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Maximizing crop yield using IOT based system and MachineLearningAlgorithm

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Abstract:

Farmers are currently suffering from crop yield problems. Though crop selection is the main boosting key to maximise crop yield by doing soil analysis and considering metrological elements, the main reason for low crop production is a lack of information about soil fertility and crop selection.

Through IoT Robots, drones, remote sensors, and computer imaging, combined with constantly improving machine learning and analytical tools, are used in agriculture to monitor crops, survey and map fields, and Farmers may use the data to make more informed farm management decisions, saving both time and money.

Smart Crop Selection (SCS) and Crop Yield Prediction Algorithm (CYPA) models were exhibited in the survey report, as well as an IoT framework with a cloud database and smart crop prediction employing IOT devices and machine learning algorithms.

Iot monitors many elements such as humidity, temperature, soil, crop and so on and provides a real-time observation. Machine learning in agriculture is used to predict accuracy using algorithms like Decision Tree, KNN, Random Forest, and Gaussian Naïve Bayes.

Keywords **—IOT,Machine Learning**

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I. INTRODUCTION

The agriculture sector is the lifeline of human Beings and plays main role in economy. Crop selection was done by farmers using their crude understanding in traditional farming techniques.

Mostly, farmers prefer to select the trendiest crop in their areas or the crop in their neighbourhood. Due to a lack of scientific knowledge about farming and no rotation of crops, fertility of lands is affected negatively. Soil nutrients, ground water level, and fertiliser type are all important determinants in crop quality. A traditional farmer faces recurrent challenges. Soil acidity may increase due to selection of wrong crops and lacking soil nutrients. The unsure climate is the main factor for effecting crop's quality and yield. Soil fertility is an important factor for right crop selection and its health.[1]

Since farming is the primary source of income in emerging nations like India, agriculture is crucial to the nation's economy. Because almost 70% of the people in India relies on the agricultural sector for their survival and farming is their primary occupation, India is an agriculturally oriented country. Particularly in rural areas where you will observe that the majority of the population is entirely dependent on farming. This is due to two factors. First, they have inherited their ancestors' farming skills and wisdom.[4]

Farmers typically utilise manual intervention to control the greenhouse climate. They may obtain accurate real-time information on greenhouse parameters such as illumination, temperature, soil condition, and humidity by using IoT sensors. Weather stations can automatically modify the conditions to match the supplied parameters in addition to gathering environmental data. A similar idea is used by greenhouse automation systems.Farmapp and Grow link, for example, are IoT agriculture technologies that have similar capabilities, among others. [6]

The Internet of Things (IoT) is a technology that allow us to add a device to an inert object that can measure environmental parameters, generate related data and transmit through communication networks. By allowing for more direct interaction between the physical world and computer-based systems, IoT understanding in traditional farming techniques. Mostly, farmers prefer to select the trendiest crop in their areas or the crop in their neighbourhood. Due to a lack of scientific knowledge about farming and no rotation of crops, fertility of lands is affected negatively. Soil nutrients, ground water level, and fertiliser type are all important determinants in crop quality. A traditional farmer faces recurrent challenges. Soil acidity may increase due to selection of wrong crops and lacking soil nutrients. The unsure climate is the main factor for effecting crop's quality and yield. Soil fertility is an important factor for right crop selection and its healthCan enhance productivity, accuracy, and financial gain. [2]

Towards carefulness agriculture, IoT can be a key enabler. The formation of IoT systems is form on three layers: perception, network, and application. On perception layer, physical devices like sensors, RFID tags, and cameras are used for data collection. The network layer is where data is communicated and forwarded.. Application layer is used to combine IoT with specific domain of usage [1].

Historical sensor development is the progress in measuring various parameters such as temperature, pH, Humidity, Analytical parameters such as potassium, phosphorous, nitrogen measurements from a remote location and the data gaining is possible to attain all the measurements using sensors, and the data is then stored in the cloud or network server for further processing[3].

Machine learning (ML) is to teach machines how to handle the data more efficiently.Input dataset will divide into two pairs train and test.the train dataset have the output variables which needs to predicted or classified[5].

II. Related Work:

The proposed SCS system is based on real-time sensing of the soil parameters by sensors and the rain fall prediction on the basis of external dataset. The real-time data is saved in database on cloud, and ML algorithms are applied for analysis and prediction. An Ensemble Learning (EL) technique is applied on some distinct ML algorithms, i.e., Decision tree, Naïve Bayes, Support Vector Machine, K-Nearest Neighbour, and Random Forest. [1]

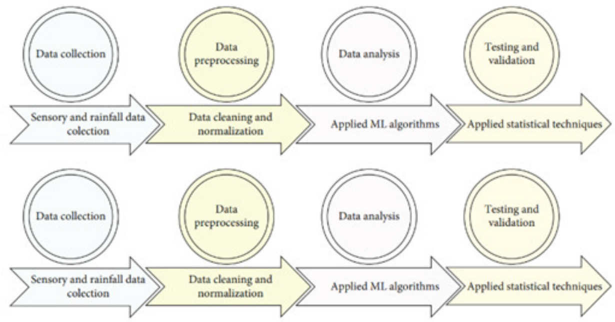

Fig 1: scs architecture

Data collection:

two dataset are used in a model. one dataset is used to train the model, and the other is used to test and validate the model.

