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Crop Prediction using IoT and Machine Learning

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ABSTRACT: In India Farming is the primary means of financial sustenance for most individuals. It is part and parcel for sustainability. In our day-to-day life, we consume wide variety of agricultural products. Agricultural methods must adopt climate change in order to fulfill the increased demand. By understanding the weather conditions and their effect we can significantly increase production. IoT-enabled machine learning-aided farming improves the overall agriculture system by monitoring the field in real time. It keeps track of environmental characteristics such as humidity, temperature, etc. In the farming sector, ML is utilized to optimize crop output and the standard of yield. The application of appropriate algorithms to sensed data can aid in crop recommendation. This system which is based on the IoT and ML will predict the appropriate crop for the particular area. This system takes into account of two factors which are Temperature and other one is Humidity. This system takes the input data from the sensors and applies the ml algorithms such as Decision tree and SVM (Support Vector Machine).

KEYWORDS: Crop Prediction, IoT, Machine Learning, crop recommendation

I. INTRODUCTION

A. Purpose

This document provides a detailed description of “Crop Prediction using IoT and Machine Learning”. This includes the motivation, abstract, Literature survey, requirement analysis, Methodology used, conclusion, and references. This also explains the various parameters and its operating environment.

B. Product Scope

This project is primarily intended for local farmers. This project is designed to maximize the product yield by choosing the suitable crop according to the location-specific weather conditions. The major goal of this project is to increase crop production by optimizing the crop which is best for that temperature and humidity conditions. This project will predict the crops based on the local field parameters. It will be specific to only certain agricultural land.

C. Motivation

India is an agricultural first country. This agricultural economy is the country’s one of largest economic sectors and it is the major factor in the developing GDP of the country. Close to 60% of India’s land is used for farming and its related business for the fulfillment of the demands of the 1.3 billion people and 1/7 of the world population. Therefore, modern technology adoption and its usage is important for its growth.

This technological adoption will lead to profit for the farmers and thereby the betterment of the country's economy. The crop and yield predictions were made in the past but they were not as scientific and statistical as today. The previous study lacks specific knowledge of the environment and soil nutrients such as nitrogen, and phosphorus. The crop suitability not only based on the amount of minerals and supplements in the soil, the level of pH, etc but it also depends on external factors such as temperature, humidity, and moisture

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II. LITERRATURE SURVEY

Agricultural tactics were always applied to the whole field, or, at best, part of it. In agriculture, machine learning can greatly improve accuracy, allowing farmers to treat crops and animals almost independently, improving decision-making effectiveness.

Machine learning has proven to be a valuable tool in predicting crop yields by analyzing a variety of factors related to the environment and management practices. These factors include weather conditions, soil health, and the application of fertilizers. Machine learning algorithms have the ability to detect patterns and correlations in past data, allowing for accurate predictions of future crop yields. This information can help farmers make better decisions regarding crop planting, harvesting, and marketing, leading to more efficient and profitable farming practices. As machine learning models continue to improve, they are expected to have an increasingly significant impact on the field of agriculture.

Ashwani Kumar Kushwaha explains how to predict yields and suggests suitable crops to improve farmers' profits and the quality of the agricultural sector. In this yield forecasting paper, Hadoop platform and agricultural algorithms are used to obtain a great amount of information (data) called big data (soil and meteorological data). Therefore, based on data in the repository, they predict crop suitability for specific conditions and improve crop quality.

In the research paper given by Pawan Patil and others, they compared the accuracy of different machine learning algorithms like Decision trees, KNN, and Naive Bayes for crop prediction. They conclude that predictions show average results when dataset have variations. They also mentioned that naive Bayes provides impressive results compared to the decision tree. In the research pager given by Nishchita and others, for the rainfall prediction SVM algorithm is used and for crop prediction Decision tree is implemented. They have suggested that the accuracy of the outcome can be improved by taking data from the sensor input.

