Smart Agriculture using Trending Technologies

Priya.M[1] Sriram.S[2] Vinusa.R[3] Vaijayanthimala .J[4]
[1,2,3]Research Scholar [4]Assistant Professor
[1,2,3,4]Department of Computer Engineering
[1,2,3,4]Dhirajlal Gandhi College of Technology, Tamil Nadu, India

Abstract— *In this paper we proposed an interdisciplinary model for smart agriculture based on the trending technologies. In this paper we proposed an interdisciplinary model for smart agriculture based on the vital technologies. Agriculturist, Agro-Trading agencies and Agro-Vendors need to be registered in the AgroCloud module through Mobile App. AgroCloud storage is used to store the details of Agriculturist, agro-vendors and agro-trading agencies, Agro e-governance schemes and current environmental conditions. Soil and environment resources are sensed and persistently sent to AgroCloud through IoT (Beagle Black Bone). Mobile-Computing, big data analytics. Agriculturist, Agro-Trading agencies and Agro-Vendors need to be registered in the AgroCloud module through MobileApp. AgroCloud storage is used to store the details of Agriculturist, agro-vendors and agro-trading agencies, Agro e-governance proposal and current environmental conditions. Soil and environment resources are sensed and persistently sent to AgroCloud concluded IoT (Beagle Black Bone). Bigdata analysis on AgroCloud data is done for manure requirements, best crop sequence analysis, total production, and stock and market specification. Proposed model is beneficial for increase in agricultural production and for cost control of Agro-products.*

Keywords— Internet-of-Things, Cloud Computing, Big data Analytics, Mobile Computing, Sensors, Smart Agriculture

I. INTRODUCTION

Internet-of-Things and big data analytics are trending technologies from past few years and applications are being developed in various fields using these technologies. Sensor technology has also been advanced and many types of sensors like environmental sensors, gas sensors are refined and used in applications. Cloud-Computing and Mobile-Computing are developing technologies and applications prevail in almost every field using those technologies. Uses of these technologies in the field of agriculture are also brought in and are used for improvement in this sector.

A. Internet of Things (IoT), Wireless Sensor System and Sensors

Internet of Things is a technology which aims to connect all the objects in the world to the Internet. Applications are developed based on IoT enabled devices for supervising and controlling various domains including industrial processes, home devices, health monitoring applications, smart homes and smart cities.

Wireless Sensor system is said to be mature technology and lot of work has been done for crop production. Sensors are available for sensing and analyzing the various frameworks that are required in agriculture domain WSN architectures were proposed, executed and tested for monitoring the soil properties.

B. Mobile Computing

Mobile computing has altered a lot in our day to day life due to its availability and has a cheaper cost of communication. System based on mobile computing has been proposed for sending seasonal report to farmers regarding the product information and weather information.

C. Big-data and Big-Data Analytics

Big-data is a massive amount of data fetched from different sources and for extended period like sensor data, social networking data, and trading data it is in use for business data processing along with big data analytics to search for undisclosed patterns in the data. Big-data in agriculture domain is used for supply chain management of agro products to lessen the production payment.

D. Data Mining Analysis

Data mining is process of examining data to find some patterns hidden in the data. Data mining have been used for analyzing the soil types and properties to classify them. Soil data mining is beneficial for crop prediction and determining the better crop sequence based on previous crop progression in the same farmland with the current soil nutrient facts.

E. Cloud Computing

Cloud computing administer sharing of resources with cheap cost. Cloud computing has been used as a storehouse of agriculture data. It has been used in agriculture sector along with IoT.

F. Agriculture Industry in India

Agriculture is the major source of income for the largest population in India and is major patron to Indian economy. However technological engrossment and its usability still have to be grown and cultivated for agro zone in India. Although few initiatives have also been captivated by the Indian Government for providing online and mobile messaging assistance to farmers related to agricultural objection, agro vendor's information to farmers. It provides stable data related to soil quality at each part. The system which utilizes real time data of soil kind based on its current properties for decision making has not been put into progress. Soil characteristic determine the quality of soil. The soil pH value and amount of minerals in the soil is an important factor which determines the soil quality and type of crop production. Real time supervising of these properties helps to maintain soil health intact by applying only needed amount of fertilizers. Soil moisture analysis helps to apply the water whenever necessary avoiding wastage of water. The environmental circumstances such as temperature and moisture also affect the crop production. In this respect we require a dynamic model which collects such real time data. In support to this all agriculture material need to be connected to have decision making system to enhance the

production and ease the distribution of agricultural products from farmers to marketing firm and from vendors to farmers. Such system will also be responsible for controlling other frameworks like agro product rates.

