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IOT BASED SMART AGRICULTURE SYSTEM

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Abstract: Smart agriculture system aims at mitigatingthe primitive tedious techniques of agriculture. We use Internet of Things (IOT) concepts which is a system of interrelated computing devices, mechanical and digital machines, objects that are provided with unique identifiers. IOT has the ability to transfer data over a network without requiring human-human or human-computer interaction. Our system includes IOT pH sensor which detects the pH level of the soil. Here the N,P,K values are taken manually. By taking temperature and water content from the CSV file, pH level of the soil and N,P,K values the crops that is suitable to grow in that land is predicted using Decision tree algorithm and suggested to the farmers. The crops that are in demand for a particular festival are informed in prior to the farmers. We have built aweb application where the customers can specify their crop requirements. The farmers can cultivate the crops based on the crops that we suggest, and festival and industry requirements, and sell them through our application.

Keywords: pH sensor, Arduino Uno, Cloud server, Decision Tree Classifier, NodeMCU ESP8266

I. INTRODUCTION

Agriculture is the basic source of livelihood of people in India. It observed that there is not much crop development in agriculture sector. Food prices are continuously increased because the crop production is declined. It has pushed over 40 million people in the world into poverty since 2010. The factors which are responsible for this is due to in-efficient crop selection, water wastage, etc. It is very essential to make effective intervention in agriculture and the solution is IOT in integration with pH sensor which detects the pH level in the soil and details are sent to the server by connecting pH sensor with Arduino board. Other parameters are taken from the CSV file. Based on these parameters and the crops that are on demand for that festival season, suitable crops are predicted. After growth of the crops the farmers can directly sell the crops to the owner of the industries through our application. This helps the farmers to avoid the intrusion of the middlemen who purchase the crops at lower rate than the original rate and sell the crops at higher price than they purchased, through which they are profited.

Arduino based controlled irrigation system is designed using Wi-Fi module. It detects the moisture content, pH level and temperature using moisture sensor, pH sensor and temperature sensor. Arduino board should connect with all types of sensors, power supply, Wi-Fi module and two motors which are used to drive the pumps. When power get turn ON, arduino board get triggered and collects data from all sensors and link the data to the cloud. The data is sent to the IoT platform which can access through smartphones and PC. The main advantage is that owner of the farm can remotely monitor their farm [1]. The purpose of this project is to provide embedded based system for soil monitoring and irrigation to reduce the manual monitoring of the field and get information via mobile application. The soil is tested using various sensors such as pH sensor, temperature sensor and humidity sensor. Based on the result, the farmers can cultivate the appropriate crop that suits the soil. The sensor values are sent to the field manager through the Wi-Fi router and the crop suggestion is made through mobile application [2]. Internet of things is introduced for monitoring the soil parameters including pH level, soil moisture, temperature and humidity. The soil parameters are detected and monitored using various sensors like pH sensor, temperature and humidity sensor, soil moisture sensor and infrared sensor. Infrared sensors are used in order to detect disease in plants. The sensors are connected to the raspberry pi using jumper wires and raspberry pi is connected to the personal computer for displaying the details about the soil parameters. The values detected are stored and updated in cloud server for future. Also an application is developed for farmers in order to know the pH level of nutrients in soil, soil moisture and temperature for efficient productivity of crops [3]. The android based app “Virtual Fruits Market” is developed to give India’s huge farming community a fair and consistent price for their produce. In this system the farmers register himself and get their id and password. These credentials can be used to login to their account through which they can upload the fruit details. The customer will search and se the available fruits and all related details about fruits updated by the farmers. The customers can buy fruits directly from the farmers by going to the farm [4]. Selection of crops is an important issue for agriculture planning. It depends on various parameters. Many researchers studied prediction of yield of crop, soil classification and crop classification using machine learning techniques. A technique named Crop Selection Method (CSM) is used to select sequence of crops to be planted over season. The proposed method resolves selection of crops based on prediction yield rate influenced by parameters. It takes crop, their sowing time, plantation days and predicted yield rate for the season as input and finds a sequence of crops whose production per day are maximum over season [5]. This is an application that serves as a platform for movement of agricultural products from the farms directly to the customers or retailers. This mobile and web application provides privilege for both farmers and consumers or retailers to buy and sell the required farm products without involvement of a middlemen at its right profitable price. The agriculture experts shall analyze the product that comes into this platform, approve it and provide

ratings based on quality. This makes all the available farm products easily accessible [6].

