

Soil Data Collection for Research and Application Using IoT and Cloud

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ABSTRACT: The Internet of Things is a recent, modern technology to make data accumulation intelligent. It is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. This technology can be used to accumulate information about soil moisture and local temperature humidity values of agricultural land. Irrigation is an important process for increasing food grain production. Improving water use efficiency will play a significant role in sustaining food and water resources for future generations.

Research progress and practical applications were introduced to increase agricultural water use efficiency. Soil moisture is a key variable in controlling the exchange of water and heat energy between the land surface and the atmosphere through evaporation and plant transpiration. As a result, soil moisture plays an important role in the development of weather patterns and the production of precipitation. This paper discusses a mechanism to automate the process of soil moisture monitoring by introducing a component to collect information about the soil moisture and local temperature and humidity values. All the data will be collected and maintained in a Cloud. These data will be monitored periodically and will help to make periodic notifications to the farmers when the soil moisture level increases above the threshold level through a mobile notification and the stored data can be used to make irrigation pattern predictions for the future.

KEYWORDS: Internet of Things, Interrelated computing devices, Cloud.

I. INTRODUCTION

Soil moisture is important for forecasting both temperature and precipitation in a region. Soil moisture, along with the temperature is a major player in the rate of soil respiration. These factors help in deciding the rate and transport of carbon in the environment and the type of crop that can be cultivated in soil. The data collected will help in studying the soil moisture patterns in a particular region at a particular time of the year. The proposed system will collect moisture, temperature, and humidity values from a particular soil region and the data will be stored in the cloud. The system is even capable of being notified in extreme conditions of soil moisture or temperature levels.

The Internet of Things(IoT) is the network of any physical devices, in general, any objects that have embedded software, and electronics that enables connectivity between these objects to communicate and share information. IoT involves extending the connectivity beyond the devices like laptop, mobile phones to any physical device or everyday

objects. Applications are developed based on IoT enabled devices for monitoring and control in various domains including industrial processes, home appliances, health monitoring applications, smart homes, smart cities [6, 7, 10, 11, 12, 13]. In the agriculture domain, few researchers have proposed architectures based on IoT to monitor supply chain management of agricultural products [8, 9].

A sensor is a sophisticated device that is used to detect and respond to a signal. A sensor changes physical parameters into electrical signals. A sensor is a module or a subsystem that detects events in the environment. Wireless Sensor Networks is a mature technology. A lot of work done in the agriculture domain with Wireless Sensors [25, 27]. Sensors are available to sense and analyze various parameters required in the agriculture domain. Many applications are in use which utilizes sensors in agriculture [14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28].

Cloud computing provides sharing of resources with cheap cost [54]. Cloud computing service providers offer services like Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) with cheap cost. Agricultural data can be stored in the cloud [38, 39]. It is used along with IoT in the agriculture sector [36, 37].

Agriculture is the primary source of income for most of the people in India. Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, more so in the vast rural areas. It also contributes a significant figure to the Gross Domestic Product (GDP) [56]. Incorporating many technologies in the agro sector have led to the development of this sector. A few initiatives are taken by the Indian Government to provide online and mobile services to farmers, and agro the vendor's information [53], it presents data related to soil quality. Smartphones are nowadays available even in rural areas. The nodeMCU is a cheap IoT device that helps us to create a light weighted portable sensor system. These sensor systems are portable devices that can be installed and changed at any point in time. Hence a cost-effective sensor kit can be developed.

II. RELATED WORK

Researchers have proposed different models for the agriculture sector with one or multiple technologies mentioned above. Use of IoT in the agriculture domain has been proposed in [40, 8, and 9]. Utilizing the future internet characteristics using the FMS architecture is explained by the authors in [40]. This architecture provides easy access to information. The context of providing a cost-effective supply chain to the farmers is discussed by the author in [8]. The controlled architecture for smart agriculture is described by the author in [9]. In [36, 37] cloud computing and IoT are utilized in the agricultural sector. Using cloud computing for storing agricultural data is explained in [39].

Although researchers have proposed a few models in the agricultural domain by using one or more of these technologies, there is a need for a dynamic model that provides: **Automation of the farming process:** The Internet of Things, though it has been utilized in the agricultural sector to a small extent, the entire potential of the Internet of Things is not utilized. We can make use of IoT to completely automate the process of farming. Monitoring the soil properties periodically by using a portable IoT device and automating the process of watering the crops and applying the fertilizers as per need. This will reduce the excess wastage of water and unnecessary application of the fertilizers. The model must not only be useful during the farming process but it should also satisfy both post-farming and pre-farming needs.

III. METHODOLOGY

The IoT based implementation for the system makes use of simpler components and sensing units making it easy to manufacture and use. The module will operate in the presence of internet connectivity and the data will be periodically sent to the cloud for storage. The data available in the cloud is made opensource and the data can be utilized by budding researchers to explore a lot of new domains and find new applications with the data. The controller module once installed will start operating and the user will get periodical notifications under extreme conditions.

