Demand Based Crop Prediction Using Machine Learning Algorithm

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ABSTRACT

Agriculture sector is backbone of our country and it contributes about 18% of Gross Domestic Product (GDP) as per annual report 2018-2019 from Department of Agriculture, Co-operation and Farmer Welfare. Agriculture is the most important sector of the Indian economy that provides employment to almost half the population of the country's workforce. But still farmers are not getting profitable margin for their products in the market. Even though India is being a second-largest producer of fruits and vegetables in the world as per annual report 2018-2019 from Department of Agriculture, Co-operation and Farmer Welfare, farmers are financially distressed due to crop loss. The most important cause for this is due to the fact of inappropriate crops selection or additionally sometimes they didn't get precise price for his or her crop due to surplus production of the crop. By analysing the soil and environmental factor at particular region the best crop is predicted in order to have more crop yield. This prediction will help the farmers to choose appropriate crops for their land according to the soil type, temperature, humidity, water level, soil fertility. The objective of the project is to provide a system that helps farmers to select a suitable crop based on soil nature and environmental factors such as temperature, soil moisture, humidity and market demand using the technological advancement such as Data analysis, Cloud storage and Internet of Things.

KEYWORD : Internet of Things, Smart Farming, Cloud Computing

INTRODUCTION

Agriculture is the foremost division of the Indian economy that gives work to nearly half the population of the country's workforce. India is the second-largest producer of fruits and vegetables in the world. Agriculture is the backbone of Indian economy, since it has the largest contribution in the GDP of our country. But still the farmer doesn't get worth price of the crops. It mostly happens due to improper irrigation or inappropriate crops selection or also sometimes they did not get exact rate for their crop because of surplus production of that crop. By analysing the soil and atmosphere at particular region best crop are predicted in order to have more crop yield. This prediction will help the farmers to choose appropriate crops for their farm according to the soil type, temperature, humidity, water level, soil PH.

LITERATURE SURVEY

Christopher Brewster *et al.* (2017) plans to control industry partners and scientists who have embraced the assignment to fabricate huge scope pilots in farming that are intensely founded on IoT innovations. The IoT-related troubles and limitations for the agro-nourishment area are depicted together with the center targets of IoT-based LSPs. An arrangement of-frameworks engineering approach is proposed, with an accentuation on the interoperability angles which are basic for the take-up of IoT advances in the agro-nourishment part. The Agricultural Information Model methodology is proposed to address semantic interoperability, and a ranch to-fork the executives data framework arrangement guaranteeing information interoperability is delineated. There stay numerous difficulties including the requirement for new plans of action, security and protection and information administration and proprietorship arrangements, as they are basic for executing IoT-based LSPs in agro - nourishment. At long last, a nitty gritty record is introduced of the most suitable IoT advancements and agro-nourishment application to be utilized just as the principle key execution pointers to assessed the presentation of the proposed LSPs in a quantifiable way. The execution of such LSPs will without a doubt advance the use of IoT in agribusiness, along these lines streamlining different tasks in the whole nourishment store network bringing about diminished exertion and cost for the makers, and higher nourishment quality and security just as expanded nourishment mindfulness for the customer. In any case, the fundamental hindrance that should be defeated before IoT is broadly abused by the partners over the nourishment inventory network is the difference in culture.

Suyash S. Patil *et al. (2016)* proposes a system that uses Hidden Marko Model for data analysis and to detect the diseases of grapes plant in early stage which help the farmer to use little amount of pesticide and also provide suggestion of pesticides to protect the crop from that particular diseases. This system also helps the farmer get the information regarding the use of fertilizers, pesticides spraying and irrigation. It provides an efficiency rate of about 90.9% in classification.

Narongsak Lekbangpong *et al.* (2019) was proposes a design of an intelligent greenhouse feedback control system is designed for plant that grows only in cooler region and naturally has active ingredients against many diseases. This system collects and stores environmental factor such as Temperature, Air humidity, Soil moisture through WSN. Multiple linear regressions has beed used to analyse the observed data and makes alert to the user. Based on analysed result the system allows the user to control the environmental factors in the greenhouse. The system implements the control by using cooling systems, lighting systems, fogging systems, and irrigation systems. Farmer can control the environmental factor through web and mobile applications based on the alert from the system. Disadvantage of this system is it is designed only for constrained crops and also for the controlled greenhouse environment.

