Cloud of Things for Smart Agriculture

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Abstract: The combination of IOT and cloud has become an upcoming technology and applications from iot and cloud has been used in many sectors agriculture, security, and smart cities. IOT is nothing but many number of physical devices that are connected to internet for access and sharing of data. The main components of IOT are sensors. IOT is implemented in such a manner that information is collected through sensors are stored in cloud and processing of information that is collected can be performed by developing an application in cloud.

I. INTRODUCTION

Agriculture is the main source for many countries in the world. it is interrelated to the country‘s economic growth by providing raw material to non-agriculture sector thereby increasing employment. Irrigation is the basic need for agriculture. Proper utilization of water resources is an important thing such that there is great need to save water. Mostly in developing countries farmers are using traditional approaches for crop cultivation which leads to ineffective usage of natural resources Throughout the world most commonly used traditional methods are check basin method in which the field is divided into basins that are raised by earthen walls these basins are filled with water such that water slowly percolate to fields through earthen walls. And furrow irrigation method where furrows are dug between crops and farmers flow water down the furrows so that water can be provided to field .These traditional irrigation though they are cheaper but they can't serve the purpose and also has some disadvantages such as there is a greater risk of underground salts coming up to surface area of field.

There are many proposed modern methods for the effective utilization of water resources in areas where rain fall is scanty these models include irrigation where water droplets are directly dripped into the roots of plants and pot irrigation where pitchers are deployed in field to make water percolate and provide moisture to plants .The most used type of irrigation is sprinkler irrigation where water is sprayed to plants in the same way as natural rain fall and there are also techniques such as evapotranspiration where moisture in field is transferred to atmosphere by evaporation of water and transpiration from plants .It became an important parameter to schedule irrigation.

Apart from methods such as evapotranspiration there are certain methods such as deploying humidity sensors to detect soil moisture.

This method is more effective and saves more water compared to sprinkler irrigation. The combination of cloud and iot plays a major role to implement best possible ways for saving water and proper utilization of water .Generally agriculture needs more water for irrigation purposes but in some areas the water resources may not be available so there is a great need to utilize the water resources in a best possible manner .so to implement it there is a need to determine the conditions of the soil such as amount of moisture present in soil, humidity that is present in the environment and some additional constraints such as determining the leaf wetness, determining the speed of wind are used to find out the actual field conditions .

In order to measure all these constraints we need special kind of sensors such as moisture sensor for determining the moisture content present in soil, humidity sensor for determining the humidity content present in air, location sensors in order to determine the latitude and longitude of the field, electro chemical sensors in determining the ph and nutrients of the soil .By using these information collected in the sensors one can determine the actual condition of field .smart agriculture is nothing but maximizing the yield by utilizing minimal amount of resources so implement smart agriculture the data collected from the sensors is utilized and processed .based on the data the field is watered.

II. RELATED WORK

The implementation of smart agriculture with the integration of IOT and cloud from the implementation of automated irrigation to detection of rodents that reduce the yield of crops. There are many proposed models for the implementation of cloud-IOT in agriculture, for smart agriculture, irrigation automation, construction of plant factory for the production of all varieties of crops throughout the year by adjusting environment conditions automatically and crop machinery scheduling and implementation of precision agriculture by deploying IOT sensors in the field [1] we can implement smart irrigation and plant factory(production of yield throughout the year by adjusting the climatic conditions artificially) by implementing sensors, RFID that work together for providing information about the plant and the information collected by sensors and RFID is delivered GPRS and 3G wireless broadband the information delivered is processed and analysed using PDA, regulation equipment [2].

We can provide smart agriculture and information to farmers about fertilizers to be used and market value to a particular crop by creating an agro cloud such that farmers along with details such as field data, crop sequence, area of field and agro marketing agencies, agro vendors are

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registered in agro cloud the data collected from sensors is sent to agro cloud where processing is done and farmers can get information such as amount of fertilizer should be used for that particular land area from agro vendors by a mobile application.[3]we can schedule agriculture machinery by taking in to account the crop mature time, harvest time and these information is used for intelligent scheduling of farm machinery according to the region.[4]We can implement proposed a solution for the implementation of precision agriculture by developing a three tire architecture such as front-end layer, gate way layer and back-end layer Where front end is deployed with various sensors for sensing soil ,environment and plant conditions(Humidity, temperature, moisture, leaf wetness speed and wind direction, rain volume).The information collected from sensors is sent to micro controller and a wireless communication is achieved by transreceiver. to relay information collected to gate way.