Real time dataset is collected for the NPK, pH, EC, T, and H by connecting NPK, pH, and EC sensors with Arduino. Microcontroller.

The rainfall data of last 15 years is obtained from government website https://bakhabarkissan.com/.

Experiment will performed on two types of soils: loamy and clay

Data pre-process:

The real-time sensory data is usually in raw form. The data mining techniques are applied for data pre-processing.

As real-time data is coming from different sensors so there could be chance of getting errors. The pre-processing techniques are applied on dataset are given next.

Filling missing entries (cleaning) and feature scaling (normalisation): Because the user input in the rainfall dataset is string-based, a data transformation technique is used to convert string data into numeric form.

Data analysis:

After pre-processing the data, decision rules are applied on dataset. Standard parameter ranges for each crop are defined in decision rules.

ML algorithms are used for dataset training. The execution of each ML algorithms is compared and then concerned voting Ensemble technique on applied algorithms for better performance and good accuracy.

Testing and validation of the system:

A real-time sensory dataset is used. For rain fall and soil type attributes, a user input is gained from Android app. The findings of crop prediction are displayed on an Android application. This is very productive way to assist farmers.

The Crop production Prediction Algorithm (CYPA) uses many data sources to forecast annual crop yields, including climate, weather, agricultural production, and chemical data. The CYPA illustrates the implementation in two scenarios: (i) Machine learning methods; (ii) Statistical approaches (correlation). [2]

1 Using machine learning methods: Machine learning algorithms are used to anticipate the ten crop yields consumed globally. Wheat, paddy, rice, sorghum, sweet potatoes, soy beans, plantains, cassava, and other crops are among them.

i. Decision Regressor Tree

The Decision Tree Regressor is a straightforward method that can deal with both numerical and categorical input. It can also effectively manage missing numbers and outliers.

ii.Random Forest Regressor

Random Forest Regressor is a regression machine learning technique that predicts a continuous output variable based on input data. It is a method of learning that integrates many decision trees to produce a more accurate and robust model.

iii. Additional Tree Regressor It will construct an algorithm utilising untrimmed decision or regression trees. It differs from other tree-based group models. It begins by randomly splitting nodes based on the cut points chosen. Furthermore, rather learning a bootstrap copy, it develops the trees using the complete learned sample set.

2Using statistical methods (correlation): To test the impact of climate changes on crop yields, we follow two methods: (i) Pearson's Correlation Coefficient (PCC), and (ii) Multiple Regression (MR).

1 Pearson's correlation coefficient (PCC) to gauge how closely two variables are related to one another, correlation coefficients are used.

2 Multiple regression (MR) the second phase is using multiple regression analysis to determine how much the chosen features have an impact on drop yield.

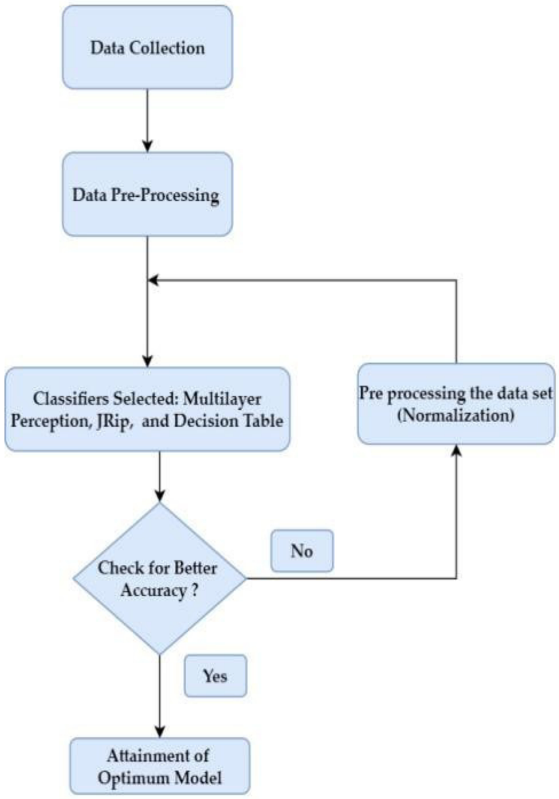

Fig2:Modellingofcroprecommendmoduleset up

This experiment's terms and materials are defined. [3]

1. Agriculture IoT Framework

The suggested solution involves transferring real-world data from storage media to a cloud database management system, from which the request is sent to the Machine learning trained model. The module's result is one of 22 possible crops for implementation.

2. Data Mining and Network Implementation

The basic level of design enables data capture and communication facilities.

