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Implementation of Technologies for Evolution in Agriculture

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Abstract*: As India is rightly said "The land of Agriculture", the main part of income in India is agriculture. Ever since people learned to grow crops, harvest and sell them to market. But the farmers are not aware about the fact that changes in weather conditions, pests, soil fertility and diseases etc. affects the final outcome and they have grown the same crops for centuries. Now there is need to formulate techniques for smart and sustainable agriculture. Smart in sense, employment of technologies such as IoT, Cloud computing, Big data etc. In this proposed system, we emerge sensors into farmland and then Soil and environment properties are sensed, are periodically sent to cloud through IoT. The Cloud is used to store the details of farmers, periodic soil properties of farmlands, and current environmental conditions also information about crop diseases. The Big data analysis on data is done for fertilizer requirements, best crop sequence analysis, and for better cop production.

Index Terms*: Smart Agriculture, Internet of Things, Cloud Computing, Android Application and Big data analysis.

I. INTRODUCTION

Agriculture is the major source of income for the largest population in India and is major contributor to Indian economy. However, technological involvement and its usability still have to be grown and cultivated for agro sector in India. Although few initiatives have also been taken by the Indian Government for providing online and mobile messaging services to farmers related to agricultural queries, agro vendor's information to farmers, it provides static data related to soil quality at each region. The system, which utilizes real time data of soil quality based on its current properties for decision-making, has not been implemented. Soil properties determine the quality of soil.

The soil pH value and amount of properties like Nitrate, Phosphate and Potassium in the soil is an important factor, which determines the soil quality and type of crop production.

Real time monitoring of these properties helps to maintain soil health intact by applying only required amount of fertilizers. Soil moisture analysis helps to apply the water whenever necessary avoiding wastage of water. In addition, environmental conditions such as temperature and moisture also affect the crop production and crop diseases. In this respect, we need a dynamic model, which collects such real time data. In support to this, all agriculture entities need to be connected to have decision-making system to increase the production and ease the distribution of agricultural products from farmers to marketing agencies and from vendors to farmers. Such system will also be responsible for controlling other parameters like agro product rates.

Pic controller, which can be interfaced to soil and environmental sensors to collect soil properties and current environmental conditions. This motivates to develop a cost effective and portable sensor kit for sensing the soil properties for current requirements of fertilizers. 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 analyzed for the required actions for production.

II. LITERATURE REVIEW AND PROBLEM DEFINITION

A. Problem Definition

We see farmers take crop in crop field without knowing the Fertility, nutrients and pH values of soil. Taking crop without understanding these all information could not make production well. Trying to grow crops without knowing the soil pH or fertility levels of each crop field is like driving a car with broken speedometer; eventually you are going get in trouble. Farmer takes crop without any information, which is related to the soil and use large amount of fertilizers, which are sometimes not required for the soil to grow crop. For these fertilizers farmers spend more money for. The centers for Agriculture, Food and Environment does the sampling of soil and most of the farmers rely on soil analysis results realizing this fact. Soil sampling involves the analysis of a soil sample to give you clear information on the soil. This will include its nutrient content, composition and other characteristics that are important to plant health, such as acidity and pH level and detrimental contaminants.

B. Drawbacks

Limitations of existing work

1) Time-consuming process
2) Manual Process
3) Inefficient
4) Economical overhead
5) Require more human interaction

III. METHODOLOGY

This proposed system explores the potential of Wireless Sensor Network (WSN) and Internet of Things in the area of agriculture in India. Farmers have already begun to employ high-tech farming techniques and technologies. With the evolution of precision agriculture wireless sensor networks era of great use in the field of agriculture for measuring temperature, humidity, soil PH, light intensity etc. With the emergence of Internet of things (IoT) farmers can use their smart phones or computers to remotely monitor their crops, and rewarded with information about possible diseases on crops. This paper conducts a survey on smart agriculture technologies in order to formulate an understanding of different techniques for smart and sustainable agriculture. Here it also addressed a simple conceptual model based on Cloud, Big data mining and analysis. In farming there farmer makes use of water without having knowledge about the requirement of water level to the particular soil. More use of water to the soil is harmful for the soil that is it reduces the productivity level of soil. Here in proposed system we will focus on water treatment to soil.

