International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Smart Precision Farming Monitoring and Controlling in Rural Areas using IoT

Puja Shinde[1], Pooja wale[2], Pratibha Bibave[3], Amol Mahajan[4], Anita Gawali[5]

[1]*Student VIII Semester BE (IT), Amrutvahini College of Engineering, Sangamner-422605 Maharashtra, India*
[2]*Student VIII Semester BE (IT), Amrutvahini College of Engineering, Sangamner-422605 Maharashtra, India*
[3]*Student VIII Semester BE (IT), Amrutvahini College of Engineering, Sangamner-422605 Maharashtra, India*
[4]*Student VIII Semester BE (IT), Amrutvahini College of Engineering, Sangamner-422605 Maharashtra, India*
[5]*Associate Professor, Dept. Information Technology, Amrutvahini College of Engineering, Sanganer-422605, Maharashtra, India*

Abstract - *In the domain of smart farming and agriculture Internet Of Things (IoT) has given a new dimension. To connect the rural area farms to the digitalized structure and architecture of Smart Farming IoT and Fog Computing plays a great role specially in rural areas effectively.We propose scalable and efficient network architecture for controlling and monitoring farms in rural areas. We have introduced a better IoT structure system model as compared to the existing system as we have decreased the latency of network by using a Fog Computing into it. We have designed routing solutions by using hardware and software solution for the system that should not require network at each and every time is proposed in this paper. We analyze the crop growth based on humidity, temperature, soil moisture and intensity of sunlight.*

***Key Words*: Internet of Things (IoT), Cloud computing, fog computing, smart agriculture, Arduino, HTTP, API.**

1. INTRODUCTION

Farming is the only source and income in remotely based farmland. So, it's very important to generate an appropriate amount of food grain from certain amount of field area. Internet of things plays a better role in certain cases to calculate and also able to control the various farming equipment's [1]. The IoT can't lonely able to generate large revenue for the farmer So, The IoT can't lonely able to generate large revenue for the farmer So, that IoT also needs a combined functionality for data analytics, cloud computing, machine learning models to generate a better revenue for farmer So, that he can survive in such a fast life style. The internet of thing is currently booming in market as it directly connects your hardware to your software, cloud and many more things that we can just available in second by clicking a single button. The systems those are designed before are purely based on IoT and inter and intra network ability to complete the work [1].

The part here is to be noticed is inter/intra network where it's very difficult to setup it in the remotely based farm land. To overcome such situation the fog computing concept we have used here.

This will directly store data into a local system and whenever there is network availability it will send data to cloud server and further to it data to data analytics part comes and reports, graphs and charts will get generated. The farming can be done better by using sensors and actuators. The sensors are those devices which can sense the physical movement and get converted into current signals where actuators are those devices which can converts the electrical signals into the physical movement [1]. It is very important that total number of sensors and actuators are get used. As they are the basic building block for the system. Their numbers will give you a precision based farming ability as their number get increases the precision of the farming will also get increased as they are directly proportional to each other. Where the data calculation and sensed data is also need to monitor and calculate in certain time span like one second, two seconds and like this. It will help to generate reports and charts as it's a very sensitive data in the whole system. So, security is also a very important for it. The data is stored in MySQL database which is in local machine. The farming is need to be done in proper manner meaning fertilizers, pesticides, crop stress calculation, water management for farm. The first thing first water is a very basic and very much important element which helps to make the crop grow better. It needs to be supplied in such a way that at particular interval of time which is very important to proper growth of that plant.

The fertilizer is also a very important factor in growth of plant and they need to give as how many days the plant grow after it's sowing date or before it's sowing date also some fertilizers need to give. The pesticides are also play's very important role in crop production and they are also comes in certain season and environment and climate condition. The crop can also go through the stress by not availing of water supply in a day. So, stress is calculated by using soil moisture and humidity in air. In summary, the primary contributions of this paper are as follows.

1) We excluded the previous network architecture and introduced a new one using fog computing concept.

2) There are total four modules are designed and they are Sensing module, control module, intrusion detection module, Data analyzing module.

3) The final result is in the form of reports and charts.

