

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES SMART AGRICULTURE MODEL USING MODERN TECHNOLOGIES

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ABSTRACT

This paper presents different techniques of smart agriculture based on the key technologies such as Internet Of Things(IOT), Wireless Sensor Network (WSN), cloud computing, mobile computing, precision agriculture. These technologies help in the improvement of the crop production. A multidisciplinary model is proposed a for smart agriculture which includes two modules. First is Agro cloud module and second is mobile module. Agro-Marketing agencies, Agro-Vendors & farmers need to be registered to the Agro Cloud module through the MobileApp module. Agro Cloud storage stores the details of farmers, periodic soil properties of farmlands, Agro-vendors and Agro-marketing agencies, Agro e-governance schemes and current environmental conditions. Soil and environment properties are sent to Agro Cloud through IoT. Proposed model helps to increase the agricultural product.

There is an increasing need of decision support systems for agriculture which is provided by is Precision Agriculture (PA). Through WSN, agriculture can be connected to the IoT, regardless of geographical differences. This approach provides real-time information about the lands and crops that will help farmers to make right decisions. The implementation of WSN in Precision Agriculture (PA) will optimize the usage of water, fertilizers while maximizing the yield of the crops and help in analyzing the weather conditions of the field.

Keywords-Internet of Things (IoT), Wireless sensor Network (WSN), Precision Agriculture (PA), Cloud Computing, Mobile Computing.

I. INTRODUCTION

Main occupation of 69% of Indian population is agriculture. It is the art for not only cultivating the soil but also producing crops using different preparation methods and technologies. Traditional farming practices with conditions like dependences on monsoon, fragmented land farming and holding, and poor infrastructure in rural areas.

Indian agriculture is behind in the race of modern agriculture as less use of new techniques. Modern farming practices are revolving around the new concepts like IOT, wireless sensor network, cloud computation, mobile computation, and Precision agriculture. IOT is the network of physical objects which is embedded with the electronics, sensors, which enables these objects to collect data for exchanging data and is the broader technology and innovation business. WSN is used to build decision support system; it overcomes many problems in real world.

Mobile computing is the technology which allows transmission of data via computer or other wireless enabled devices. WSN is a mature technology and a lot of work has been done for agriculture in this domain whereas cloud computing provides easy sharing of resources and storage of agriculture data. Wireless sensor network, will optimize the usage of water, fertilizer in precision agriculture while maximizing the yield of crops. With the use of sensor, application on the mobile phones and the transfer of useful information generated by the system will make it easy to use. The system is having wide area of applications such as Open Farm, Greenhouse Farming.

Internet Of Things

Internet of things is rapidly growing network of the connected objects, able to collect and to exchange data. The Internet of Things is also referred as the Internet of Objects, which will change everything including us. In IOT, the communication language will be based on interoperable protocols, operating in different environments and platforms. IOT is also used to improve the crop production for the completion of the growing needs of increasing

population in India, it helps to charge pay per usage and thus reducing the cost. The IoT sensor uses various types of connections such as RFID, Wi-Fi, Bluetooth, and ZigBee. Internet of things is having many applications in human life, making life easier, safe and smart, such as smart cities, homes, transportation, energy and smart environment.

Indian farmers have started taking help of the modern and agriculture tools and machines. But as far as usage of IOT is concerned, Indian farmers are at an introductory level in using the IOT technology for agriculture as compared to other countries which have reached to the advance level in utilizing the technology for farming[6].

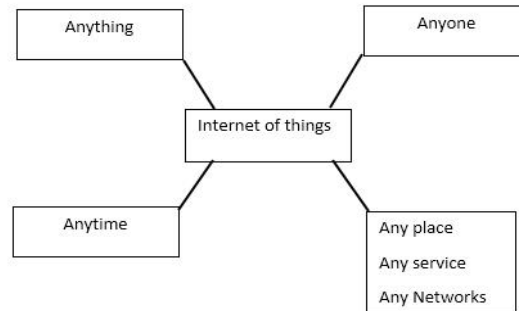


Figure1.IOT

Wireless sensor network

A wireless sensor network contains thousands of sensor nodes [1].The sensor nodes can communicate among themselves using radio signals. WSN have emerged to offer low-cost, flexible, easy-deployment, and high-accuracy advantages for monitoring crop in real time. WSNs devices are small in size, low cost, and require low power to work.

Mobile Computation and Cloud Computation

It is used in every field and also in agriculture sector. Mobile Computing is used for transmission of data, voice etc. via a computer or any other wireless device without any connection to a physical link. The main concept involves Mobile communication, Mobile software, and Mobile hardware.

