International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 8, Issue 4, April 2019, ISSN: 2278 -7798

IoT based Smart Agriculture

Sidhanth Kamath B[#1], Kiran K Kharvi[#1], Mr. Abhir Bhandary[#2] , Mr. Jason Elroy Martis[#2]

[#1] *UG Student, Department of Information Science and Engineering*

[#2] *Assistant Professor, Department of Information Science and Engineering*
NMAM Institute of Technology, Nitte,
Udupi, Karnataka, India

Abstract— **With technological evolution in agriculture practice, there is an exponential increase in productivity. The modern agricultural developed technology contains solutions for data collection and monitoring but it is not available at a low cost and does not provide predictions on best crops to be grown on a particular land. The advanced agricultural practices are more reliable, capable, and help to boost the productivity. Environment of an agricultural system can vary from small plants in a home to massive farming centres. These automated agricultural systems will assist in managing and maintaining the quality of agricultural lands. In this paper, we suggest a low cost IoT enabled smart agricultural system which can evaluate the farmland and predict which crop is best for that land based on the data collected from local conditions of that land varying from humidity to soil moisture content. The main intention of this system is to maintain the acceptability of farming environment.**

Keywords— **Internet of Things (IoT); Sensor technology; Automation; Agriculture.**

I. INTRODUCTION

One of the most significant parts of the Indian Economy is Agriculture. Eighteen percent of India's Gross Domestic Product (GDP) is based on Agriculture and is responsible in providing employment to half of the nation's workforce. Productivity in agriculture means a productive India. So, to bring Productivity in agriculture IoT plays a major role. Smart agriculture is a revolution in the agricultural industry that helps to guide actions required to modify and reorient agricultural systems to effectively support the development and guarantee food security during an ever-changing climate. Agriculture policy of 2014/2020 presented new objectives; the primary goals of this policy are minimizing the utilization of synthetic manure in farming and furthermore picking up vitality efficiency [1]. This can be accomplished by applying IoT innovations to the farm. We can get different advantages by executing IoT in agriculture, benefits like reducing labour cost, getting details of the state of the soil, water conservation, and temperature of the field so on.

Being inspired by the above advantages and capability of IoT implemented in smart agriculture, considering the non-presence of solid, entrenched and complete solution system in this area, we propose smart agriculture system as a profoundly adaptable online stage for empowering large scale information handling, programmed thinking dependent on ongoing streams of data coming from sensors, processors & so on. Our paper is organized as follows. Section II describes the literature survey gathered accordingly and Section III describes the proposed system. Section IV describes results of the data obtained from the proposed system.

Crops in India can be classified into four categories i.e. plantation crops, cash crops, food crops and fruit crops. In precision farming field unevenness are checked and the valuable resources are verified using advance technologies to increase cultivation and production. This can be the tool for agriculturist for deciding the crops, setting goals to get Return on Investment while safeguarding natural resources. Precision Farming deals and takes care of principally three parts of science:

1. Crop Selection: On the basis of weather condition and available resource best crop is selected.
2. Eco friendly: Emissions of Methane, Carbon and Nitrogen will decrease with the help of precision farming.
3. With the implementation of advanced technology there is reduce in the consumption of reserved resources , improves efficiency, improves economy and abridged efforts.

Standard classification structures include use of flow-charts and tables and in this method the time consumed is more, hence an automatic system which is fast and dependable is required for classification of soil which helps in better use of technician time. The crops of particular farms are important for various reasons. Besides producing more food, significant growth in crops of a farm will unsettle the regions possibility of growth and competitiveness on the agricultural trade, Revenue circulation and labour migration. Once the farmer starts accepting new technique and variation in their production there will be increase in farmer’s income as described in [2]. Before selecting a crop several aspects are considered, essential requirement must be initiated in advance of commencing farming initiative.