III.PROPOSED ALGORITHEM

The Random Forest algorithm is a popular classification method that builds multiple decision trees and combines them to produce more accurate results. It randomly selects a subset of the training data to create a decision tree, and this process is repeated several times to generate multiple trees. The classification decision of each tree is then combined to create a final output. Random Forest can handle both numerical and categorical data and is more resistant to overfitting than other decision tree-based algorithms. However, it can be computationally intensive and may struggle with imbalanced datasets.

The Naive Bayes algorithm is a classification method that uses Bayes' theorem to calculate the probability of each class given a set of features. It assumes that the presence of a particular feature is independent of the presence of other features. This algorithm is commonly used in text classification tasks such as sentiment analysis, spam filtering, and topic classification. The algorithm is simple, fast, and efficient, making it well-suited for large datasets. However, one of the main drawbacks of the Naive Bayes algorithm is that it assumes feature independence, which may not always be accurate, leading to suboptimal results.

Here is a simple pseudo code for the naive Bayes algorithm for classification:

1. Collect the dataset of labelled examples.
2. Calculate the prior probabilities for each class by dividing the number of examples in that class by the total number of examples.
3. For each feature in the dataset, calculate the likelihood probabilities for each class by dividing the number of examples in that class with the feature by the total number of examples in that class.
4. Multiply the prior probability of each class with the likelihood probability for each feature for that class.
5. Classify the new example based on the class with the highest probability.

We trained the machine learning model using random forest and naïve bayes. The accuracy of the trained model found optimal with naïve bayes. Accuracy of model with naïve bayes is 99.5%.

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Training Accuracy Score: 99.5%
Validation Accuracy Score: 99.3%
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Fig.1. Naïve Bayes Accuracy.

Training Dataset Source. - The dataset was created by combining data on rainfall, climate, and fertilizer from various sources available for India. The data was collected over time by ICFA (Indian Chamber of Food and Agriculture).

1	N	P	K	temperature	humidity	ph	rainfall
2	90	42	43	20.8797437	82.0027442	6.502985	202.935536
3	85	58	41	21.7704617	80.3196441	7.038096	226.655537
4	60	55	44	23.0044592	82.3207629	7.840207	263.964248
5	74	35	40	26.4910964	80.1583626	6.980401	242.864034
6	78	42	42	20.1301748	81.6048729	7.628473	262.717341

Fig.2.Dataset Sample Rows.

IV.PARAMETERS

A. Temperature - Temperature is a vital parameter for determining the suitable crops for a particular area. The growth of different crops is influenced by their temperature requirements, and it is essential to ensure that the temperature range is optimal for their growth. For most agricultural plants, the ideal temperature range for maximum growth is between 15 and 40 degrees Celsius. The temperature of a place is determined by various factors such as latitude, altitude, and seasonal changes, which can affect crop distribution and productivity. Therefore, farmers need to consider the temperature conditions when selecting crops for cultivation to ensure that they can thrive in the local environment. By selecting crops that can tolerate the local temperature conditions, farmers can achieve better yields and maintain healthier crops.

B. Humidity- The invisible form of water present in the air vapours is called humidity. Relative humidity is measured as the ratio the of moisture present it the air to the saturation capacity of the air. The relative humidity of 40 to 60% is favourable for most of the crops. Above 80% very less plants can sustain and operate.

C. Rainfall- Rainfall is an essential factor in determining the appropriate crops for a particular region. The moisture requirements of different crops vary, and the amount and distribution of rainfall play a crucial role in determining their growth and productivity. A lack of rainfall can cause water stress, while excessive rainfall can lead to waterlogging and soil erosion, both of which can negatively impact crop yields. Moreover, the timing of rainfall is critical, as crops require an adequate and timely supply of water during their growth phases. Farmers must consider the rainfall patterns in their area when selecting the best crops to grow. By choosing crops that can thrive in the local rainfall conditions, farmers can ensure their crops receive sufficient water and achieve optimal yields.