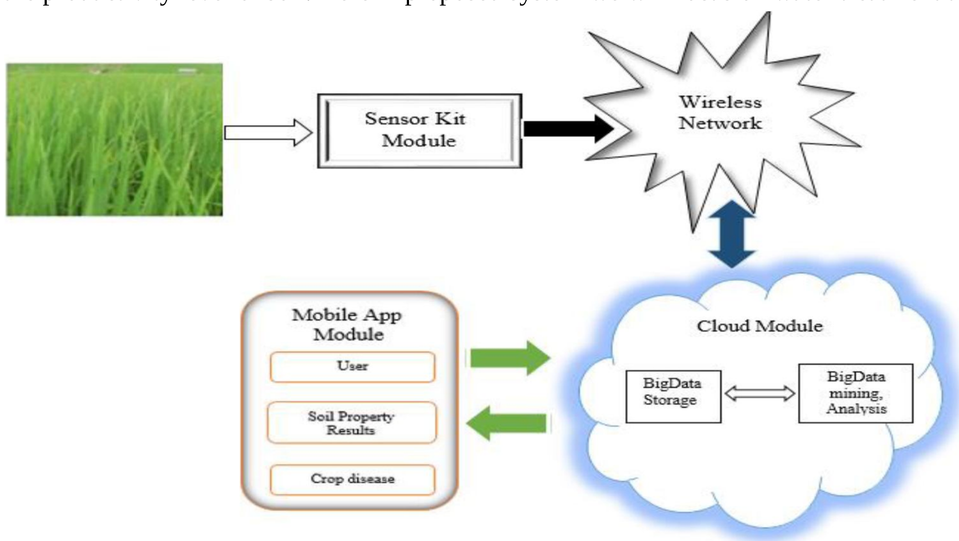

Figure 1: System architecture

System architecture delivers the knowledgeable elements, relationships among those elements, and the rules governing those relationships comprises a system. The architectural components and set of relationships between these components that an architecture description may consist of hardware, software, documentation, facilities, manual procedures, or roles played by organizations or people.

The proposed architecture of multidisciplinary model for agriculture is as shown in figure 1 consists of the four modules:

Sensor Kit module is portable IoT device with soil and environment sensors. Cloud Module consists of storage, Big-Data mining, analysis and knowledge building engine and application module to communicate with the users. Android App module provides interface to the users.

A. Sensor Kit Module

This module is important part of this architecture and is responsible for soil sampling at periodic intervals to get soil property values. Sensor Kit is a cost effective and portable kit in which we have considered the use of pic controller which is IoT enabled device with memory and processing capability. The major components of this kit are soil nutrient sensor and environment sensor devices connected to it. Soil attributes sensors we have considered for this model are soil pH sensor, light sensor ,soil humidity sensor, rainfall sensor, water-level sensor which are interfaced to the IoT device.

B. Agro Cloud Module

All the users of agriculture sector needs to be registered to Agro Cloud through Android App. Agro Cloud storage consisting of Big-Data storage will store all the details of farmer, agro marketing agent details, and agro vendors and service 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 are get connected to this service and the data size grows rapidly over the time resulting into the Big-Data.

C. Big-Data Analysis and Mining

This module resides at Agro Cloud and as it 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 prediction, best crop sequence analysis from the data collected over the period, best crop for corresponding soil properties, watering required based on soil moisture level. This database also provides information of region wise crop production details for each crop, total crop production for each crop in the state, based on this and current requirements for the consumers will be helpful to control the costs for each agro product.

As this database collects information over the years for soil properties and crop information details with its production amount for each farmland, inference results with data mining can be calculated for better crop sequences to be carried for best production and to preserve good soil health. As well as this database can provide suggestions to the farmers for crops to be taken on the farmland with peculiar soil properties based on previous stock of agro products and current requirements in the market. Big data analysis can be carried out to estimate future production of each product based on previous knowledge base.

Application module at the cloud storage is used for sending the notifications to the users, suggestions based on analysis, crop disease notifications based on current weather conditions and previous knowledgebase.

D. Android App Module

New user has to register with all of his details to access the data. User can registered through Android application. User who has already registered, he can login with authorized username and password. After getting log on to application, he will be able to access data for cloud. Mobile application will give current properties of soil. Also it will be responsible to give suggestions about the production rate, Fertilizers, Future Diseases etc.