PROBLEM STATEMENT

Agriculture is a science and technology for cultivation, agricultural products of various crops will use various methods and techniques for growing crops. The farmer's economic growth depends on the growth of the crops. Unfortunately most of the farmers use the traditional way of farming, where the problems arise due to in-efficient detection of growth factors of crops like pH, temperature, moisture of the soil. This leads to the degradation of quality of the crops. The farmers mostly sell their crops into nearby markets. But some crops are taken by middlemen at the cost lesser than the crop's value and sell it to the restaurants, industries, etc., which might cause huge profit to the middlemen and farmers face the losses.

II. EXISTING SYSTEM

In the existing system, the farmers visit to a nearby soil testing lab by carrying the soil sample. The soil is tested and factors like pH, temperature and humidity contents are detected and the suitable crops and fertilizer are suggested to the farmers based on some books or websites which might not be accurate. The quality of crop might get lowered due to improper suggestion of crops to the farmers. The crops get degraded due to irregular water supply by not knowing the soil moisture level of the soil properly. The crops are sold by the farmers to the market, but the middleman will purchase the crops and sells it to the customers.

III. PROPOSED SYSTEM

We have proposed an IOT based smart agriculture system is proposed to overcome the limitations of the existing system. In our proposed system five crops are predicted and suggested based on the soil parameters that were detected using pH sensor and considering CSV file and also the details of the crops that has maximum yield in previous years in that land.

Our online application helps to break intrusion of the middlemen. The middlemen are the one who purchases crops in the market at a lower price and sells it to large scale restaurants and industries at a higher price. The farmers and industry owners can register to our application by providing their unique ID number so that they can interact with each other and farmers can sell the crops directly to the industries without any middlemen intrusion.

Our proposed method consists of the following components:

Fig 3 a): Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The pH sensor is connected to the Arduino board via jumper wires. A set of analog pins of Arduino can be used to take analog signals from the pH sensor.

Fig 3 b): pH Sensor

The pH sensor senses, measures and also reports pH value of the soil. The pH stands for the measurement of the hydrogen ion concentration in the soil. The pH electrode has a single cylinder that allows direct connection to the input terminal of a pH meter, controller or any pH device which has a BNC input terminal. The data from the sensor is sent to NodeMCU ESP8266 via seial connection.

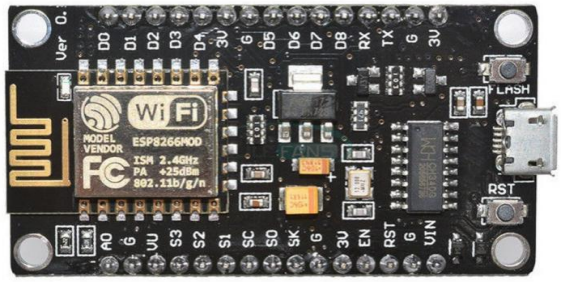

Fig 3 c): NodeMCU ESP8266

NodeMCU ESP8266 is an open-source Lua based firmware and development board specially targeted for IoT based Applications. In our system, Arduino Uno and NodeMCU ESP8266 are serially connected. Through this serial connection, the pH value detected by the sensor is sent to to the Arduino and then to the NodeMCU wife module. The data is then sent to the cloud server and stored.