IoT model which is previously proposed is having a concept which sends sensed data to cloud where if there is network issue is in very large manner.

Consider if at certain interval of time the network is not available then sensed data of that particular interval of time is gone forever as it's not stored. So, to overcome this problem we have used a fog computing concept over here. The sensed data is getting stored in local system as there is large network issue in rural area farms. The sensed data is air temperature, soil moisture, air humidity are firstly comes inside of Arduino Uno board [1]. After that Arduino Uno board is connected with the storage module and sends data to the storage module. Where storage module is consisting of SD card for storing of the sensed data. The monitoring module consists of element like jumper wires, Arduino Uno board, DHT11, Soil moisture sensor.

1.1 LITERATURE SURVEY

[1] Internet of Things (IoT) for Smart Precision Agriculture and Farming in Rural Area

The authors main aim of the project is to develop smart precision agriculture and farming with the help of fog computing and the Wi-Fi based long distance connecting networks in IoT [1].The author proposed scalable network architecture for monitoring and controlling agriculture in rural areas [1]. The developed project is more costly for the developing countries for the use of the system for smart farming [1].

[2] IoT Based Smart Irrigation Monitoring And Controlling System.

The author developed a remote monitoring and controlling of drips through wireless sensor network for smart irrigation system for the farm field [2].Smart farm irrigation system uses android phone for controlling of the system for management of the farm irrigation water [2].

Distribution of water supply as per requirement for better use of the water supply for the farm crops [2]. System is based on IoT that uses real time input data to control the water supply in the farm Field [2].

[3] Smart Farming Using IoT.

The developed a remote controlled vehicle for operations like spraying, cutting, etc. for surveying and controlling of the devices smart farming devices [3].

The Monitoring of the temperature, humidity, soil condition did with the remote controlled vehicle [3].

Distribution of water supply as per requirement management is also getting done with remote controlled vehicle [3].

[4] Internet of Things Application for Implementation of Smart Agriculture System

The author tried to simultaneously generating more output from the same amount of input, but there is need of improvement [4]. The author controlled the operations like spraying, cutting, etc. with IOT based smart device and do monitoring of farm field [4].The author done monitoring of farm field like temperature, humidity, soil conditions [4].

[5] Design and Development of Precision Agriculture

System Using Wireless Sensor Network

The author introduces a scalable solution for the smart farming. He introduced a smart irrigation system for the farming to handle the irrigation in the farm [5].

Author introduces sensor network architecture for the farming. He introduces the system as the main problem in the farming is bad irrigation system to overcome the problem he introduces smart irrigation system and architecture [5]. He also manages the system with controlling of the water level in side water tank to distribute water in the farm land efficiently [5].

[6] A control system in an intelligent farming by using Arduino technology.

Author introduces a smart farming system in which the system uses a GPS system for working for the weather data for the farm Location [6]. He introduces the smart farming architecture in the system also collects the weather forecast data and predict the next possible condition for the farmland [6].

He first acquires the data from sensor and the GPS and predicts the next possible outcomes then process the data give instruction to system, but the system is costlier to use the system [6].

[7] Smart Farming IoT in Agriculture.

The author developed smart farming system with help of Internet of things in which it uses a server which receives the data from the farm field [7].

The server takes the action on the farm field such as watering the plants if water moisture is less in soil [7]. He created a smart farming architecture for the poly house farming in which if the air moisture is less then water get distribute to crops. If heat is more than air then condition is get on according to the system works [7].

[8] AgriSys: A smart and ubiquitous controlled-environment

Agriculture system.

The author developed a smart farming system they called it as AgriSys. AgriSys is a smart and ubiquitous controlled-environment agriculture system [8].

Author aims at providing the benefits through the AgriSys smart farming system are increased the productivity of crops, enhanced safety of farm field, easier agriculture procedures for farming, instant interventions around the clock, advanced lifestyle [8]. The author also said AgriSys is found to be superior in its edibility, ease of maintenance, web interface, and portability [8].

1.2 TECHNOLOGIES

1) Internet of Things(IOT)-

This is a system of inter-communicated computing digital equipment and mechanical devices, objects, animals or people which is provided with unique identifiers and the capability to transfer data over a network without the need of human to human and human to computer interaction.