F. Viani *et al.* (2017) proposed a wireless decision support system for the enhanced supervision of the irrigation. Demoralized version of WSAN has been used to collect various environmental data required for smart irrigation system. The system uses Fuzzy Logic in order to mimic the human experience to get good knowledge about the crop status. By including Fuzzy logic in the system gives accurate suggestion to the farmer for daily irrigation schedule without any human input.

Zaminur Rahman *et al*. (2018) proposes a model that predicts the soil series and suggest suitable crop to be planted. This model has been tested on soil datasets of Khulna region. Different machine leaning algorithm has been tried and SVM has the highest accuracy in classification. Gaussian radial basis function is used as kernel function in classifying the non-linear data which is used to map data to higher dimension. SVM provides 94.5% accuracy in soil classification.

Suyash S. Patil *et al*. (2016) proposes a system which is designed as an Android Application, in which user has to feed their inputs to get the necessary information. Artificial Neural Network is employed for demonstrating that help in prediction and it is implemented using Feed forward Back Propagation Network. This paper suggest farmer a suitable crop for their land and also help in suggesting the fertilizer and also suggest whether the farmer chosen crop will provide high yielding or not. Disadvantage of this paper is user have to collect data by testing his soil in laboratory and weather data from weather station to feed the input to system. The system provides 92% prediction accuracy.[5].

1. PROPOSED SYSTEM

Suitable crop for particular land is predicted by considering parameter such as Nature of soil, Humidity, light, Soil moisture and market demand. Data from the sensor which are deployed in the field are collected via NodeMCU and sent to cloud for prediction of suitable crop for that particular land. Predicted crop list are sent to End User as SMS. End User can decide one of the crops from suitable list and how many acres he wish to cultivate and gives his input as a reply message to cloud. If the End User's selected crop supply satisfies the market demand threshold then threshold is updated in the server. Else End User gets message to select alternative crop.