In consonance with the survey, Application that are currently existing in agriculture field are divided into two types i.e. farming applications and farm management applications. Main objective of farming applications is to deliver support on the field based work to the farmer. Farming involves series of processes involved such as sowing, weeding, fructifying, cross-fertilizing etc. Agricultural exercises centres around the ways to apply manure, raise plant, analyse and rectify the disease of plants, eliminate unwanted plants or pests and evaluate the yield or growth of crops. Agricultural practice centres on the ways to apply manure, raise plant, recognise the disease of plant and evaluate the yield or growth of crops. In Order to carry out this process for a large field, it requires individual monitoring and can reduce the labourers needed. In [3] , the authors have designed and implemented a system which is capable of monitoring the crops and helps in boosting overall productivity. In this system they have used motes with various sensors to check moisture of the leaves. Further in [4-6] the implementation of IoT has been proposed. The advantage of implementation of IoT is that it will provide a platform to analyse and manage real time data and notify the farmer instantly. Another advantage of implementation of IoT is that it will grant access to the quality information that are received from various sensors. Additionally , implementing the Cloud architecture to IoT will help in maintain agricultural Big Data such as, information about soil, detailed data of past weather conditions collected via sensors, Information about fertilizer etc as shown in fig[1]. Analysis of the collected data has been done by the author to find out interrelationship between work, yield and environment for conventional model construction. In [7] authors have described about applications of Data Mining using WEKA tool and analysis model using of advanced machine learning algorithms. In [8] authors has focused on monitoring of crop. Information on rainfall and temperature is obtained as geospatial data and evaluated to improve the production of crops. Although there are many models already proposed in agricultural domain, there is lack of low cost efficient model with advanced technology that can help in frequently monitoring environmental conditions and different properties of soil of agriculture field via IoT devices and the data collected are stored at centralized place in cloud which will be a Big data as time passed. This data will helps the farmer to decide which crop is best for the particular field to get maximum yield.

II. LITERATURE SURVEY

In [9] the author describes that, on the basis of market demand and profit the best crop which is to be grown is decided, but till now we have been using old existing system which is not hundred percent effective. In [10] it has been described that, Agricultural system is combination of the results of previous history and present conclusions by governments, individuals and communities. These conclusions are normally based on training, tradition, predictable profit, personal first choice and resources etc.

India has different kind of crops. There are two season in north India, i.e. Kharif and Rabi which have the time period between July to October and October to March respectively. Zaid are the crop produced during March to June. India has wide range of climate, soil and topography. Crops of both moderate and tropical climate are found in India. India is one among the few rare countries which has such variability as specified in [11]. In [12] the authors have developed a system which can sense the soil moisture, humidity, temperature of a agricultural field and transfer the data over a long range area . From this we understood that we can collect the data of the different parameters of the agricultural land and assembling of various data collecting sensors with the main microcontroller. We can predict the suitable crops for particular land based on the data collected from Agricultural land using different sensors which collects the data of different parameters like temperature, Humidity, light intensity, soil moisture etc [13]. The above papers highly suggest the concepts of IoT fused into the Agricultural system for better monitoring of agricultural production and monitoring. The conventional system is kind of rigid and is not capable to be produced in a very low cost manner. As a result, we have found a better solution to upgrade the technology with better functionality and predicting system which includes decision tree algorithms for faster and accurate analysis of data obtained.

III. PROPOSED SYSTEM

One way to address the Agriculture issues and increase the quality and quantity of agricultural production is using sensing technology to make farms more "intelligent" and more connected through the so called "precision agriculture" also known as 'Smart Agriculture. We are creating the module which senses Humidity, Temperature, Moisture of soil, rain frequency and light Intensity. Through an interface, it suggests to the farmer which is the suitable seed for the farm. The architecture of the system consists of sensors like humidity, moisture and temperature sensor , a Wi-Fi module. The software consists of an IoT platform which includes set up of the profile for irrigation based on the seasons or on daily and weekly mode. The software sends notification Main Module to switch On/Off the system. Sensors sense all the physical parameters and convert the analogue value to digital value. Humidity and Temperature sensors are used to estimate the humidity and temperature respectively on field. Soil Moisture Sensor immersed in the soil are of capacitive type, and are used to estimate the moisture content of the soil. For obtaining data in real time from the sensors, a module is combined. This data is then transmitted to the IOT gateway. The IOT gateway then transmits the data to the IoT platform (Cloud) using the Wi-Fi module. The cloud in the system will include a database. The database will maintain the data received from the IOT gateway. The Data collected are analysed using Decision trees as described by the author in [14]. Fig. 1 is the Diagram of Proposed system which consists of six modules i.e. Acquiring Data from the environment, Microcontroller Assembly, Network, Cloud storage, IoT based Interface and Handheld Device and are described as follows:

A. Data from Environment

The moisture from the soil is determined by the FC-28 soil moisture sensor and moisture content of the soil measured in percentage. The humidity and temperature are determined by DHT11 a Humidity and Temperature Sensor in percentage and Celsius respectively. The light intensity is measured by LM393 light sensor in candela. The rain frequency is determined by FC-37 a rain sensor in millimetres.