D. pH - The pH level of soil is a critical factor in determining the appropriate crops for cultivation. Soil pH can have a significant impact on nutrient availability, which can ultimately affect crop growth and productivity. Each crop has a specific pH range that is best suited for its growth, and deviation from this range can negatively impact crop performance. Soils with a low pH level, which are acidic, can cause nutrient deficiencies, while soils with high pH levels, which are alkaline, can lead to nutrient imbalances and toxicity. It is essential for farmers to assess the pH level of their soil and choose crops that can thrive in their soil's pH range. By selecting crops that are compatible with their local pH conditions, farmers can ensure optimal soil health and promote better crop yields.

E. Soil Properties – The presence of nitrogen, phosphorus, and potassium in the soil is vital for plant growth and development. These essential nutrients play a significant role in energy transfer, photosynthesis, and water regulation

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within the plant. Soil properties that provide these nutrients influence the crop yield and determine the types of crops that can be grown successfully. Each crop requires a different amount of these nutrients, and farmers must analyse the soil properties in their fields to ensure that the crops they choose can thrive in that environment. By selecting suitable crops for the available soil properties, farmers can ensure that the soil remains healthy and yields optimal crop growth.

V. METHODOLOGY

Sensors

1. DHT22

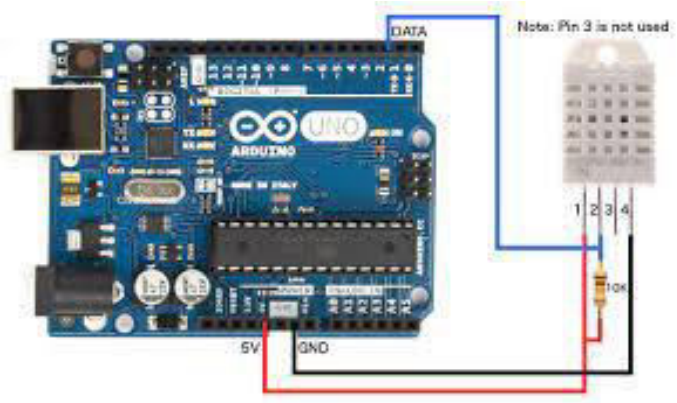

Fig.3. DHT22 WITH ARDUINO

For the readings of temperature and humidity DHT22 comes to be the best solution. This sensor has found out to be most precise and accurate. It consists of two modules which are humidity sensor and other one is thermistor to detect the temperature. This sensor sends the data in the form of digital signal to the ESP32 port pin. The recording range of temperature for DHT22 is -40 to 80 degrees celsius whereas the range for humidity lies from 0 t 100% RH.

- DHT 22 is a temperature and humidity sensor.
- The digital signal is very easy to read using any microcontroller unit. DHT22 outputs digital signal.
- This sensor uses digital signal collecting technique which allows for optimal reliability and stability. This unit is connected by the 8 bit single chip computer.
- This sensor is very efficient in the all harsh environmental conditions because of low consumption and its long transmission distance.

2. NPK Sensor

Fig.4. NPK Sensor

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An NPK sensor is an instrument designed to measure the levels of nitrogen, phosphorus, and potassium in the soil. This type of device is inserted into the soil and uses electrical conductivity to measure the nutrient levels, which are then displayed for the user to interpret. Many NPK sensors are equipped with wireless connectivity and data logging features, which allow for remote monitoring and analysis of soil nutrient levels over time. Overall, the use of NPK sensors can aid in maximizing crop yields and minimizing unnecessary fertilization.

