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# **Precision Agriculture using Machine Learning and IOT**

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**ABSTRACT:** Agriculture is a major source of income and employment in India. The most prevalent problem faced by Indian farmers is that they do not select the appropriate crop for their land and do not use the appropriate fertilizer. They will experience a significant drop in production as a result of this. Precision agriculture has been used to solve the farmers' difficulty.

Precision agriculture is a modern farming strategy that employs research data on soil properties, soil types, and crop yield statistics to recommend the best crop to farmers as well as fertilizer recommendations based on site-specific features. This decreases the number of times a crop is chosen incorrectly and increases productivity.

In this paper, this problem is solved by proposing a recommendation system through ML models with majority voting technique using Random Forest, Naive Bayes, Support Vector Machine (SVM), Logistic Regression and Random Forest, as learners to recommend a crop for the site-specific parameters with high accuracy and efficiency. In Addition to that we are performing real time testing using IOT system. The fertilizer recommendation system is purely python logic based. In this we compare the data (optimum nutrients for growing the crop) with the user's entered data. Then nutrient having maximum difference is made as HIGH or LOW and according to that suggestions will be fetched.

**KEYWORDS:** SVM, Logistic Regression, Random Forest.

## **I. INTRODUCTION**

A farmer's decision about which crop to grow is generally clouded by his intuition and other irrelevant factors like making instant profits, lack of awareness about market demand, overestimating a soil's potential to support a particular crop, and so on. A very misguided decision on the part of the farmer could place a significant strain on his family's financial condition. Perhaps this could be one of the many reasons contributing to the countless suicide cases of farmers that we hear from media on a daily basis. In a country like India, where agriculture and related sector contributes to approximately 20.4 per cent of its Gross Value Added (GVA), such an erroneous judgment would have negative implications on not just the farmer's family, but the entire economy of a region. For this reason, we have identified a farmer's dilemma about which crop to grow during a particular season, as a very grave one. The need of the hour is to design a system that could provide predictive insights to the Indian farmers, thereby helping them make an informed decision about which crop to grow. With this in mind, we propose a system, an intelligent system that would consider environmental parameters (temperature, rainfall, geographical location in terms of state) and soil characteristics (N, P, K, pH value, soil type and nutrients concentration) before recommending the most suitable crop to the user. In addition to that a fertilizer suggestion is also made which is based on the optimum nutrients of the crops grown. In India, agriculture is one of the most important professions. Many of the people do agriculture but are unable to determine which types of crops are more suitable to their soil. Means there are variety of crops which are only suitable for wet soil, some requires medium humidity in the soil to grow but this knowledge is less known to farmers as well as newbies who develop some interest in farming. As of now there are very less resources as well as software's which will help them to improve quality. Such type of software is Precision agriculture using machine learning and IoT.

## **II.MOTIVATION**

Agriculture is that the backbone for developing countries like India as quite 70% of population depends on agriculture. Agriculture in India plays a predominant role in economy and employment. The common problem existing among the Indian farmers are they don't choose the proper crop supported their soil requirements and also which fertilizer to be used for his or her crop. thanks to this they face a heavy setback in productivity. This problem of the farmers has been addressed through precision agriculture.

## **III. EXISTING SYSTEM**

More and more researchers have begun to spot this problem in Indian agriculture and are increasingly dedicating their time and efforts to assist alleviate the difficulty. Different works include the employment of Regularized Greedy Forest to see an appropriate crop sequence at a given time stamp. Another approach proposes a model that creates use of historical records of meteorological data as training set. Model is trained to spot climate that are deterrent for the assembly of apples. It then efficiently predicts the yield of apples on the idea of monthly weather patterns.

The use of several algorithms like Artificial Neural Network, K Nearest Neighbours, and Regularized Greedy Forest is demonstrated in [5] to pick out a crop supported the pre-diction yield rate, which, in turn, is influenced by multiple parameters. Additional features included within the system are pesticide prediction and online trading supported agricultural commodities.