B. Micro-controller assembly

Fig. 2 is the constituents of Microcontroller assembly in the proposed system. This Microcontroller assembly is the hardware part of the system and governs the data acquisition via the sensors present in it. The microcontroller job is to communicate with cloud storage and has a Embedded Wi-Fi module which has the Wi-Fi range up to 300 meters which helps to propagate information through the network.

C. Network and Cloud storage

The Network is responsible to propagate the data to cloud storage, which analyses and performs calculations with sensor data obtained which is in the form of raw data and displays it on the IoT interface. The network between the Hardware components to the cloud can be established in two ways, either it can be through MQTT agents using the MQTT protocol, or through HTTP module utilizing the HTTP protocol. MQTT is preferred over HTTP, as it is message driven and HTTP is document driven, so MQTT could be more reliable.

D. IoT based interface

IoT integration is concerned with APIs, the applications communicates with each IoT devices using logical connectors. APIs exhibit data that enables those devices to transmit data to the application, acting as a data interface. They also allow your application to take control of the device and act as a function interface.

E. Hand held Device

The monitoring of the data can be done in web based or mobile application. The data received from the sensor are displayed in these applications which act as user interface. These application are operated in portable device like mobile phones which has LCD or OLED to display the data.

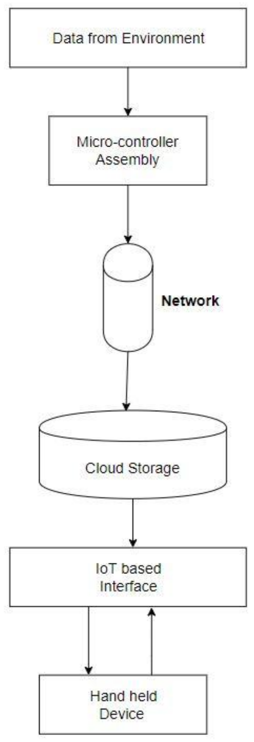

Fig. 1 . Diagram of Proposed system.

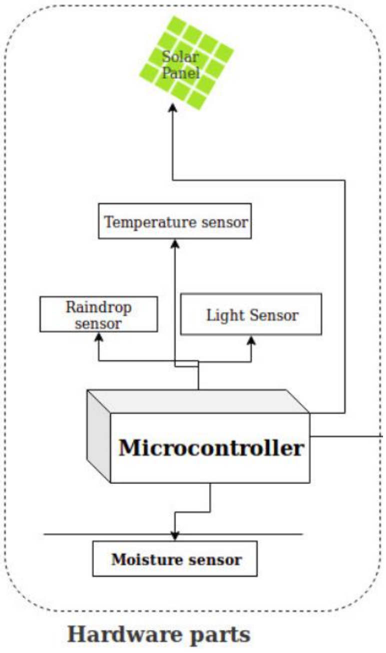

Fig. 2 . Microcontroller Assembly

IV. RESULTS

The comparison of Kharif and Rabi crops is carried out with data like temperature, humidity and rainfall. From the obtained data we can analyse and predict the best crop for the field. The obtained data are as follows which is demonstrated with the values obtained during experiment in Table 1, 2 & 3. Fig. 3, 4 & 5 deals with the temperature trends, Soil moisture trends and Rainfall trends during Kharif and Rabi Seasons respectively.
The table 1, table 2 and table 3 shows the average temperature data, average surface soil moisture trends and rainfall trends respectively for different seasons over past years starting from the year 2015. The graphs are plotted for these table data values, which can be further used for prediction over coming years.