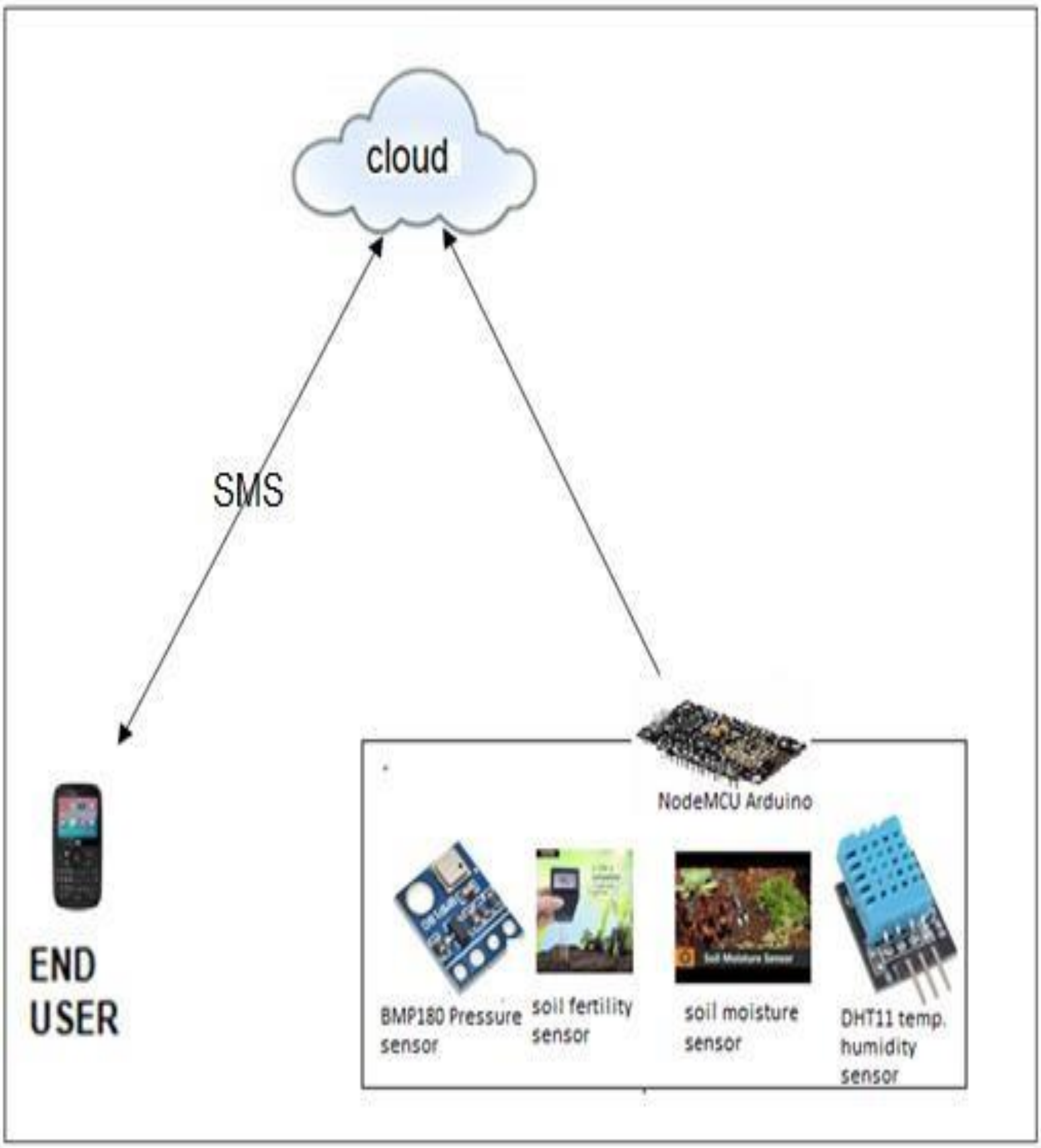

Fig. 1: System Architecture

2. FUNCTIONAL ARCHITECTURE

The functional architecture consists of three modules

Data collection is used to collect the data from the field through sensor and upload to the cloud through Node MCU.

Analyse and Prediction is used to analyse the sensor data to predict suitable crop list and send to the End User.

End User is used to select his/her own choice from predict suitable crop list and area he/she going to cultivate that particular crop to check for demand of the crop in market.