Agriculture includes cultivation and water management along with various IOT application areas. A wide range of sensors can be used for agriculture application etc.

IOT contains of deployment of sensors at the respective application. The same phenomenon can be used for irrigation system for controlling and monitoring. IOT can help farmers in multiple ways with the deployed sensors / actuators across farm fields & machinery, farmers can gain as an abundance of insightful data such as temperature, fertilizer used, water used etc.

2) Fog computing-

A virtualize platform which enables strong computation and networking services in between the sensor nodes and the existing cloud computing centers. It analyzes agriculture data close to the deployed field to reduce latency. A fog node is a part of connected network situated closer to things of IOT and extends services toward the cloud. The fog node structure helps to provide distributed computing in the network.

3) Wireless Sensor Network (WSN)-

Wireless sensor network tends to a group of importantly displayed & dedicated sensors for recording and monitoring the physical organizing the collected data at a central location node.

Sensor node is attached with sensors which sense and receives the information which is required. In addition to one or more sensors each node in a sensor network is equipped with radio trans-receiver or other wireless communication device or antenna which is used to communicate with other neighboring nodes.

Wireless sensor network consists of base stations & nodes (wireless sensors). These networks are used to monitor physical or environmental conditions like pressure, temperature & pass data through the network to a main location. A sensor node is made up or basic components such as sensing units, processing unit trans-receiver unit and a power unit.

4) LOWPAN – Based wireless sensor / Actuator Network

The LOWPAN-based wireless sensors and actuator network is used in the farm domain for sensing and actuating purpose.

The law power personal area network use to form the personal network of sensor, actuator other devices connecting with wireless connections.

2. PROPOSED NETWORK ARCHITECTURE FOR SMART FARMING AND AGRICULTURE

The architecture of proposed system is as given below in a diagram where architecture consists of Fog cloud, data saving cloud, Network module in the form of nRF24L01 transceiver.

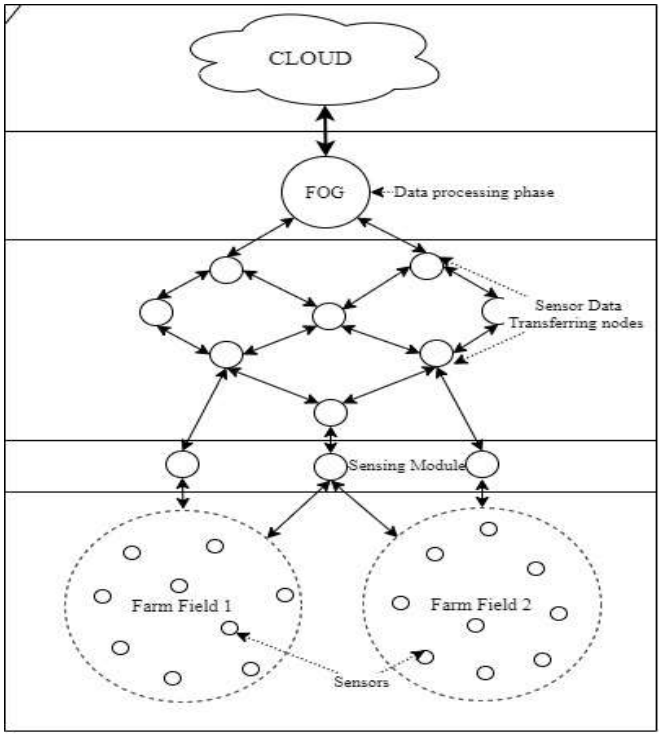

Fig -1: Proposed IoT network architecture connecting rural areas.

The first module consists of sensing module where it consists of Arduino Uno controller board, jumper wires, DHT11 sensor, LDR sensor, Soil moisture sensor[2].Where all these sensors are working on the 3.3V where it's given to them from Arduino Uno board.

The ground and data pins of sensors are connected to the Arduino Uno board. Where the Uno board needs an external power supply up to 12V. The second module is nothing but a storage module.