Smart mobile phones are available now days to many consumers including in the rural areas. Beagle black bone is a cheap IoT tool which can be interfaced to soil and environmental sensors to collect soil properties and current environmental terms. This stimulates a cost effective and portable sensor kit for sensing the soil properties for current necessity of manure. The soil data from farmlands needs to be collected through sensor kit and sent to Agro Cloud storage for further processing. The collected big-data then can be analysed for the required actions for production.

II. PROPOSED INTERDISCIPLINARY MODEL FOR SMART AGRICULTURE

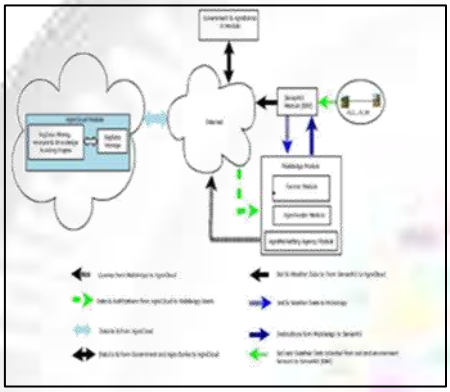

Fig. 1: Proposed Architecture

The proposed architecture of multidisciplinary model as shown in figure 1 consists of the five modules:

- SensorKit Module.
- MobileApp Module.
- AgroCloud Module.
- Big-Data Mining, Analysis and Knowledge Building Engine Module.
- Government & Agro Banks UI

Sensor Kit module is portable IoT device with soil and environment sensors. MobileApp module provides interface to the users. Agro Cloud Module consists of storage, Big-Data mining, analysis and knowledge building engine and application module to communicate with the users. Government and AgroBanks user interface is a web interface for information related to agricultural schemes and loans.

A. SensorKit Module

This module is an important part of this architecture and is responsible for soil sampling at periodic intervals to get soil property values.

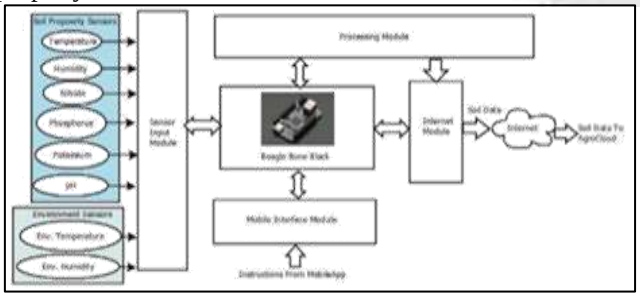

Fig. 2: Shows SensorKit module.

SensorKit is a cost effective and portable kit in which we have considered the use of beagle black bone which is IoT enabled device with memory and processing capability, GPS sensor to detect the positional information. The major components of this kit are soil nutrient sensor devices connected to it. Soil attributes sensors we have considered for this model are soil pH sensor, soil moisture sensor, minerals absorbing sensors which are interfaced to the IoT device.

B. MobileApp Module

Mobile applications need to be installed on the end users mobile phone. It has three parts.

- UI for farmer
- UI for agro marketing agency
- UI for agro vendors including fertilizer, pesticide providers and seed providers. Initially the end user has to register to the mobile app with few credentials including identity information, user type, address, geographical locations and other necessary details. If end user is farmer then has to send few credentials regarding the farmland information consisting of approximate location and total area for each farmland. The soil information per farmland is gathered through SensorKit. SensorKit gets the required instructions from MobileApp. The information will be sent and stored on AgroCloud Big-Data storage. SensorKit also collects and sends the soil information to cloud storage when the crop cultivation is in progress. Through these app farmers get suggestions regarding the fertilizers required and its amount for better crop results and cost savings. This app is also used for sending the notifications to the users. When the crop is harvested, the total production information for each crop will be sent to the cloud storage from the farmer along with current soil characteristics after cultivation of that crop. This information is stored in the cloud storage along with the time-stamp details.

Agro marketing agencies responsible for purchasing harvested crops from farmers has to send the periodic updates related to changes in cost and their purchase requirements. Agro product vendors are responsible for selling fertilizer, seed, and pesticide and agricultural equipment's. Agro vendors have to send updates related to products and cost changes periodically. Mobile application module is shown in figure 3.