## **IV. DRAWBACKS**

One shortcoming that we identified all told these notable published works was that the authors of every paper focused on one parameter (either weather or soil) for predicting the suitability of crop growth. However, in our opinion, both these factors should be taken together into consideration concomitantly for the most effective and most accurate prediction. this is often because, a specific soil type could also be it for supporting one variety of crop, but if the climatic conditions of the region don't seem to be suitable for that crop type, then the yield will suffer.

## **V. PROPOSED SYSTEM**

We to eliminate the aforementioned drawbacks, we propose an efficient Crop Recommendation system- which takes into consideration all the appropriate parameters including temperature, rainfall, location and soil condition, to predict crop suitability. This system is fundamentally concerned with performing the primary function of Agro Consultant, which is providing crop recommendations to farmers. We also provide the fertilizers to be used for crops grown in different states which gives the user an easy and reliable insight to decide and plan the crops

## **VI. PLAN OF IMPLEMENTATION**

The steps involved in this system implementation are: -

### **a) Acquisition of Training Dataset:**

The accuracy of any machine learning algorithm depends on the number of parameters and therefore correctness of the training dataset. For the system, we are using various datasets all downloaded from government website and Kaggle.

Datasets include: -

Yield dataset, Fertilizer dataset, Soil nutrient content dataset, Rainfall Temperature dataset

### **b) Data Preprocessing:**

This step includes replacing the null and 0 values for yield by -1 so that it does not affect the overall prediction. Further we had to encode the dataset so that it could be fed into our ML models.

### **c) Training ML model:**

After the preprocessing step we used the dataset to train different machine learning models like Random Forest, Decision Tree, Support Vector Machine (SVM) and Logistic regression to attain accuracy as high as possible.

**d) Model Evaluation and Saving Model:**

All the ML models which are trained would be evaluated by comparing their performance (Evaluations Metrics) and Final efficient model is saved using pickle library.

**e) Model Exportation and Integration with Web app:**

The saved efficient ML model would be integrated with Flask Web Application which would further mean for prediction in user friendly web interface.

**f) Real-time Testing of Application:**

This step includes real-time testing of our whole application using an IOT system which consists of a). Soil NPK Sensor, b). Capacitive Soil Moisture Sensor, c). Temperature Sensor, d). Wireless Transceiver module and e). Arduino Nano board. Soil NPK sensor, Soil Moisture and Temperature sensors are dipped into soil along with help of Arduino Nano board to acquire all the features of soil. We get real-time data of soil like N, P, K, Moisture, Temperature, etc which are used to test our pre-built Web Application manually and obtain the predictions done.

**VII. PROBLEM DEFINITION**

In India, agriculture is one of the most important professions. Many of the people do agriculture but are unable to determine which types of crops are more suitable to their soil. Means there are variety of crops which are only suitable for wet soil, some requires medium humidity in the soil to grow but this knowledge is less known to farmers as well as newbies who develop some interest in farming. As of now there are very less resources as well as software's which will help them to improve quality. Such type of software is Precision agriculture using machine learning and IoT.

**VIII. OBJECTIVE OF THE PROJECT**

[1] To build a robust model to provide correct and accurate prediction of crop sustainability in a given state for the particular soil type and climatic conditions.

[2] Provide recommendation of the most effective suitable crops within the area in order that the farmer doesn't incur any losses

[3] Provide fertilizer suggestion for crops supported chemical features.

**IX. LITERATURE SURVEY**

Low-cost IOT + ML design for smart farming with multiple application paper authors Fahad Kamraan Syed, Agniswar Paul, Ajay Kumar, Jaideep Cherukuri in paper [1] proposed system for water management systems and improve current irrigation methods. An IoT and ML-based farming system always keeps farmers responsive to the upcoming weather possibilities and provides them the simplest suggestions about irrigation methods and crops thereby helping in better yield.

In paper [2] authors proposed a sensible system which will assist farmers in crop management by considering sensed parameters (temperature, humidity) and other parameters (soil type, location of farm, rainfall) that predicts the foremost suitable crop to grow therein environment.