The mobile communication includes devices such as protocols, bandwidth, and portals needed to support the stated services. Mobile hardware consists of mobile devices which receive the service of mobility. That devices would be portable laptops, smartphones, tablet Pc's, Personal Digital Assistants. Mobile software is a program that runs on the mobile hardware.It deals with the characteristics of mobile applications. Mobile software is the engine of the mobile device.

Cloud computing is a software model.It allows users, and enterprises to store and process data in a privately owned cloud or on a third-party server located in a data center. Cloud computing has been used in agriculture sector with IoT.[6]

Cloud computing is used in agriculture because it is difficult for farmers to deal with service providers on an individual basis. There is a need of cost effective service providers with different services for farmers. In such case cloud computing offers data as a service (DaaS),Infrastructure as a Service (IaaS), Software as a Service (SaaS), and Platform as a Service (Pasay)[6]. Cloud computing is having five universal values:Reduction of initial cost, Allocation of resources, performed in the back-end, possibilities for global service development[7].The cost of data is reduced, only when the cloud computing storage server is used which is the main advantage[6]. The user does not necessary to pay for the service package.The cloud computing are run in the cloud desktop, hence PC, lap-tops, tablets does not need the processing power or hard disk space [9].In a cloud computing system, Computers run faster, as they are having smaller programs.

II. PROPOSED SYSTEM

Multidisciplinary Model for Smart Agriculture

The proposed model consists of the five modules:

Sensor Kit Module, MobileAppModule, Agro Cloud Module, Big-Data Mining, Analysis and Knowledge Building Engine Module, Government & Agro Banks UI .

Sensor Kit module is IoT device in which soil and environment sensor are inbuilt. MobileApp module provides interface for the system processing. AgroCloud Module is consisting of storage, big data mining, knowledge building engine and mobile app module to interface with user. Government and AgroBanks user interface is interface for providing information of agricultural schemes and loans.

Sensor kit module

The BeagleBone Black is designed to address the Open Source Community, early adopters[5]. This module is responsible for soil sampling at periodic intervals to get soil property values. SensorKit is a cost effective, portable kit in which, considered the use of beagle black bone, an IoT enabled device with processing capability, GPS sensor for the detection of information of position. The components of this kit are soil nutrient sensor devices. We have considered soil nutrient sensors for this model are soil pH sensor, soil moisture sensor, Phosphorus (P), Potassium (K), Nitrate (N) sensors which are interfaced to the IoT device[1].

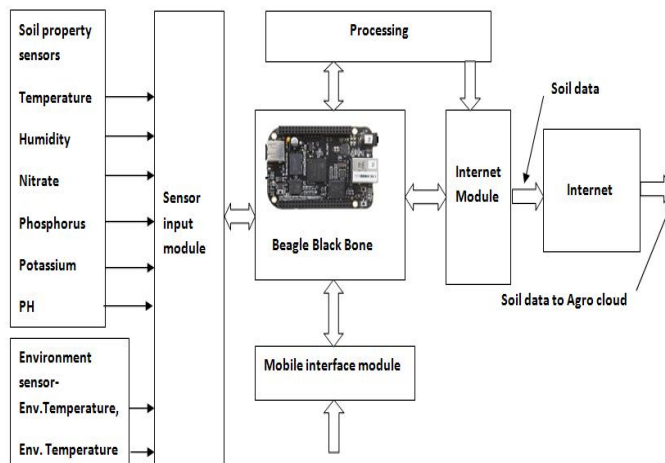


Figure 2. Beagle Black Bone

Mobile App module

Initially the user has to register to the mobile app with few identity information, user type, geographical locations, address and useful information. If the user is farmer then he has to send information regarding the farmland consisting of approximate location and total area for each farmland[1]. The soil information is collected through SensorKit. MobileApp sends the instructions to the sensor kit. Then the information will be stored on AgroCloud Big-Data storage. When the crop cultivation is in progress, at that time Sensor Kit sends the soil information to cloud storage. Farmers get suggestions, instructions regarding the fertilizers through this app and also get information about its amount for better crop results and cost savings. This app also sends notifications to the users. The farmer sends the total production data for each crop with current soil characteristics after cultivation of that crop when the crop is harvested to the cloud storage. Such information is then stored in the cloud storage with the time-stamp details. Agro marketing agencies have to send the updates related to changes in cost and their purchase requirements. Agro marketing agencies are mainly responsible for purchasing harvested crops from farmers. An Agro vendor sends updates related to products and cost changes. Agro vendors are responsible for selling fertilizer, seed, and pesticide and agricultural equipment[1].