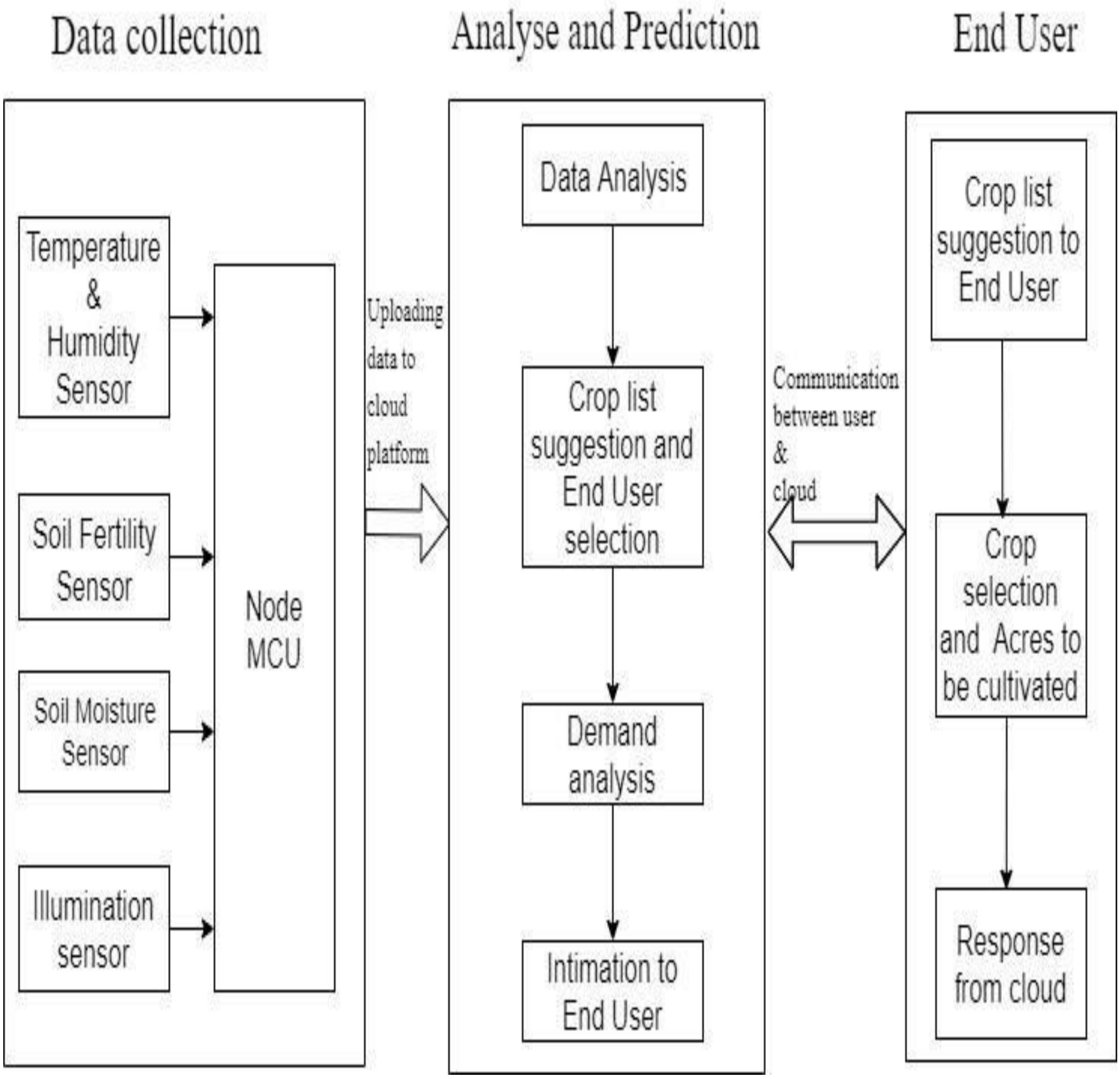

Fig. 2: Functional Architecture

2.1 Data Collection

The Data collection system is inbuilt with temperature and humidity sensor, soil fertility sensor, soil moisture sensor, illumination sensor, Node MCU Arduino. Data collection is the method of measuring a natural phenomenon such as temperature, humidity, light, moisture, soil fertility. A Data collection framework comprises of sensors, hardware, and a computer with programmable software. A power is supplied as 230V AC, a step- down transformer is used to step down the voltage from 230V AC to 15V AC. AC power is converted to DC power using bridge rectifier. Bridge rectifier contains four diodes. The main function of the task is that it allows only forward bias. Output of the register is 15V DC consisting of ripples which is called as pulsating DC. Capacitance is used to filter the ripples in pulsating DC to produce pure DC. 15V DC voltage can be stepped down to 5V DC voltage using a DC step-down converter called as voltage regulator. Finally, 5V DC power is distributed to DOT board, Arduino, sensors. Arduino is an open-source electronics platform that is easy-to-use hardware and software. The temperature and humidity sensors are used to monitor the temperature and humidity conditions and delivers digital output to Arduino. Soil moisture sensor measures the moisture and returns digital output. Illumination sensor measures light intensity and returns analog output to Arduino, then Arduino will convert analog to digital values.PH sensor is used measure PH value of the soil. Code for each sensor working are import from Arduino software and upload to NodeMCU through PC. The link is specified to which data has been sent to cloud for further processing.

2.2 Analyse and Prediction

MYSQL database has been created using PHP script. Table are created in the database and the data from the field are inserted into it. PHP uses $ GET command to fetch data from the table for processing purpose. Get method use HttpGet and HttpClient class to connect. The variables are passed as parameter in url to fetch the data or record from table. PHP is an open source scripting language which are executed on the server side. PHP has been chosen to write coding on the server side because it has lot of options such collecting data, send the result which can be viewed on the browser.