Reference Paper [3] determines real time sampling of soil properties using MODIFIED SUPPORT VECTOR REGRESSION, a preferred machine learning algorithm and 4 modules. The Modules include Sensor interfaced to IoT device, Agri cloud, Analysing the important time sensor data and Agri computer programme (AUI). the primary module is portable IoT device (Nedeleu) with soil moisture sensor and pH sensor, environmental sensors. Agri cloud module consists of storage. Analysing the 000-time data module is processing of forms of crops and little plants suggested using modified support vector machine algorithm. Agri-user interface could be a basic web interface. Thus, with the assistance of soil properties farmer are going to be able to get sorts of crops and little plants is grown in farmland with help of Modified support vector machine algorithm.

In paper [4] author's proposed new technologies include the employment of Internet of Things (IOT) and Machine Learning. the 0-time data from the sector area is collected using IOT system. The collected data from the sector area is

fed to the trained model. The trained model then makes the predictions using the information. The result produced by the model greatly helps in sowing the acceptable crops within the particular field area.

### X. EXTERNAL INTERFACE REQUIRMENTS

#### User Interfaces:

- Front End Software: Flask Framework integrated with HTML, CSS, BOOTSTRAP
- Back End Software: Machine Learning (Python)

#### Hardware Interfaces:

- RAM - Minimum 512 MB.
- Processor - i3 or above and above with 2.5 GHz

#### Software Interfaces:

- OS: Ubuntu, Windows, Mac
- Tools: VScode or Python IDE and Jupyter Notebook.
- Programming Language: Python flask, HTML, CSS, BOOTSTRAP.
- Dataset: A Dataset which is openly available in Kaggle.
- Libraries/Tools:
  1. Pandas
  2. NumPy
  3. Matplotlib
  4. Sickit-Learn

#### Other Requirements:

The below hardware instruments are used for testing our model in real-time using IOT system which has following set of instruments.

- Soil NPK Sensor
- DS18B20 Temperature Sensor
- Capacitive Soil Moisture Sensor
- NRF24L01 Wireless Transceiver
- Arduino Nano Board