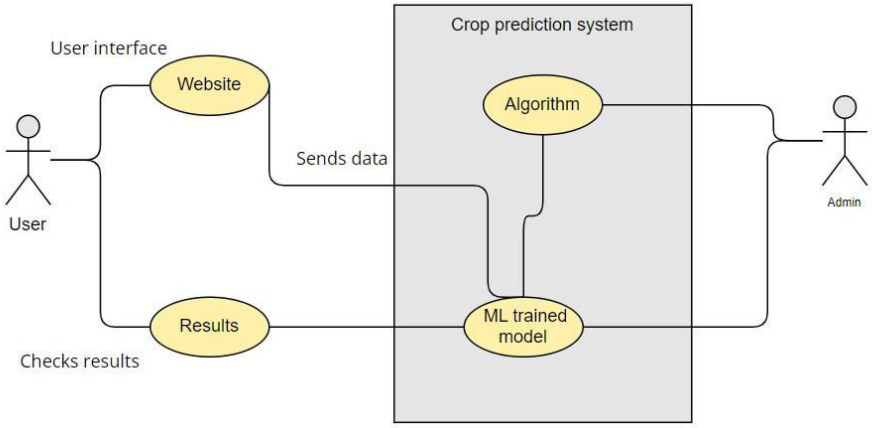

Fig.5. Use case Diagram

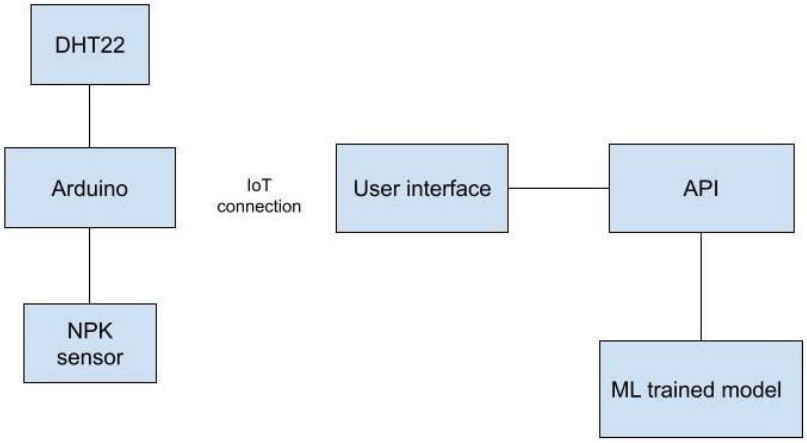

Fig.6. Block Diagram.

VI.SYSTEM DESIGN

The system uses technologies such as Machine learning (ML) and Internet of things (IoT). The ml model is trained with the data set collected from ICFA government site with the naive bayes algorithm. The accuracy of the model found to be 99.5%. The hardware devices such DHT22, NPK sensor and pH sensor are connected to the Arduino. The sensors readings are taken on the web interface using the serialportNode.js library.

IoT Configuration

- The main Objective of this setup is to collect live data from environment.
- We have used Arduino Uno for connecting different peripheral sensors.
- The Arduino board is connected to local computer via USB cable.
- The communication between Arduino and computer is achieved using serialport.
- The sensors are programmed using Arduino IDE.

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Web Interface Configuration

- The frontend is designed with HTML, CSS and React.
- The backend is written in NodeJS and Express.
- The frontend and backend are communicating using API and web sockets.

MLConfiguration

- Various libraries such as pandas, NumPy, Matplotlib,Sklearn etc. are used for training the model.
- The model is trained in the cloud using Google Colab.
- The trained model is saved using pickle file for future use.