IV. RESULT ANALYSIS

There are at least 16 elements known to be essential for plant growth. Carbon (C), hydrogen (H), and oxygen (O) are derived from carbon dioxide (CO2) and water (H2O). Nitrogen (N), phosphorus (P), potassium (K), sulphur (S), calcium (Ca), magnesium (Mg), boron (B), chlorine(Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn) are normally derived from the soil in the form of inorganic salts. Ninety-four to 99.5 per cent of fresh plant material is made up of carbon, hydrogen and oxygen. The other nutrients make up the remaining 0.5 to 6.0 per cent.

Following table shows the source of nutrition for plants.

Table 1. Essential Plant Nutrients

Supplied from air and water	Supplied from soil and fertilizer sources	
	Macronutrients	Micronutrients
Carbon (C)	Nitrogen (N)	Zinc (Z)
Hydrogen (H)	Phosphorous (P)	Copper (Cu)
Oxygen (O)	Potassium (K)	Iron (Fe)
	Sulphur (S)	Maganese (M)
	Calcium (Ca)	Boron (B)
	Magnesium (Mg)	Chlorine (Cl)
		Molybdenum (Mo)
		Cobalt (Co)

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A. Soil pH

Soil pH is a measure of the soil's relative acidity or basicity. The pH scale ranges from 0 to 14. A pH of 7 is a neutral state, representing the value found in pure water. Values above 7.0 are basic, while values below 7.0 are acidic. The pH scale is logarithmic, meaning each unit has a 10-fold increase of acidity or basicity. Thus, compared to a pH of 7.0, a pH of 6.0 is ten times more acidic, and a pH of 5.0 is 100 times more acidic.

Table 1–2. Relative Amounts (out of 100) of the Essential Nutrients Required by Most Plants

Primary Nutrients	
Carbon (C)	45
Oxygen (O)	45
Hydrogen (H)	6
Nitrogen (N)	1.5
Potassium (K)	1
Phosphorus (P)	0.2
Secondary Nutrients	
Calcium (Ca)	0.5
Magnesium (Mg)	0.2
Sulfur (S)	0.1
Micronutrients	
Iron (Fe)	0.01
Chlorine (Cl)	0.01
Manganese (Mn)	0.005
Boron (B)	0.002
Zinc (Zn)	0.002
Copper (Cu)	0.0006
Molybdenum (Mo)	0.00001
Amounts unknown for Nickel (Ni) and Cobalt (Co)	

Following two figures shows an output screens.
Properties of current weather and soil
Suggestions based on current properties.

