application

VI. IMPLEMENTATION

Fig 11.Thingspeak Cloud

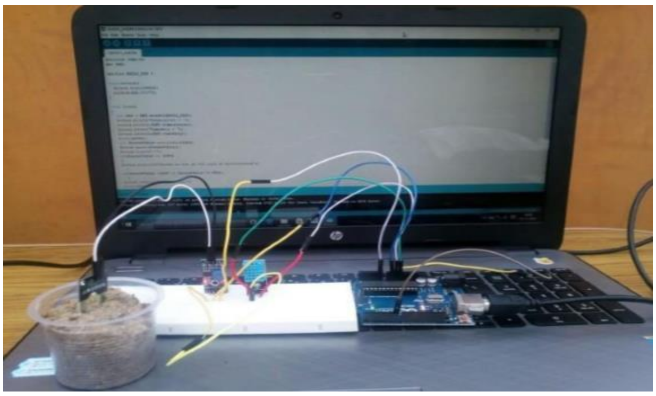

Fig 12. Implementation Setup

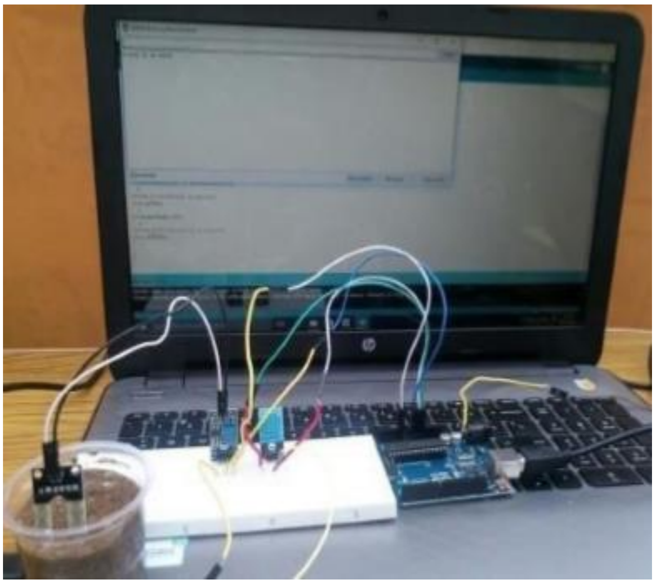

Fig 13. Output of Soil Moisture Sensor for Wet Soil

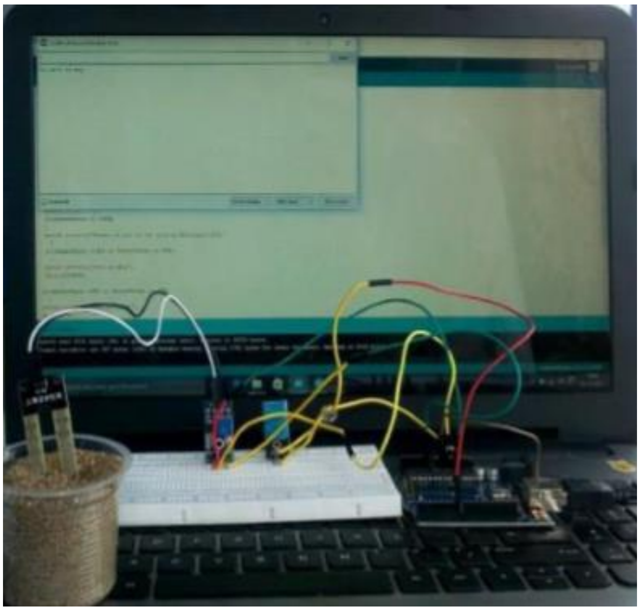

Fig 14. Output of Soil Moisture Sensor for Dry Soil

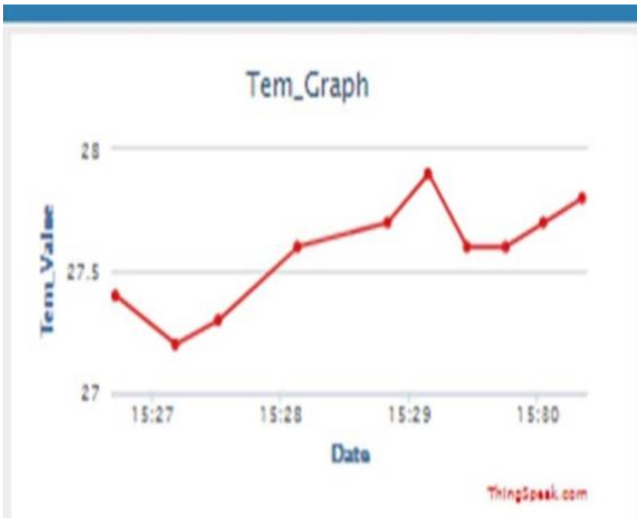

Fig 15. Graphical Output of Temperature Sensor in Thingspeak

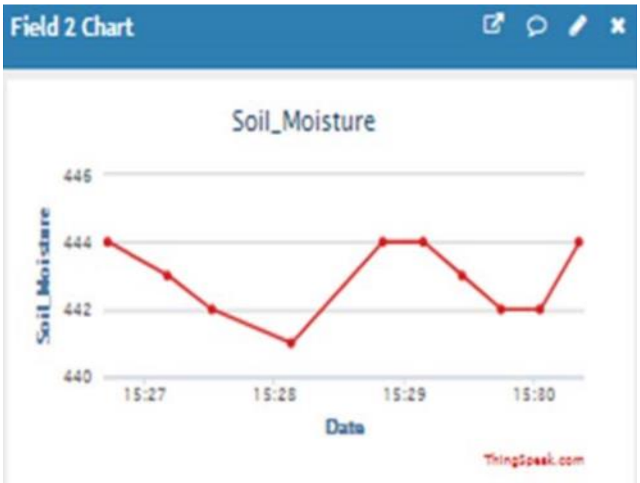

Fig 16. Graphical Output of Soil Moisture Sensor in Thingspeak

VII. FUTURE SCOPE

Our future work will focus on powering the Arduino using solar power instead of using a traditional power source as Indian farms do not usually have 24 hours electricity supply so it will enable us to provide continuous and automated monitoring of the crop even without the electricity. We will also be adding different soil nutrient sensors to the Arduino to add more dimensions to the existing system and enable better crop monitoring facilities. We plan to implement this system, in the future, to collect data from varied crops and regions by using Global Positioning System devices to get the soil types of the current location and be able to analyse current condition of soil and then suggest the suitable crop to plant in that area.

VIII. CONCLUSION

Bill Gates once said, "I can see firsthand that agricultural science has enormous potential to increase the yields of small farmers and lift them out of hunger and poverty." This summarizes the main agenda of our system, where we utilize a multidisciplinary model to create a device that is accessible, usable and helpful to farmers. It minimizes wastage and maximizes produce, in turn maximizing profits. In a country where farmers are the backbone of the economy, starving the backbone itself is an unacceptable situation. Technology is progressing every day, from being able to sense and store the environmental data, to analysing this large amount of data, to predicting whether the conditions are optimal or not, to providing a fully functional interface for the user, this system conjointly aids the progress of agriculture as well. The whole process is automated and keeps the farmer informed, while giving him the time to do other work that needs attention, or just take a break from the toil. This system is the first of many steps to stop those who feed us, from going hungry.

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”.
2. S. R. Prathibha,Anupama Hongal,M. P. Jyothi “IOT Based Monitoring System in Smart Agriculture”.

3. Amandeep,Arshia Bhattacharjee,Paboni Das,Debjit Basu,Somudit Roy "Smart farming using IOT**".**
4. Shitala Prasad, Sateesh K, Peddoju, Debashis Ghosh "AgroMobile:A Cloud based framework for Agriculturalists on mobile platform
5. S.Balachandar , R.Chinnaiyan (2018), Centralized Reliability and Security Management of Data in Internet of Things (IoT) with Rule Builder, Lecture Notes on Data Engineering and Communications Technologies 15, 193-201.