Year	Kharif Season (°C)	Rabi Season (°C)
2015	27.1	21.4
2016	26.9	20.6
2017	27.5	22.1
2018	26.85	21.7

Table 1. Temperature trends data during Kharif and Rabi Season

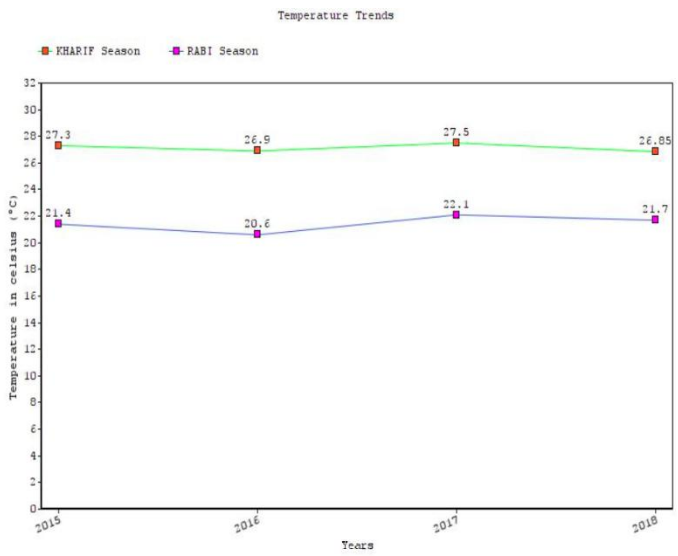

Fig. 3. Temperature trends during Kharif and Rabi seasons

Year	Kharif Season (mm)	Rabi Season (mm)
2015	8.5	10.2
2016	8.2	10.7
2017	9.7	10.4
2018	8.1	11.2

Table 2. .Surface soil moisture trends data during Kharif and Rabi Season

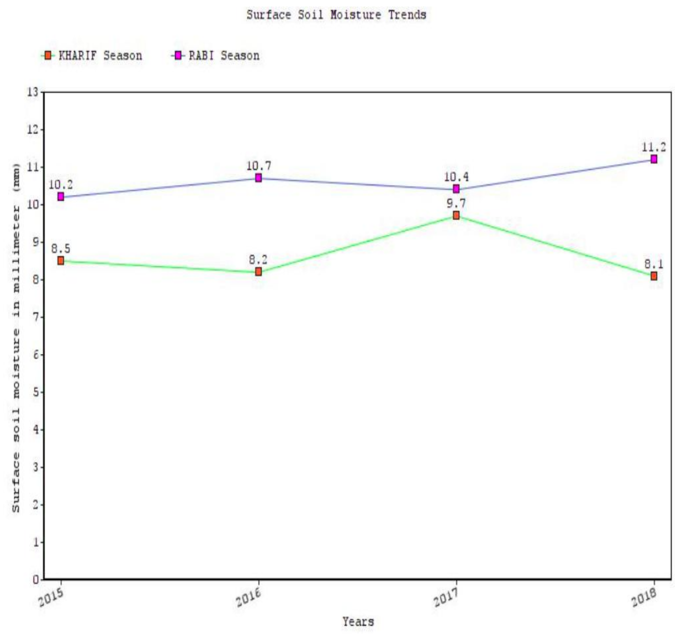

Fig. 4 . Surface soil moisture trends during Kharif and Rabi seasons

Year	Kharif Season (mm)	Rabi Season (mm)
2015	775	108
2016	650	192
2017	846	84
2018	585	172

Table 3. Rainfall trends data during Kharif and Rabi Seasons

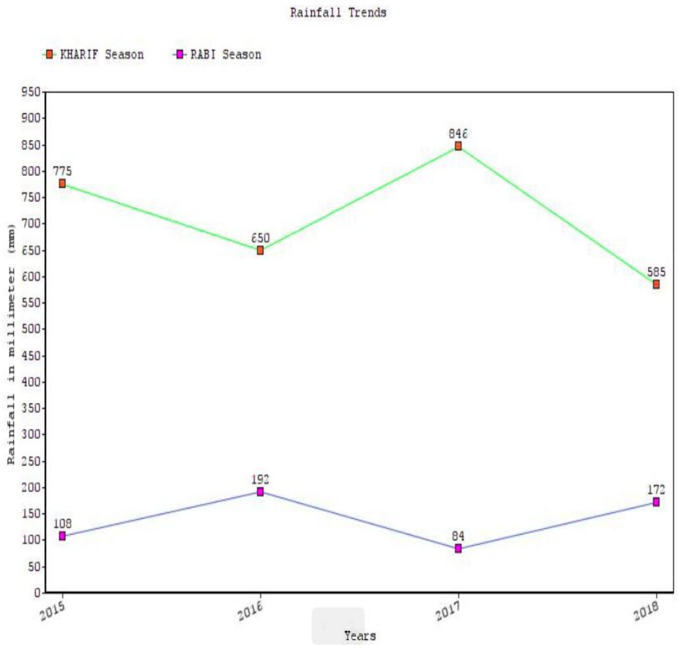

Fig. 5 . Rainfall trends during Kharif and Rabi seasons.