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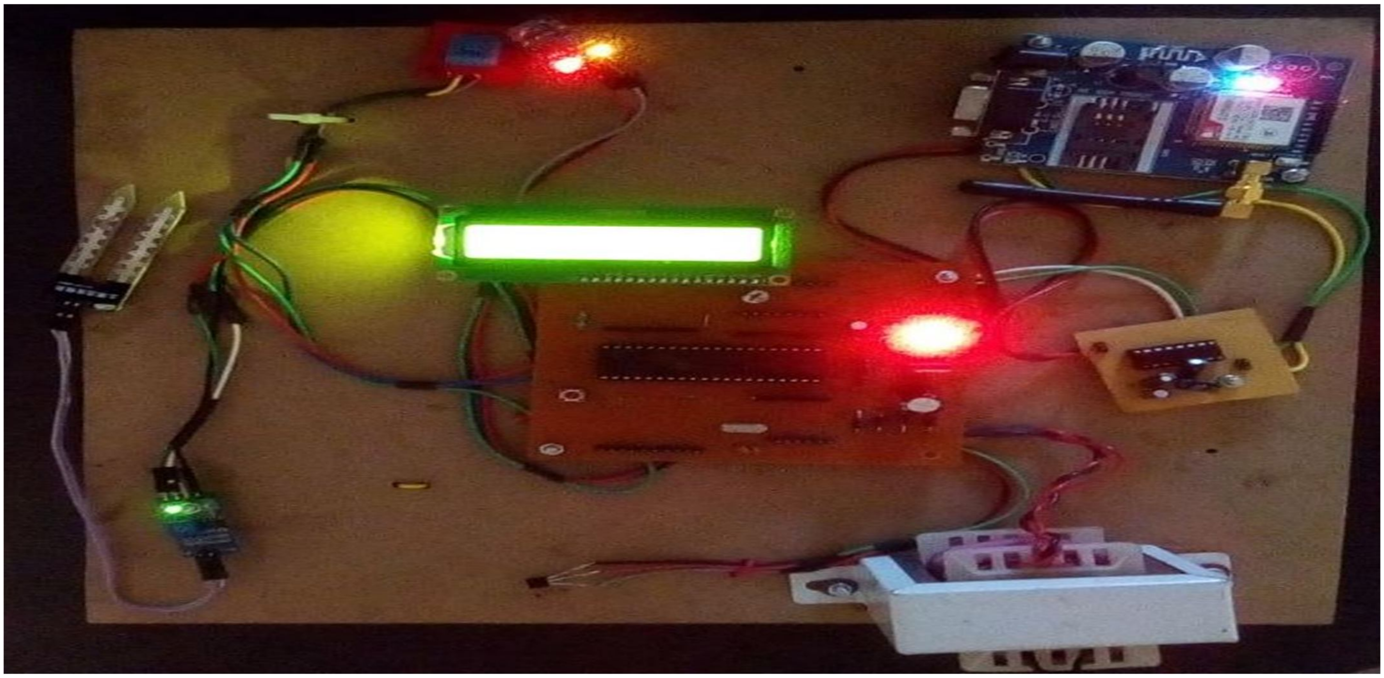
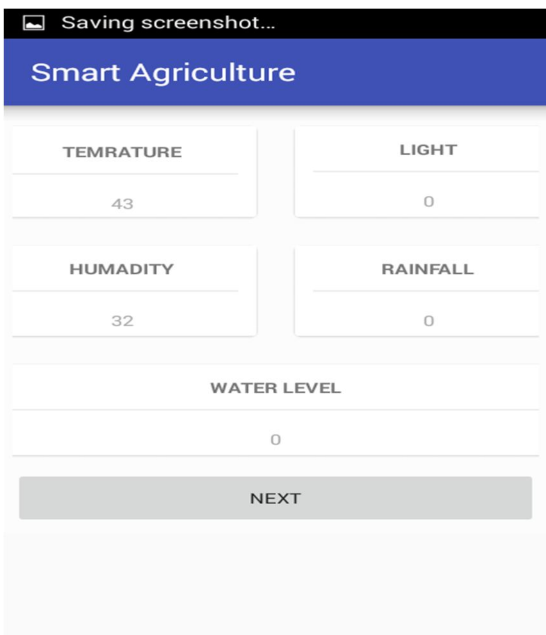
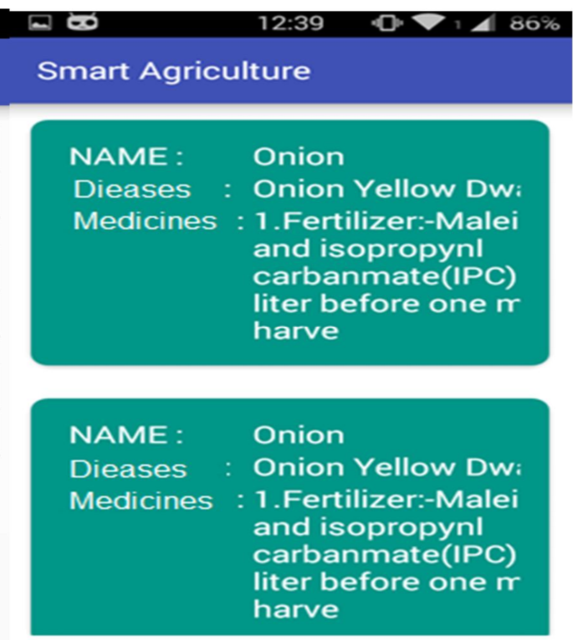
B. Experimental Modules







V. CONCLUSION

In this paper we have proposed an evolutionary model for smart agriculture by collaborating recent technologies: Internet of Things, Sensors, Cloud Computing, Android application and Data analysis. System is developed to collect the data from farmland and sent it to server, after which analysis on collected data will be performed at server side itself and will send suggestions as result to particular registered user's mobile application. The system will help farmers to get good advice to take better care of crops and helps to increase their productivity. Use of technology will help farmers to grow a better quality of crops and will keep updated about their crops better growth. Predictions will keep the farmers aware of the current state of their lands fertility so that growth can be predicted as well.