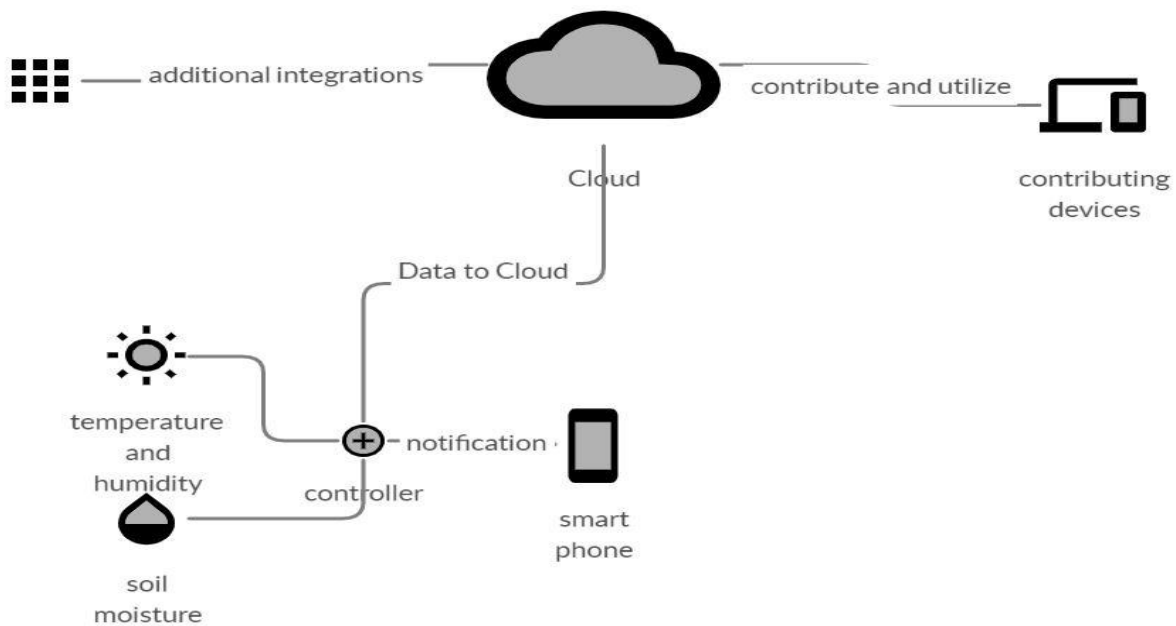


Fig (1): Workflow of the proposed module.

The figure depicts the working of the module. The two sensors that are implemented include the moisture sensor and the temperature and humidity sensor. The moisture sensor senses the soil moisture content by sending electrical pulses into the soil, based on the fact that soil is an insulator and the water molecules that are present in the soil are conductors; the moisture sensor measures the soil moisture level with the conductivity observed. The value is transmitted to the microcontroller. The temperature and humidity sensor measures these values by measuring the electrical currents or the temperature values in the air.

The micro controller receives the signals from the sensors and then transmits the received values to the cloud. The microcontroller will also calculate the levels of moisture and then send the notification to the mobile application. The data present in the cloud is made open source and any researchers can make use of the data and perform research and studies regarding these observed values.

The cloud store is maintained in a format that the users of the data can make use of the integration provided and create their own applications as per their need and the applications can be used by everyone. The data will be stored from different parts of the globe making the researchers utilize the data from their own locality. The platform also allows users to contribute their studies and observed data to this cluster thus making it a much reliable source.

IV. EXPERIMENTAL RESULTS

The figure shows the value stored in the cloud and the various depictions for the values to be utilized.

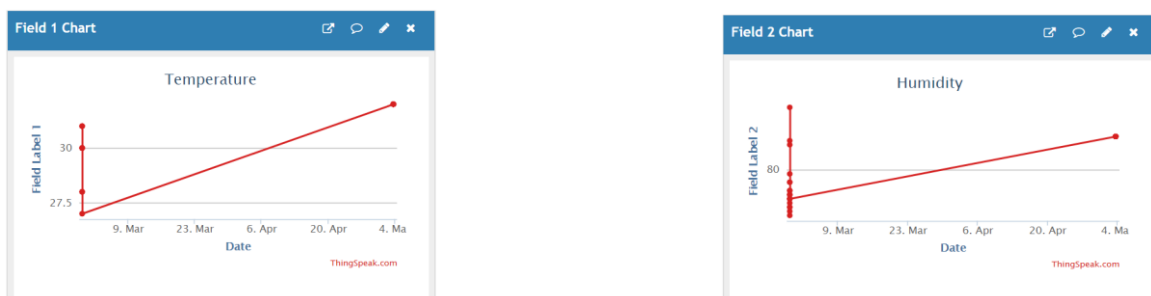


fig (2): Temperature and Humidity values stored in the cloud.

The dots specify the time stamps and the instances in which the data were pushed into the cloud. This is a pictorial representation of the data in the cloud. The data can be exported or imported by the users and researchers in any format that they wish to use and utilize this makes the adaptability of the product to increase and the utilization to be world wide.

V. CONCLUSION

In this paper, I have suggested a multidisciplinary model for automating the agricultural sector that utilizes these technologies: Internet of Things(IoT), Sensors, Cloud computing. Through real-time monitoring of the farmland, we can automate the process of agriculture by taking decisions based on the farm conditions and utilizing it to function autonomously. The architecture of the entire model, in general, can be stated as a master-slave model where the decision system acts as the master and other modules act as the slave. The decision system controls the entire functionality of all the other modules. There are some unique functions that each module will perform even if the decision system goes down thus ensuring that minimal functionality will be provided to the users. The second and most important task of the model is that it should suggest buyers for the cultivated crops. The buyers are filtered based upon their profile and their requirements. The buyers will be provided a list of farmers who have cultivated the same crop that they are looking for, ranked based upon the number of constraints that each farmer fulfills. The same is applicable to farmers who search some buyers for their crops. Hence this automates the entire process of farming and eases the job of marketing the products.

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