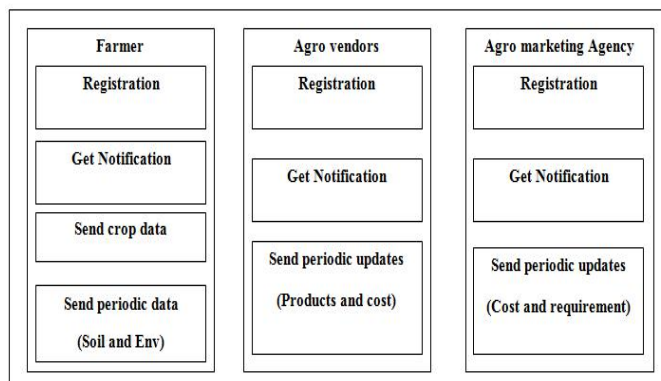


Figure3.Mobile App module

Agro Cloud module

Through MobileApp,Users of agriculture field needs to be registered to AgroCloud. AgroCloud storage consists of Big-Data storage which will store all the information of farmer, agro marketing agent data, and agro vendor’s data, service provider’s data and also government schemes for agriculture sector, bank loans for farmers and concessions on seed, fertilizers[1].This Agro cloud module also stores data collected from soil and environment sampling. As number of end users gets connected to this system service and data size grows rapidly which results into the Big-Data.

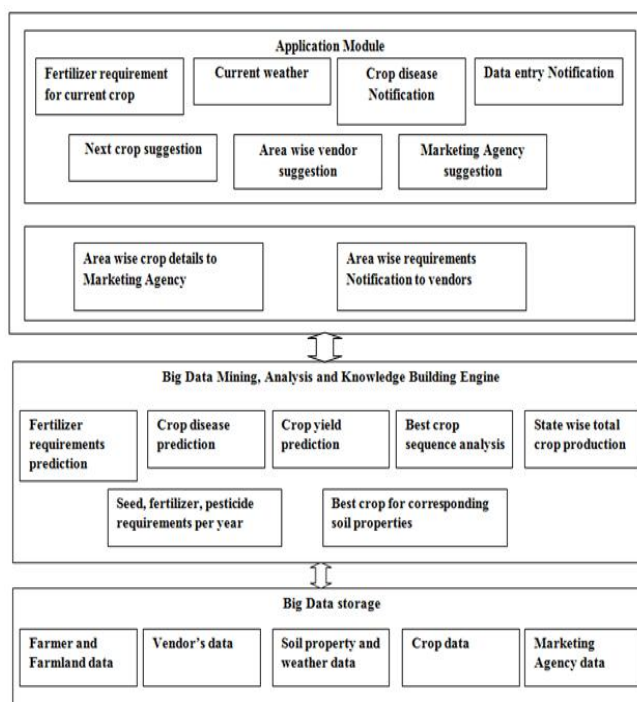


Figure4.Agro Cloud module

Big-Data Mining,Analysis and Knowledge building Engine

Big Data analysis is a research topic with the availability of large amount of storage and computing abilities offered by advanced computing infrastructures.Big Data like mobile sensing require real-time data processing, data extraction for decision support. Extracting values from Big Data require thefollowing:[8]

1. Mine geospatial and topological networks from the data of IOT.

2. Develop a class of mining methods, which embrace the storage and processing capacity of cloud platforms.
3. Provide new mining algorithms.
4. Develop holistic research.

Big data analysis is done for the estimation of future production of each product. This module makes decision for the fertilizer requirements for current crop based on current soil properties for better production, crop disease prediction based on current soil properties. As database collects data for soil properties and crop information with production amount for each farmland can be calculated for better crop sequences to be carried for best production of crops and for preserving good soil health. Also this database provide suggestions, advices to the farmers for crops to be taken on the farmland with soil properties based on previous stock of agro products and current requirements in the market.

Government and Agrobanks UI

Agricultural banks (Agro banks) provide the details of loan schemes through the UI and it will be stored on the AgroCloud storage. Through the notifications, farmers and beneficiaries who are registered on the AgroCloud storage will get the information whenever the schemes are announced without physically visiting and without enquiring to the government offices [1].