VI. FUTURE SCOPE

Our future work will be focusing on interfacing different soil sensors which will collect the more detailed soil properties at real time using begal black bone and analyzing the results to get better results. We would implement a model that will be built into several farmlands and storage platform that will store the huge amount of data at the same time, we could collect these data from several farmlands and can analyze it to judge information about farmland and their productivity. Likewise we can determine the agricultural information of whole region according to their soil property, Production (Yearly), changes in temperature that affect the farming, etc.

Also as in app we are suggesting a fertilizer for particular disease, we would add a module which will show them nearest shops where they could buy the fertilizer also online buying facility of those fertilizers, which would be done by agreement with Government, shop owners and Banks.

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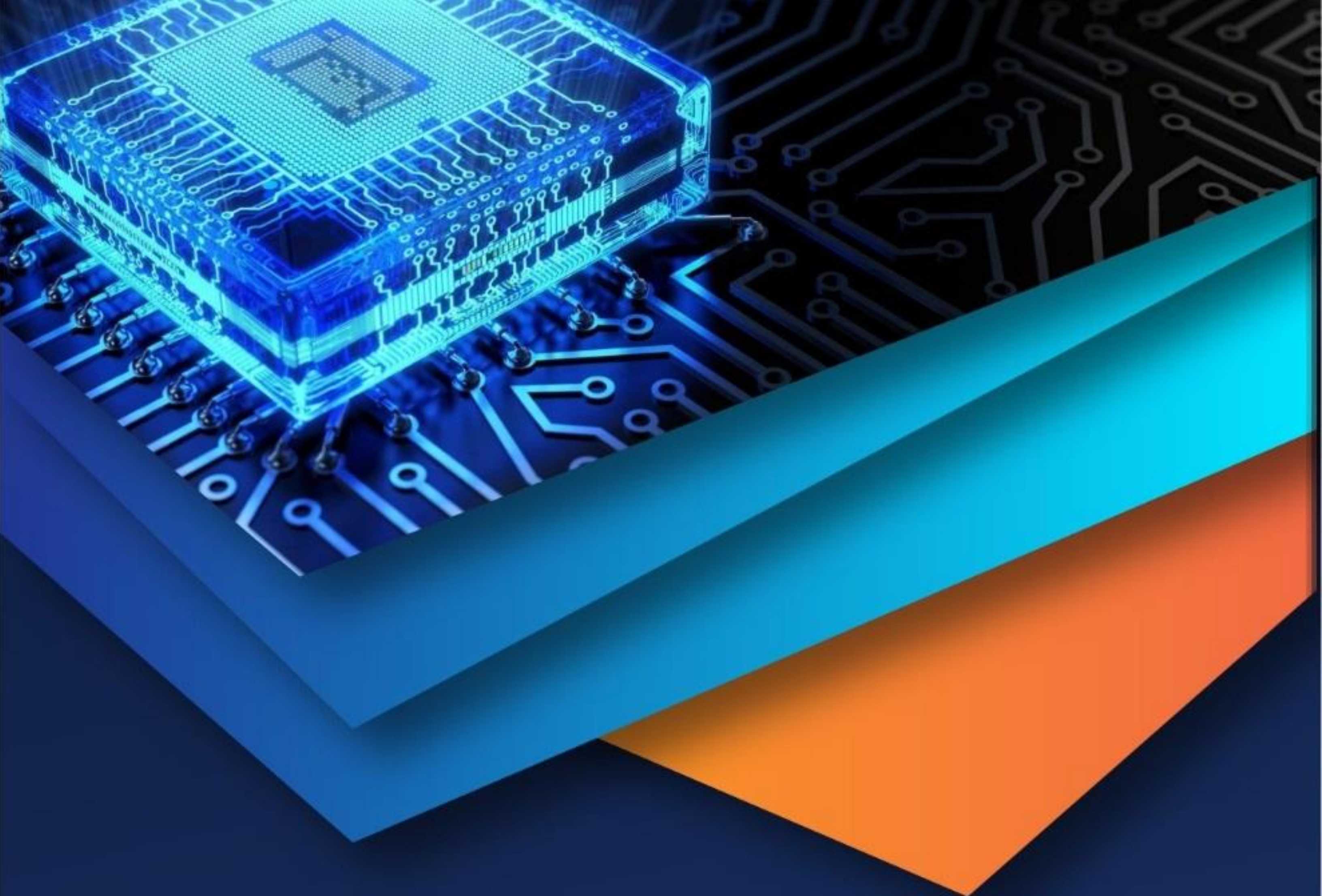

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