VII.OUTPUT

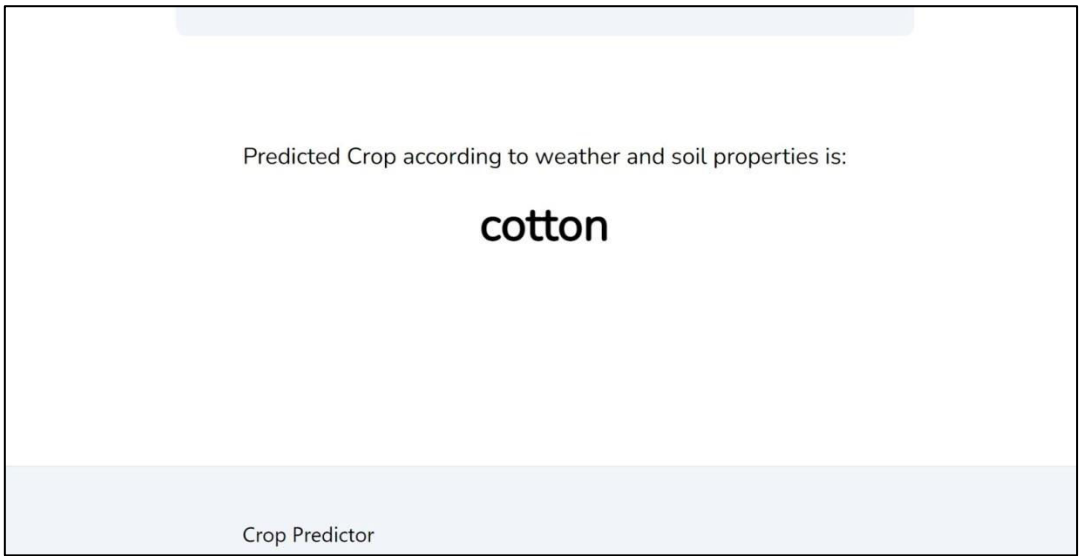

Fig.7.Predicted Crop

VIII. CONCLUSION

The objective of this project is to predict the crop. We propose a smart agricultural strategy, which is based on two developing technologies: the Internet of Things and machine learning. The accuracy of the result is improved by using both real time and historical data. Rather than predicting crops directly from the trained model, we have improved the accuracy by taking the real-time data reading from the sensors. The accuracy of the system is also improved by comparing multiple machine learning techniques. This strategy will be utilized to assist farmers in overcoming hurdles and increasing the quantity and quality of their products.

REFERENCES

1. Crop Recommendation using Machine Learning Techniques - ICEI - 2022 (VOLUME 10 - ISSUE 11)
2. F. F. Haque, A. Abdelgawad, V. P. Yanambaka and K. Yelamarthi, "Crop Yield Prediction Using Deep Neural Network," 2020 IEEE 6th World Forum on Internet of Things (WF-IoT), 2020, pp. 1-4, doi: 10.1109/WFIoT48130.2020.9221298
3. M. Kavita and P. Mathur, "Crop Yield Estimation in India Using Machine Learning," 2020 IEEE 5th International Conference on Computing Communication and Automation (ICCCA), 2020, pp. 220-224, doi: 10.1109/ICCCA49541.2020.925091 5.

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4. Ashwani kumar Kushwaha, Swetabhattachrya "crop yield prediction using agro algorithm in hadoop". Rahul Katarya, Ashutosh Raturi, Abhinav Mehndiratta, Abhinav Thapper "Impact of Machine Learning Techniques in Precision Agriculture".
5. Akshata Wani, Viraj Yadav, Ritika Todankar ,Pradnyan Wade , Prof. Shikha Malik [5] "crop prediction using Iot and ml"
6. F. Javed, M. K. Afzal, M. Sharif, and B. S. Kim, "Internet of Things (IoT) operating systems support, networking technologies, applications, and challenges: a comparative review," IEEE Communication Surveys and Tutorials, vol. 20, no. 3, pp. 2062– 2100, 2018.
7. Performance Evaluation of Best Feature Subsets for Crop Yield Prediction Using Machine Learning Algorithms Maya Gopal P. S. Bhargavi R . - 2019.
8. Pavan Patil1, Virendra Panpatil, Prof. Shrikant Kokate, "Crop Prediction System using Machine Learning Algorithms " IRJET 2020, e-ISSN: 2395-00

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