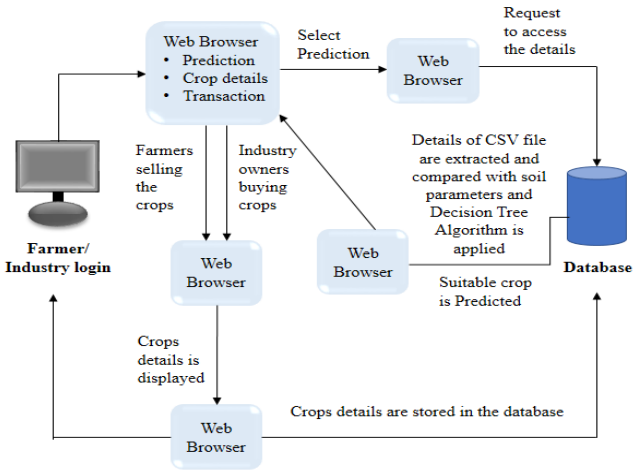

Figure 3 d): Proposed System Architecture

IV. METHODOLOGY

We have two parts in our proposed methodology:
a] Prediction
b] E-farming
Our proposed methodology mainly includes prediction and suggestion of crops and then selling the crops. It is explained as follows:
a] Prediction: For the efficient prediction crops, firstly we prepare a CSV file which hasN,P,Kmin and max pH, min and max temperature, soil type, min and max water content, min and max growth duration. All these parameters are collected based on an individual crop. We use soil pH sensor to detect the pH value of the soil. For the temperature and water content we have prepared a separate CSV file along with different district names. The N,P,K values that are taken from the farmers, pH level, temperature and moisture content values are considered and Decision Tree Algorithm is applied for the prediction of five best suitable crops for that particular soil nature. The soil parameters are compared with data in CSV file and prediction is done. By considering the water content level and growth duration of the crops, it is categorized into three set of crops based on the three seasons. The crops with growth duration <=130 are 1st set, growth duration<=180 are 2nd set, growth duration>180 are 3rd set. The predicted crops are suggested to the farmers. The crops that are in demand for a particular festival are considered the informed to the farmers in prior, so that they can get the benefit out of it.

b] E-farming:We have built a web application where the farmers can sell their crops to the industry owners. The farmers and industry owners can register to our application through the 13 digit unique ID given by the government of India. The farmers can upload their personal details such as name, phone number, district name and pin code. The crop details such as crop name and quantity available cab be uploaded by the farmers. The industry owners can upload their personal details such as Industry name, phone number, district name, pin code and CEO name. They can upload their crop requirements i.e., the crop name and the quantity required. The industry owners can contact the farmers directly and purchase the crops from them. This has a great advantage that the intrusion of middlemen is avoided.

The working of Decision Tree Algorithm
Decision trees are multiple algorithms to decide to split a node into two or more sub-nodes. The creation of the sub-nodes increases the homogeneity of resultant sub-nodes. The purity of the node increases with respect to the target variable. The decision tree splits the nodes on all available variables and then selects the split which results in most homogenous sub-nodes.

V. ADVANTAGES

The proposed system is easy to process and use. By considering some factors, we predict and suggest best suitable crops to be grown, to the farmers through which the crops productivity can be increased. The farmers can register to the web application that we have developed and put up their personal and crop details that are grown and industry owners also can register to our application and mention their crop requirements and interact with each other. The industry owners can directly purchase the crops from the farmers, so that the intrusion of middlemen is abridged. The farmers uses 13 digit unique ID given by the government of India for registration and hence our system is secured.

VI. EXPERIMENTAL RESULTS

The snapshots of the results are shown below. The system is capable of predicting right crops. The farmers can sell their crops to the industries.
Fig 6 (a) shows the login page for farmers and industries. Fig 6 (b) shows the crops that are predicted based on the soil parameters. Fig 6 (c) shows that the industry owners have successfully specified their crop requirements. Fig 6 (d) shows the crops that are available to purchase. Fig 6 (e) shows that the details currently available crops and also crops that are available in future are added. It can be deleted if needed.