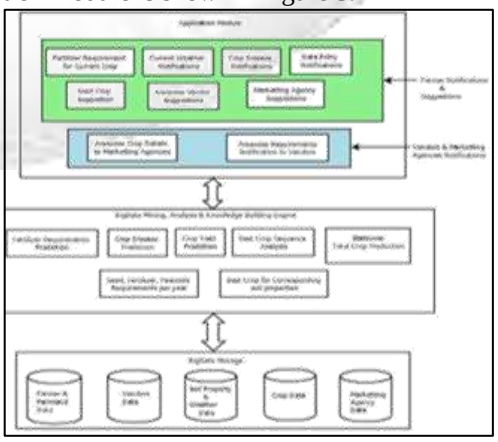

Fig. 3: Mobile application module

C. AgroCloud Module

All the users of agriculture sector needs to be registered to AgroCloud through MobileApp. AgroCloud storage consisting of Big-Data storage will store all the details of farmer, agro marketing agent details, and agro vendors and service providers (fertilizer/pesticide/seed and agro equipment providers) details and government schemes for agriculture sector including bank loans for farmers and concessions given on seed and/or fertilizers.

This module also stores periodic data collected through soil and environment sampling. As larger and larger number of end users gets connected to this service and the data size grows rapidly over the time resulting into the Big-Data. The AgroCloud module with Big-Data storage, Big-Data Mining, Analysis and Knowledge Building Engine and application module is shown in figure 4.

Fig. 4: AgroCloud module with Big-Data storage, Big-Data Mining, Analysis and Knowledge Building Engine and application module

D. Big-Data Mining, Analysis and Knowledge Building Engine Module

This module resides at AgroCloud and as shown in figure 4 plays important role in decision making for the fertilizer requirements for current crop based on current soil properties for better yields, crop disease prediction based on current soil properties and current weather conditions, crop yield production, best crop sequence analysis from the data collected over the period, best harvest for corresponding soil properties, watering required based on soil moisture level. This database also provides details of region sensible crop production details for each crop, total crop production for each crop in the state, based on this and current needs for the consumers will be helpful to control the costs for each agro product.

As this database collects data over the years for soil characteristics and crop details with its production amount for each farmland, inference outcome with data mining can be determined for better crop sequences to be carried for best production and to protect good soil health. As well as this database can provide resolution to the farmers for crops to be taken on the farmland with unique soil properties based on previous stock of agro products and current requirements in the market. Bigdata analysis can be carried out to evaluate future production of each product based on previous knowledge base.

E. Government and AgroBanks UI

Through the user interface of this this module ministry of agriculture will be able to provide the details of recent schemes and subsidies for farmers and agriculture sector. Agricultural banks also provide the details of loan schemes through the UI. All these details will be stored on the AgroCloud storage and farmers and other beneficiaries who are registered on the AgroCloud storage will get this information through notifications when the schemes and subsidies are announced without physically visiting and enquiring to the government offices.

In this paper we have proposed a multidisciplinary approach for smart agriculture using five key technologies: Internet of Things, Sensors, Cloud Computing, Mobile Computing and Big-Data Analysis. Through real time sampling of soil farmer will be able to get current fertilizer requirements for the crop. This is an essential requirement towards agriculture sector in India to get improved crop production with reduction in cost of fertilizer requirements keeping soil health intact. As the data is collected over the years for crop details and soil conditions, this model provides Big-Data analysis for best crop sequence, next crop to be cultivated for better production, total crop production in the area of interest, total fertilizer requirements, and other data of interest can be analysed. As all the agriculture related entities are connected together, this will also facilitate the distribution of harvested crops to the agro marketing agencies and farmers will also be able to get required agriculture products and services from agro vendors. This model also facilitates the estimates of total production per crop region wise and state wise, total fertilizer requirements. This will be helpful to keep the cost of agricultural products in control. Through notifications farmers will also informed about current schemes for agriculture.

Our future work will be focusing on interfacing dissimilar soil nutrient sensors with beagle black bone and analysing the results to get correct and better results, implementing this model and collecting data from various farmlands, analysing data mining algorithms suitable for agricultural Big-Data analysis for getting the desired outcome.

III. CONCLUSION

Although agronomic has been adopted in few countries; the agriculture industry in India still needs to be renovated with upcoming technologies for better production, dispersion and cost efficient.

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