The storage module also consists of sensors like NRF24L01 trans receiver, Uno board, SD card reader and writer device which is directly connected to Arduino Uno board via Serial Peripheral Interface (SPI). This module stores the sensors data in local file. The file is .txt file. The third module that we have designed is Intrusion detection and monitoring module. Where the module requires the IR sensor, Uno Board and one buzzer as alarm.

ESP 8266	Arduino Mini	Raspberry Pi	Dragon Board	Arduino Mega
2 digital	14 digital	17 digital	12 digital	54 digital
	6 PWM	SPI	1UART	16 analog
	8 Analog	UART	SPI	4 UART
	1 UART	12C	2 12C	SPI
			16 Analog expansion	12C
			Connectors	

The last module is designed as a web application where it gives the final result to the farmer in the form of reports, graphs and charts. The cross-platform IDE uses standard web development languages [2]. The single web application is developed for different mobile devices hence it avoids reimplementation. We understand the setup of energy monitoring and utilization system by using wireless sensor network. The wireless sensor network plays a key role in extending the smart grid implementation on energy management application. The monitoring module sense data and send it to the middleware module by using a communication protocol named as MQTT and it stands for Message Queuing Telemetry Transfer protocol.

The control function is used for making ON and OFF the home devices by taking command from the middleware module [1]. The middleware module consists of different servers and software tools as given below: The middleware consists of four different servers. The first server is MQTT server.

The MQTT server provides a medium of communication between the home appliances and also with middleware. It also provides a high security by providing read only and writes only privileges to certain topics that prevents unauthorized access and control over system. The Second server is storage server.

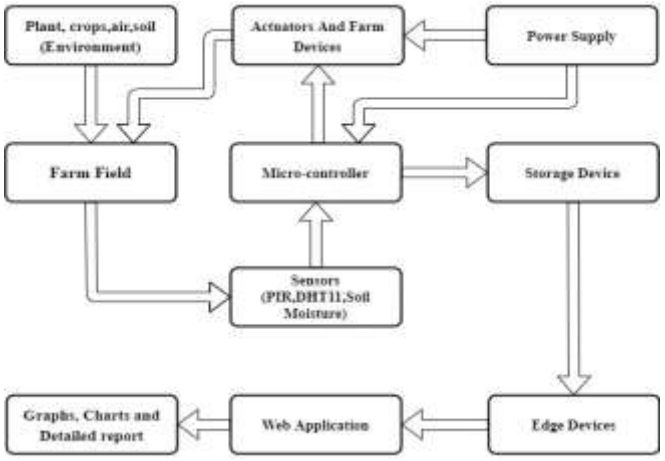

Fig -2: Block diagram of smart farming system.

It's highly scalable and used for storing sensors data and user information on real time basis [2]. It provides high performance and scalable database for storage of devices energy consumption data. The third server is analytics engine server. In this server the business intelligence software tool is used for making smart decisions. It also used for generating graphs and charts for farmers.

Formation of WSN simulation environment requires consideration of many things via suitable operating system, adequate RAM requirements and storage [1]. A virtual platform is required to fulfill above requirements that is cloud based. Besides storing all the measurements received from WSN, data sources identification, performing data validation, partitioning, and processing. Then later includes running the irrigation algorithm for detecting whenever the plants need irrigation" [1].

The cloud storage usage provides advantages as 1) Hardware requirement and cost reduces. 2) Data can be accessed from anywhere and at any time. 3) Data is get secured. The smart farm embedded with IoT, also be known as connected farm, which can support a wide range of devices from diverse agricultural device manufacturers. Also, connected farms could provide better intelligent farming services based on shared expert data information. Factors alone are never adequate to increase productivity of crops since a lot of other factors have a role to play [1]. This may include spraying of insecticides and pesticides to prevent invasion of pests and insects, monitoring the fields at all times to stay aware of attacks by animals and birds, and thefts of crops during the stages of harvesting.