The sensor network is linked with the gateway and the base station. The classification specification and algorithm module are included in the second level. The next level is implementing the ML algorithms to acquire the results from the server. A trained module on the server retrieves the specific crop for irrigation. The parameters like Nitrogen, Phosphorous, Potassium, and pH are measured using analytical sensors and stored in the module, Parameters like temperature, Humidity, and rainfall are measured using specific sensors and stored in the database. The assembled data is saved in a spreadsheet with the ground truth by having knowledge of the specified 22 different crops.

Classifiers Selected (Supervised Learning Algorithms) Some of the classifiers chosen for this module are The tree category includes multilayer perceptron, JRip, and decision table.

3.1. Perceptron Multilayer It is also known as a Feed forward neural network supplement. MLP is made up of three layers: the input layer, the hidden layer, and the output layer. MLP is unusual in that it can estimate continuous functions as well as linear functions.

3.3.2. Decision Table Rule-based classifier that classifies using a basic decision table. This classifier is made up of a hierarchical table whose entries are further subdivided by the values of a pair of additional features to build another table. This is similar to dimensional stacking.

3.3.3. JRip This classifier in the WEKA tool is a class-based prepositional rule learner, Repeated Incremental Pruning to Produce Error Reduction (RIPPER). The growing phase and the pruning phase are the two basic phases.

The technology attempts to assist farmers in making informed crop predictions. Along with live data, past data for temperature and humidity from the government website is collected and kept to improve accuracy. In addition, historical rainfall data is gathered and maintained. To be definite and accurate in crop prediction, the project analyses the temperature and humidity of the field - live data collected using the DHT-22 sensor and historic data collected from the government website and/or Google Weather API, type of soil - used by the farmer, and historic rainfall data. It is possible to accomplish this using either an unsupervised or supervised machine learning approach. A dataset is trained using learning networks.

The accuracy obtained by several machine learning approaches is compared in order to obtain the most accurate result, which is then presented to the end user. Along with the best crop, the system also suggests the best fertiliser for that crop. Farmers communicate with the system via a responsive, multilingual website. [4]

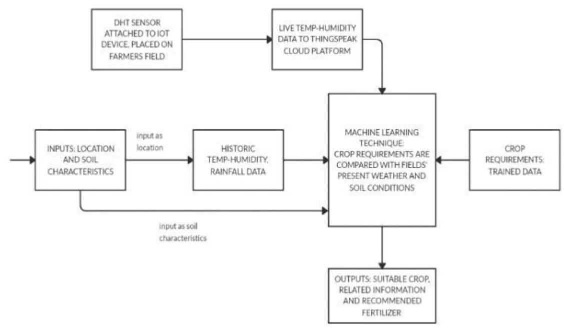

Fig 3:BoxModel

Digital Temperature & Humidity Sensor: The DHT22 sensor is preferred for monitoring live temperature and humidity. This sensor has been shown to be more precise and accurate. It measures the surrounding air with a capacitive humidity sensor and a thermistor and outputs a digital signal on the data pin to the Arduino Uno port pin. DHT22 has a humidity range of 0 to-100% RH and a temperature range of -40 to 80 degrees Celsius.

The functionality of the architecture is as follows:

The farmer logs in and provides the location of the field as well as the type of soil available for farming as input, which is then processed further in the website. The field is used as an input to collect historical data from the specified location. The historical data is gathered through the use of government websites or third-party applications such as APIs for weather and temperature, as well as the amount of rainfall in the region. By placing the IoT gadget on the pitch, live data is obtained. The Internet of Things gadget consists of a DHT 22 sensor for temperature and humidity linked to an Arduino UNO and an ESP8266 Wi-Fi module. Every hour, live data is captured and saved on the Thing Speak Cloud platform.

Live and historical data are collected. On this acquired data, the VAR (Vector auto regression) model is used to forecast rainfall, temperature, and humidity for a period of time when the farmer is intended to cultivate the crop.

This anticipated temperature, humidity, and rainfall, as well as the soil characteristics submitted by the farmer, are now fed into three separate machine learning algorithms:- Decision Tree, K-NN, and Support Vector Machine, in which the combination of the foregoing results and the predetermined data set, i.e. actual crop requirements from the crop data store, is compared. Finally, the most accurate result, i.e. the most suited crop, is displayed to the user by comparing the accuracy obtained by different machine learning approaches.

As an output, the farmer receives the most suitable produce from the website. Along with this, the end user is given all of the information about the crop and the optimum fertiliser to use.

III. Conclusion:

Farmers that use traditional farming practises face issues such as low crop output owing to unpredictability of weather, insufficient water and fertilisers, and incorrect crop choices. In this study, we propose an agricultural survey based on two new technologies: the Internet of Things and machine learning. Using both live and historical data improves the accuracy of the outcome. Comparing several ML algorithms also improves the system's accuracy. This method will be utilised to alleviate farmers' challenges while increasing the amount and quality of their job. Overall, this work demonstrates the power of IoT and machine learning techniques in solving the essential task of predicting crop yields, allowing for more informed decision-making.

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