The gate way can be implemented by using Raspberry pi. The gate way is connected to back end(cloud based server) which is responsible for end users accessing data [5].Implementation of agriculture informationization can be done by developing a cloud architecture where the details such as physical and chemical requirements of crop that the farmers can query the details of crop such as diseases that may occur and appropriate pesticides and fungicides that can be used for that particular disease .The information about crop is stored in methodological form and can be updated by admin [6] Agriculture information management(AIM) can be achieved by applying a new technology called as “digital agriculture” for the production of effective yield many conditions such as geographical conditions, environmental conditions, soil conditions, plant conditions.

Information related to field and environment can be collected by using various sensors (temperature, soil moisture, humidity sensors) and GPS is used to provide data based on geographical location of soil and usage of remote sensing technologies for air borne collection of data such as aerial photo graphs. The spatial and non-spatial data stored can be queried to track the status of plant growth and usage of RFID in harvesting stage such that the information such as nutrition information ,temperature weight ,moisture level can be determined.[7]We can protect the farm from intruders and rodents by implementing infrared camera sensor that distinguishes the intruder or farmer in the field and send data to ad-hoc network using ZigBee .

The information about intruder is sent to farmer’s mobile phone through an application [8]. Agriculture information management can be implemented in green houses as well as fields by collecting information by using various kinds of sensors and the information collected is stored in internet by using WAN such that farmer can query about the state of crops .RFID technology is also implemented in it. The architecture here consists of local farm control and cloud farm control both of them work in two modes isolated and interconnected if the farm control is isolated from cloud control it works on local area network otherwise if they are connected farmer can access the data through internet connection and the data among cloud and farm controller are synchronized.[9] The major problem with providing irrigation facilities to farmers is that how plants are watered when farmer is out of station. The solution to this problem detects faulty nodes and the information collected from sensors is sent to datacentres.

The data centres process the data and compare the data with threshold values and send that data to farmer such that if the plants need to be watered the water actuators are made to water the plants.[10] We can provide security to the farm by the detection of rodents that spoils the production yield .The proposed model is a 3 layer architecture including sensing data, processing data and developing an user interface raspberry pi is used to implement the circuit, PIR sensor and ultrasonic sound rodent repeller that works on data analysis in addition to its web camera is also connected to USB port of rasp berry pi and the device is installed and the analysed data is stored in data base and the data collected from the sensors is sent to farmer’s mobile application.[11] The solution for agriculture informationization can be implemented in such a way that the data collected from farm is stored in agro cloud based on latitude and longitude positions collected by GPS is stored in methodological form farmer can query to track the condition of field.[12] For the effective utilization of water resources such that irrigation can be automated by thermal imaging and suggested an algorithm for implementation of thermal imaging.

III. PROPOSED WORK

We are using three tier architecture for the implementation of smart agriculture and agriculture security. The front-end layer consists of sensors for communication between sensed data to the gate way can be performed through micro controllers by a wireless communication module. The gate way is also made up of microcontroller which provides the needed processing power and storage to ensure all the capture data is relayed to the cloud server for analysis.

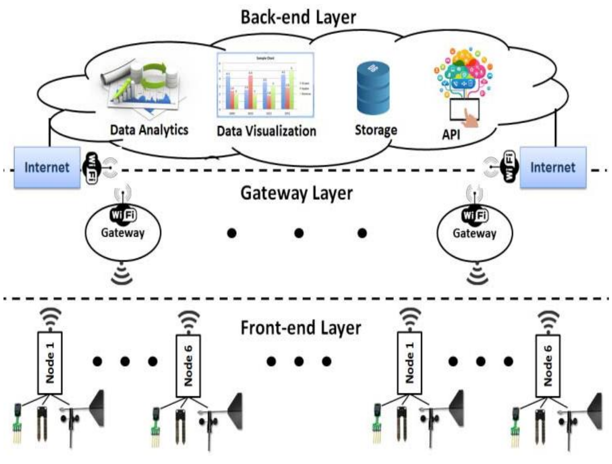

Fig. 1 Basic Model of smart agriculture

For the development of smart irrigation systems some parameters should be detected such as air temperature and humidity, so that we can perfectly determine the condition of field and environment.

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To measure these parameters various sensors are deployed in field such as:

1) Temperature sensor (SHT 11): To detect temperature changes in the field.

2) Humidity sensor (HTU21D): To measure the humidity in environment around the crop.