6. S.Balachandar , R.Chinnaiyan (2018), Reliable Digital Twin for Connected Footballer, Lecture Notes on Data Engineering and Communications Technologies 15, 185-191.
7. S.Balachandar , R.Chinnaiyan (2018), A Reliable Troubleshooting Model for IoT Devices with Sensors and Voice Based Chatbot Application, International Journal for Research in Applied Science & Engineering Technology,Vol.6,Iss.2, 1406-1409.
8. M. Swarnamugi ; R. Chinnaiyan, "IoT Hybrid Computing Model for Intelligent Transportation System (ITS)", IEEE Second International Conference on Computing Methodologies and Communication (ICCMC), 15-16 Feb. 2018.
9. M. Swarnamugi ; R. Chinnaiyan, "Cloud and Fog Computing Models for Internet of Things", International Journal for Research in Applied Science & Engineering Technology, December 2017.
10. G Sabarmathi, R Chinnaiyan (2019), Envisagation and Analysis of Mosquito Borne Fevers: A Health Monitoring System by Envisagative Computing Using Big Data Analytics, Lecture Notes on Data Engineering and Communications Technologies book series (LNDECT, volume 31), 630-636. Springer, Cham
11. S. Balachandar, R. Chinnaiyan (2019), Internet of Things Based Reliable Real-Time Disease Monitoring of Poultry Farming Imagery Analytics, Lecture Notes on Data Engineering and Communications Technologies book series (LNDECT, volume 31), 615- 620. Springer, Cham
12. M Swarnamugi, R Chinnaiyan (2019), IoT Hybrid Computing Model for Intelligent Transportation System (ITS), Proceedings of the Second International Conference on Computing Methodologies and Communication (ICCMC 2018), 802-806.
13. G. Sabarmathi, R. Chinnaiyan (2016) , Big Data Analytics Research Opportunities and Challenges - A Review, International Journal of Advanced Research in Computer Science and Software Engineering, Vol.6 , Issue.10, 227-231
14. G. Sabarmathi, R. Chinnaiyan, Investigations on big data features research challenges and applications, IEEE Xplore Digital LibraryInternational Conference on Intelligent Computing and Control Systems (ICICCS), 782 – 786.

AUTHORS PROFILE

Yamini U., completed her Bachelor Degree in Information Science and Engineering at CMR Institute of Technology , Bengaluru under VTU. Her Research Interest includes Internet of Things, Machine Learning, Big Data, Cloud Computing and Security.

Dr. R. Chinnaiyan, working as Associate Professor in the Department of Information Science and Engineering at CMR Institute of Technology, Bengaluru under VTU. He is having 19+ Years of Teaching and 14 years of Research Experiences. He published 50+ papers in referred international Journals and Conferences Currently he is guiding 4 research scholars in VTU. He is a life member of ISTE and CSI. His research interest includes Software Reliability, Internet of Things, Big Data , Cloud computing , Machine Learning, Wireless Sensor Networks and Security.