### XI. SYSTEM ARCHITECTURE

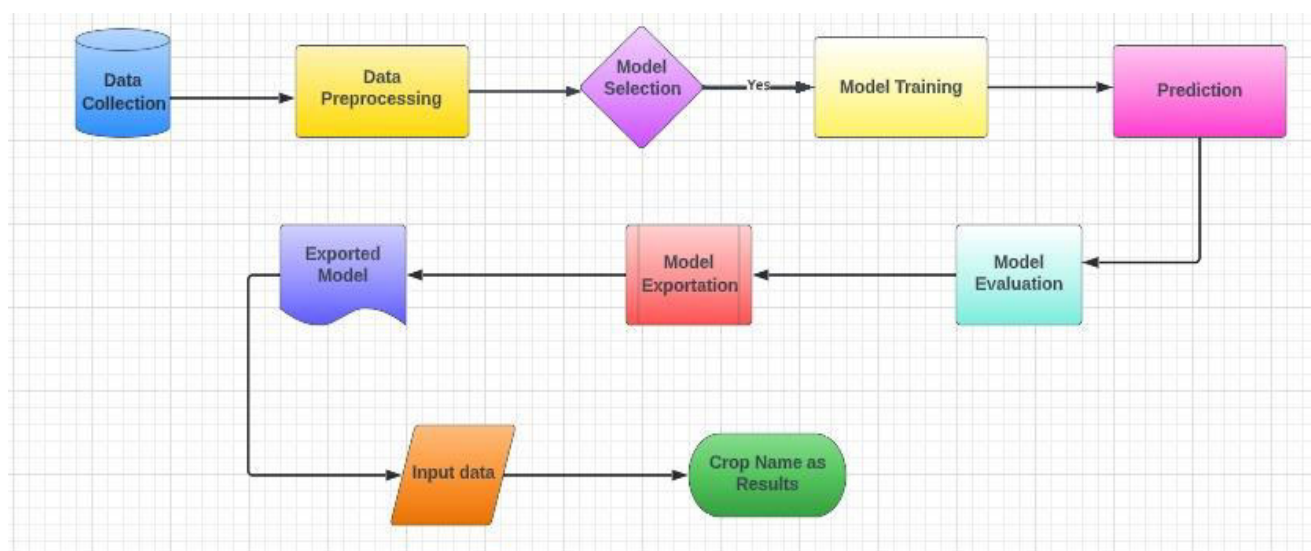


Fig.1 System architecture diagram

A system architecture is a conceptual model using which we can define the structure and behavior of that system. It is a formal representation of a system. Depending on the context, system architecture can be used to refer to either a model to describe the system or a method used to build the system. Building a proper system architecture helps in analysis of the project, especially in the early stages. Figure 1 depicts the system architecture and is explained in the following section.

### XII. RESULTS & PERFORMANCE ANALYSIS

For the purposes of this project, we have used four popular algorithms: Decision Trees, Logistic regression, Support Vector Machine and Random Forest. All the algorithms are based on supervised learning. Our overall system is divided into two modules:

- Crop recommender
- Fertilizer Recommender/Suggestion

Accuracy Comparison of ML Models:

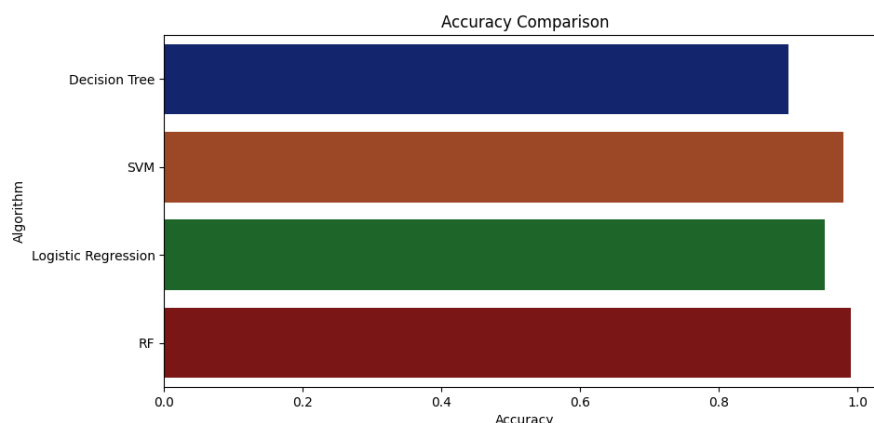


Fig.2 Accuracy comparison

Algorithm	Accuracy (%)
Decision Tree	90%
SVM	97%
Logistic Regression	95%
Random Forest	99%

### XIII. ADVANTAGES

- [1] Improve farm management efficiency by adjusting field/crop treatments
- [2] Ensure profitability, sustainability and protection of the environment
- [3] To use new technologies to increase crop yields and profitability while lowering the levels of traditional Inputs needed to grow crops
- [4] Optimize efforts and resources, reduce consumption and waste, and boost land productivity
- [5] It will reduce excessive chemical usage in crop production

### XIV. LIMITATIONS

- [1] Extremely demanding work particularly collecting and then analyzing the data.
- [2] Accuracy depends upon input dataset
- [3] Most of the farmer not aware of such program like precision agriculture using machine learning farmer don't know the technology
- [4] Complexity grows with data.

#### XV. CONCLUSION

All This system helps the farmer to choose the right crop by providing insights that ordinary farmers don't keep track of thereby decreasing the chances of crop failure and increasing productivity. It also prevents them from incurring losses. The system can be extended to the web and can be accessed by millions of farmers across the country. We could achieve an accuracy of 90 percent from the Decision Trees, an accuracy of 70.6 percent from the Support Vector Machine, an accuracy of 94.30 percent from the Logistic Regression and an accuracy of 99.09 percent from the Random Forest model. Further development is to integrate the crop recommendation system with another subsystem, yield predictor that would also provide the farmer an estimate of production if he plants the recommended crop.

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