2.2.1 Prediction of Suitable Crops

Support Vector Machine has been used in decision making. The SVM is one of the most popular classification as well as regression algorithms, which is elegant, intuitive and includes some very cool mathematics. As the data are received from the field are analysed SVM is used to classify and predict the crop based on the threshold value of each parameter. The predicted crop list has been sent to farmer. SVM uses hyperplane or set of hyperplanes in a high- or infinite dimensional space. In case of nonlinear data, SVM uses a kernel function to plot the data into a higher dimensional feature space. The advantage of using SVM is its simplicity as it requires only a few parameters to optimize the model.

2.2.2 Demand Based Prediction

When the farmer receives the predicted suitable crop list, he/she replies the message. Then demand is calculated for the farmer selected crop. The demand is based on total crop consumed plus constant. The constant refers to some value which is used to balance a shortage in production due to some critical condition such as drought, flood, any disease attack. The constant value can be adjusted based on peopleconsumption.

2.3 End User

End User (farmer) receives the predicted crop list as a message, then he/she is supposed to select a crop from the predicted crop list and have to specify the number of acres he/she decided to cultivate particular crop through message from his/her mobile. After receiving the message demand for that particular crop are analysed if it satisfies the demand the farmer receives the message to proceed else the farmer is requested to select alternate crop. The demand is fixed based on the consumption. This can be used easily by farmer no training or knowledge are required. GSM module has been used for sending and receiving messages between the cloud system where the decision and processing are done and the farmer.

3. RESULT ANALYSIS

A prototype of the proposed architecture has been implemented. Sensor nodes mentioned in the Data Collection module are deployed and tested. SVM gives a highest accuracy compared to other machine learning algorithm and also its simplicity. Fig3 Shows the comparison of different algorithm for prediction of suitable crop. Table 1 shows the threshold values of each parameter required to predict suitable crop for the farmer.

Table 1: Threshold Valve considered for Prediction of crop

CROP	**TEMPERATURE (Fahrenheit)**	**PH**	**SOIL MOISTURE**	**HUMIDITY**
Rice	68 – 81	6	40%-58%	60%-80%
Tomato	55 -75	6-6.8	70%-80%	80%-90%
Potato	60 – 70	4.8-5.8	40%-50%	85%-90%
Ginger	83- 95	5.5-6.5	30%40%	65%
Wheat	54 -77	6-7	35%-45%	50%-60%

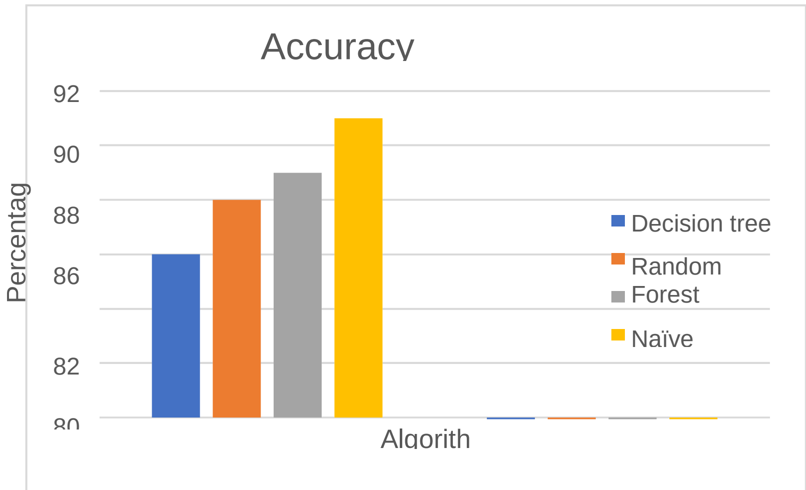

Fig 3: Accuracy graph

4. CONCLUSION AND FUTURE WORK

This system helps farmer to cultivate crops which are suitable to their land based on the soil nature, temperature, moisture and humidity. This system helps anyone without knowledge about their land can involve in farming in successful and profitable manner. One of the advantages is that this particular system does not require any smart phone or technology knowledge for farmers to use it and they can interact with the system through SMS via. Normal mobile phone, which makes this system more comfortable for usage. This help the farmer to cultivate the crop based on demand that helps them to get profitable price for their product in the market. In future, this system is integrated with the system that suggest the farmer about manure, natural pest control method to be used for their selected crop at time of requirement.

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