Internet Of Things in Precision Agriculture using Wireless Sensor Network

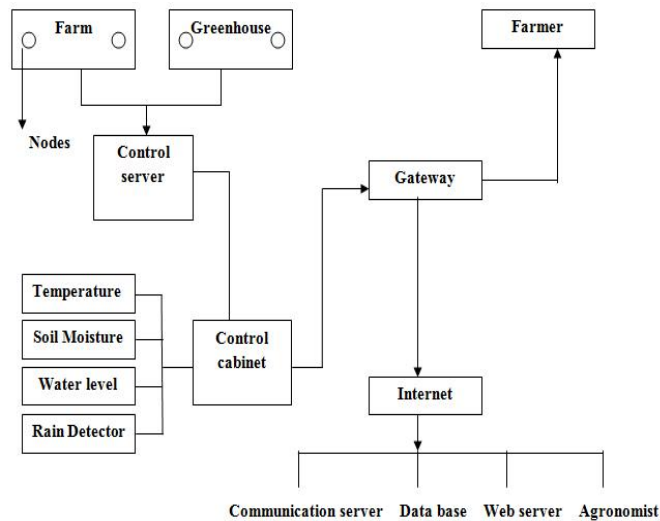


Figure 5. System Architecture

Considering the need of modern techniques in agriculture and previous drawbacks, proposes a system which integrates the control of the deployed systems which will make it easy to handle and better understanding of the results. Also it keeps the farmer updated by the notifications for each and every related event that occurs in the field. This system has useful applications in Agriculture and also Green House. The central system is the sole of this architecture, because it does half of the work of system. Central system is one which is responsible for communications between the nodes and central server and database management and for communication with the outside world. Central System which is consisting of three main entities, are Communication Server, Database, Web Server.

The nodes can be easily accessed by the Control cabinet, which is consisting of Temperature sensor, Soil Moisture sensor, Water Level sensor, Rain detector sensor. When node senses the data is then transferred to the central

system by central server. Communication with farmer about Warnings or notifications via gateway is provided. In case of unusual activities, central system contacts the Agronomist[2].

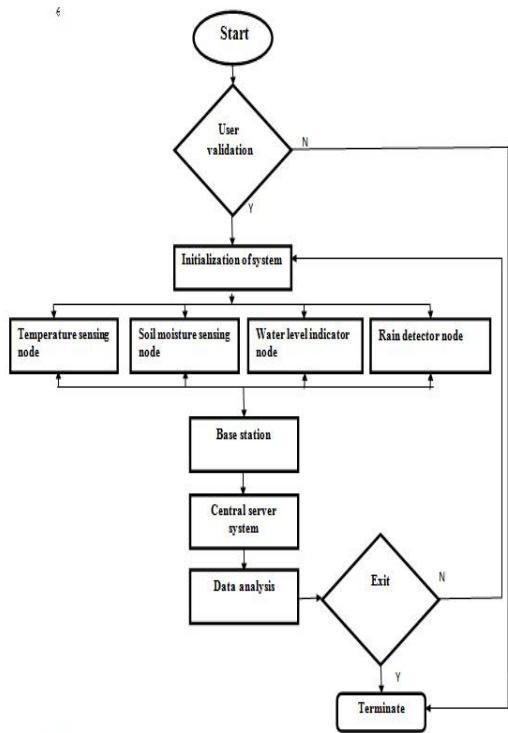


Figure 6. Flow of Algorithm

The system starts its functioning only when the user validation will occur with correct username and password. If username and password is wrong or it does not match, then the system will terminate. If the username exists and the password is correct then initialization of the system will start, by initialization, it means all the sensors in the field such as temperature sensor, soil moisture sensor, water level indicator sensor, rain detector sensor will be initialized to zero and hence refresh the memory. The data is then sensed by the sensors i.e. temperature of the environment, soil moisture content, and water level, possibility of rain, all these factors are sensed and will be collected and then transferred to the base server station in the field. The base server station will transfer the stored information to the central system over a reliable protocol. Now the central server station will analyze the data based on the threshold values set for each entity. Data will then be displayed to the user and based on above results, decisions which are favorable for the efficient farming can be taken by the farmers. If the user wants to continue with the same system data then it will tell the system to continue and the sensors will be initialized by again repeating the whole cycle again. If the user is satisfied and wants to exit the system, then the system will terminate.

The following flow shows how the system will behave from user login to user logout.



Figure 7. User Authentication



Figure 8. System Interface

The system access is secured through a username and password of the user (farmer). Therefore the useful information and notices will be only accessible by the valid user having identity. When the user is logged in, the GUI (Graphical User Interface) will provide options for next activity. From the application, Live monitoring of the farm, previous reports or last notifications can be obtained, and also for specific query it provides option for Help.

III. CONCLUSION

This paper describes a multidisciplinary model for smart agriculture. Through real time sampling of soil, farmer will get fertilizer requirements for the crop. This is an important requirement towards agriculture sector in India to get improved crop production simultaneously with reduction in cost of fertilizer requirements by keeping soil health intact. While we have also dealt with the sensor network design that enables connecting agriculture to the IoT. The connection sets up the links among agronomists, farms, which improves the production of agricultural products. It is a comprehensive system which is designed to achieve precision in agriculture.

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