3) Moisture sensor (SEN0114):For determining the properties of soil such as moisture content present in soil, It is determined by using leaf wetness sensor(FC 37).

In our implementation is a 3- tier architecture is present in which 1st layer corresponds to data collection from various sensors.

The 1st layer is also called as front-end layer where data is collected through sensors and the result of sensed data is implemented by actuators in the field .The 2nd layer is gate way layer. In this layer communication takes place between front-end layer and back-end layer, and is performed by microcontroller.

The gate way layer acts as an intermediate layer for the communication between end cloud and front-end layer. The data sensed in front-end layer is sent to back-end layer which is a cloud that manages data storage, data visualization, data processing application process, allotment of data centers for the analysis and front-end interface for a farmer to view the field condition. Generally the processing of data can be performed by comparing the sensed values with the threshold values and based on the analyzed data the information about the farm is displayed on the mobile application so that the farmers can view the condition of the field. The gate way is implemented by using microcontrollers and the communication between back-end and gate way can be provided by using WIFI module and the data rate of this module is 150Mbps.

IV. RESULT

We are installing 3 kinds of sensors for detecting crop field they are temperature and humidity sensor, soil moisture sensor, light intensity sensor and relay. These sensors have different pins and they are connected to arduino microcontroller and relay is used to on the motor relay again works on the command received from the cloud application. We are using LCD to display sensed values on the field.

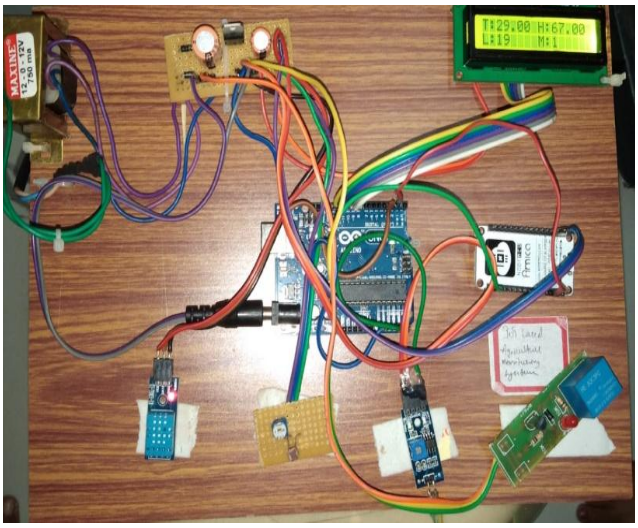

Fig. 2 Implementation of smart agriculture Iot model

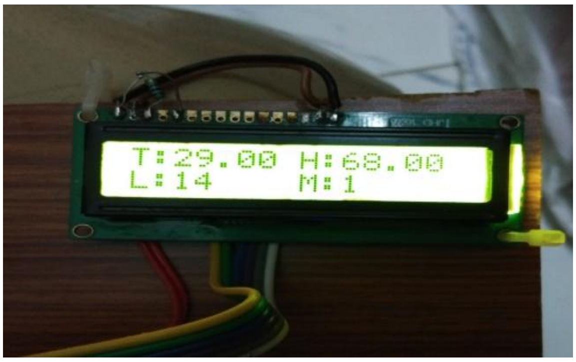

Fig. 3 Results after sensing the crop field values

V. CONCLUSION AND FUTURE SCOPE

The implementation of automatic irrigation system is achieved so that a farmer can operate the motor from a cloud based application. The data from sensors is sent from the front-end module that is sensors to the back-end module that is a cloud to store data, visualize the data and also enables the farmer to operate the devices from an application that is developed in the cloud. The data transmission from front end module to back-end module is through the help of the gate way module that consists of an Arduino micro controller and node mcu for providing the Wi-Fi to transfer the data to the back end layer.

By proper monitoring of field conditions water can be supplied to plants whenever required. The future scope can be more liable for a farmer where he can also water the plants when he is out of station by pressing a button from his phone. By this the effective utilization of water resources and continuous field monitoring can be achieved.

Smart agriculture can be implemented in many ways same as irrigation automation system we can also implement agriculture security by the integration of cloud computing and iot. Implementation of agriculture security is nothing but detecting the rodents in the farm by using various types of sensors and driving them off by a special ultrasonic repellent sensors and we can also implement some machine learning algorithms that detect and differentiate a rodent and human so that the notifications are sent to farmer. We can also measure the quality of the yield by using RFID tags. These RFID tags are placed in the bales of the yield so that humidity and moisture can be detected as these qualities are essential for determining the quality of yield.

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