V. CONCLUSION AND FUTURE WORKS

Comparing the various previous methods under IoT to make the agriculture system Smart, Our proposed system is cost effective and done with ten times less the cost than the current products in the market. By using our proposed system it helps in analysing and predicting the type of crops that is best to grow in the particular agricultural field. In the future, it is going to be integrated further using deep learning technology and make the proposed system fully automated.

VI. REFERENCES

[1] Cambra, Carlos, Sandra Sendra, Jaime Lloret, and Laura Garcia. "An IoT service-oriented system for agriculture monitoring." In *2017 IEEE International Conference on Communications (ICC)*, pp. 1-6. IEEE, 2017.

[2] Prasad, J. R., R. S. Prasad, and U. V. Kulkarni. " A decision support system for agriculture using natural language processing (ADSS)." In *Proceedings of the Intl. Multiconference of Engineers and Computer Scientists*, vol. 1. 2008.

[3] Sakthipriya, N. "An effective method for crop monitoring using wireless sensor network." *Middle-East Journal of Scientific Research* 20, no. 9 (2014): 1127-1132.

[4] Kaloxylos, Alexandros, Robert Eigenmann, Frederick Teye, Zoi Politopoulou, Sjaak Wolfert, Claudia Shrank, Markus Dillinger et al. "Farm management systems and the Future Internet era." *Computers and electronics in agriculture* 89 (2012): 130-144.

[5] Wang, Xiaohui, and Nannan Liu. "The application of internet of things in agricultural means of production supply chain management." *Journal of Chemical and Pharmaceutical Research* 6, no. 7 (2014): 2304-2310.

[6] Minbo, Li, Zhu Zhu, and Chen Guangyu. "Information service system of agriculture IoT." *automatika* 54, no. 4 (2013): 415-426.

[7] Cunningham, Sally Jo, and Geoffrey Holmes. "Developing innovative applications in agriculture using data mining." In *The proceedings of the Southeast Asia regional computer confederation conference*, pp. 25-29. 1999.

[8] Rajesh, D. "Application of spatial data mining for agriculture." *International Journal of Computer Applications* 15, no. 2 (2011): 7-9.

[9] Awate, S. J., and G. U. Todkari. "Agriculture productivity in Solapur District of Maharashtra: A Geographical Analysis." *International Journal of Agriculture Sciences* 4, no. 2 (2012): 186.

[10] Shirsath, Rakesh, Neha Khadke, Divya More, Pooja Patil, and Harshali Patil. "Agriculture decision support system using data mining." In *2017 International Conference on Intelligent Computing and Control (I2C2)*, pp. 1-5. IEEE, 2017.

[11] Karkhile, Santosh G., and Sudarshan G. Ghuge. "A Modern Farming Techniques using Android Application." *International Journal of Innovative Research in Science, Engineering and Technology* 4, no. 10 (2015).

[12] Ilie-Ablachim, Denis, George Cristian Pătru, Iulia-Maria Florea, and Daniel Rosner. "Monitoring device for culture substrate growth parameters for precision agriculture: Acronym: MoniSen." In *2016 15th RoEduNet Conference: Networking in Education and Research*, pp. 1-7. IEEE, 2016.

[13] Kumar, Rakesh, M. P. Singh, Prabhat Kumar, and J. P. Singh. "Crop Selection Method to maximize crop yield rate using machine learning technique." In *2015 international conference on smart technologies and management for computing, communication, controls, energy and materials (ICSTM)*, pp. 138-145. IEEE, 2015.

[14] Wu, Jun, Anastasiya Olesnikova, Chi-Hwa Song, and Won Don Lee. "The development and application of decision tree for agriculture data." In *2009 Second International Symposium on Intelligent Information Technology and Security Informatics*, pp. 16-20. IEEE, 2009.