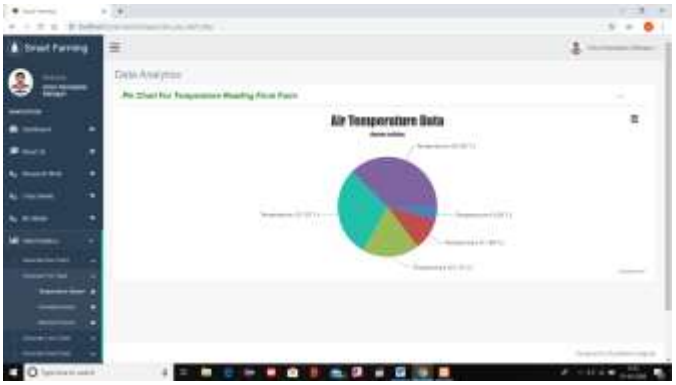

Chart-1: Air temperature data in pie chart form.

The above diagram shows that air temperature difference of various field areas. Where there are multiple modules can be shown on left side of pane.

This is the dashboard of web application where all the modules are visible and given them link. Total Smart Farmer, Total units, Total Sensors used, Total Actuators used, Report format (PDF).

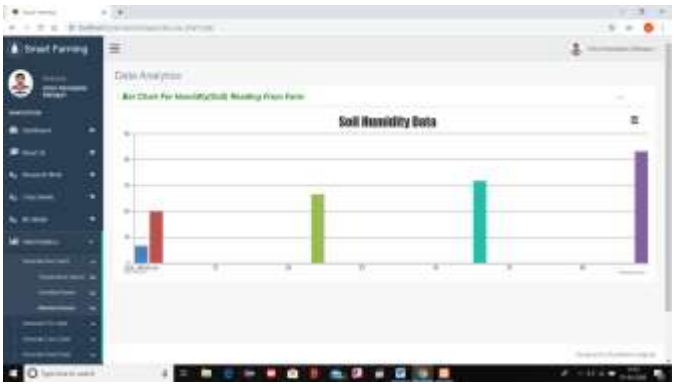

Chart-2: Soil Humidity data in bar chart form.

The above diagram shows that soil moisture and the humidity in air for the calculation of stress on farm crops various fields. This is the web analytics part of web application where all the modules are visible and given them link.

Total Smart Farmer, Total units, Total Sensors used, Total Actuators used, Report format (PDF) cannot be seen from this module. User can also download this chart in their local machine.

3. CONCLUSION

This paper has presented the smart precision based farming using IoT and Data Analytics using various JavaScript API. The paper has removed the defects those found in previous paper in large extent also use of hardware is cheaper than all previous paper without compromising in network rage. Finally the results are in graphs and charts to understand easily to the Farmer. Also gives a decision making power what to do next.

REFERENCES

[1] Nurzaman Ahmed, Debashis De , Senior Member, IEEE, and Md. Iftekhar Hussain, Member, IEEE; "Internet of Things (IoT) for Smart Precision Agriculture and Farming in Rural Areas" IEEE INTERNET OF THINGS JOURNAL, 2018.

[2] Shewta B. Saraf, Dhanashri H. Gawali, "IoT Based Smart Irrigation Monitoring And Controlling System", May 2017.

[3] Arshia Bhattacharjee;"Smart farming using IOT"2017 8th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON).

[4] K. Lokesh Krishna; Omayo Silver "Internet of Things application for implementation of smart agriculture system"2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC).

[5] S. R. Nandurkar, V. R. Thool, R. C. Thool, "Design and Development of Precision Agriculture System Using Wireless Sensor Network", IEEE International Conference on Automation, Control, Energy and Systems (ACES), 2014.

[6] N. Putjaika, S. Phusae, A. Chen-Im, P. Phunchongharn and K. Akkarajitsakul, "A control system in an intelligent farming by using arduino technology," 2016 Fifth ICT International Student Project Conference (ICT-ISPC), Nakhon Pathom, 2016, pp. 53-56.

[7] Rahul Dagar, Subhranil Som, Sunil Kumar Khatri, "Smart Farming – IoT in Agriculture", IEEE 2018.

[8] A. Abdullah, S. A. Enazi and I. Damaj, "AgriSys: A smart and ubiquitous controlled-environment agriculture system," 2016 3rd MEC International Conference on Big Data and Smart City (ICBDSC), Muscat, 2016, pp. 1-6.