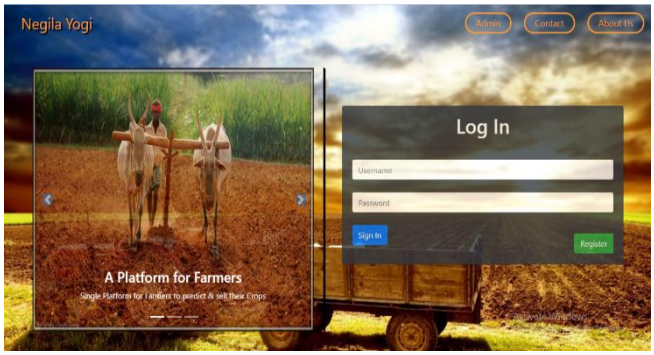

Fig 6 (a)

Fig 6 (b)

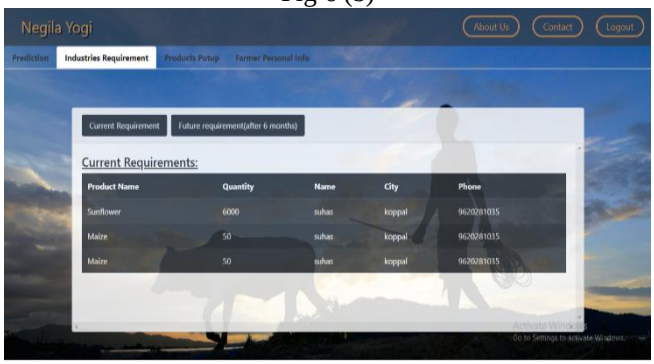

Fig 6 (c)

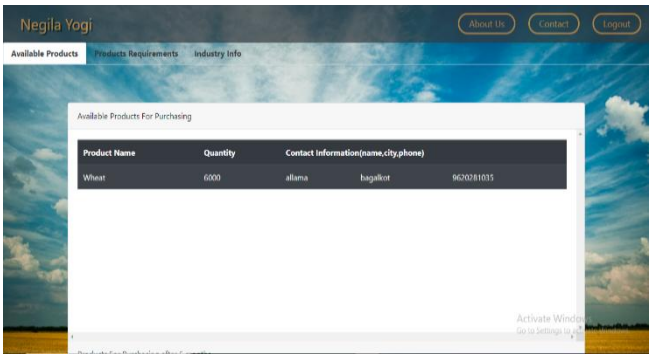

Fig 6 (d)

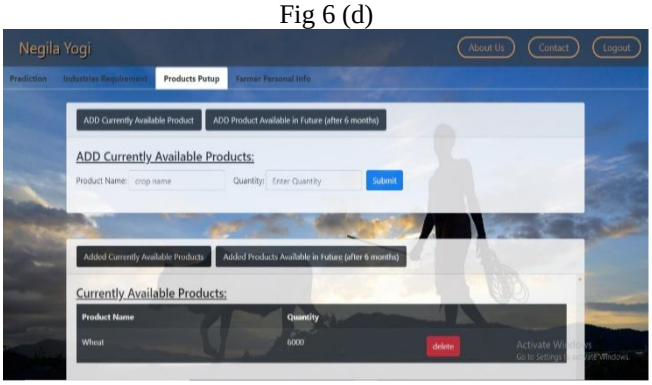

Fig 6 (e)

VII. CONCLUSION

The applications of Internet of Things have been diversified in various sectors, but the increasing leveraging has been seen in agricultural domain in the past few years. IoT Based Smart Agriculture System predicts the right cropand suggests to the farmers. Thus the farmers can cultivate the right crop increasing their yield and also the overall productivity.The online application is built through which the farmers can sell their crops directly to the customers which avoids the middlemen intrusion. Hence, profit can be optimized to maximum level for the farmers.

FUTUREWORK

To improve our present system, we can add N, P, K sensors in our system, i.e., we can fit the N, P, K sensor in the soil and fetch the values of N, P, K parameters of that particular soil land and predict the best suitable crop along with detecting the other soil parameter values which is already in use.

Cold storage facility or a frozen storage technique can be provided which refers to the storing of the crops at temperature that maintain them in frozen condition. In general low temperature reduces the growth rate of microorganisms and slows down the chemical reactions which helps to preserve the crops for longer duration.

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