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# APPLICATION OF INTELLIGENT RECOMMENDATION FOR AGRICULTURAL CULTIVATIONS

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***ABSTRACT***

***Farmers face several challenges when growing crops like uncertain irrigation, poor soil quality, etc. Especially in India, a major fraction of farmers does not have the knowledge to select appropriate crops and fertilizers. Moreover, crop failure due to disease causes a significant loss to the farmers, as well as the consumers. While there have been recent developments in the automated detection of these diseases using Machine Learning techniques, the utilization of Deep Learning has not been fully explored. Additionally, such models are not easy to use because of the high-quality data used in their training, lack of computational power, and poor generalize ability of the models. To this end, we create an open-source easy-to-use web application to address some of these issues which may help improve crop production. In particular, we support crop recommendation, fertilizer recommendation and plant disease prediction. In addition, we also use interpretability techniques to explain the prediction made by our disease detection model. In Indian economy and employment agriculture plays major role. This problem can be addressed through precision agriculture. This method gives solutions like proposing a recommendation system through an ensemble model with majority voting techniques using machine learning algorithm as learner to recommend suitable crop based on soil parameters with high specific accuracy and efficiency.***

***KEYWORDS: Deep Learning, Machine Learning, Random Forest Algorithm, Conventional Neural Network, Supervised Learning.***

## I. INTRODUCTION

Agriculture, as we all know, is the foundation of the Indian economy. Agriculture is an important occupation in India. More than 60% of the country's land is used for agriculture, which feeds 1.3 billion people. Agriculture is the cultivation of plants and animals. In India, agriculture gave rise to civilization. We need soil to cultivate crops. As a result, soil is a critical factor in agriculture. Soil

health is essential for good food production. In India, several soil varieties are available. They are alluvial soil (cotton, rice), black soil (sugarcane, sunflower), red soil (corn, ragi), laterite soil (pulses, tea, coffee), and so on. Many studies have been conducted to improve agricultural planning. The crop can be recommended using a machine learning technique. Machine learning is a subfield of artificial intelligence that describes a machine's ability to mimic intelligent human behavior. Artificial intelligence systems are employed in the same way as humans do to automate complex tasks. Machine learning begins with data, such as financial transactions, individuals, or photos. The information is collected and processed to be utilized as training data for the machine learning system. If the data is more than the software shows better results.

## II. LITERATURE SURVEY

Agriculture highly depends on the nature of soil and climate. Therefore, it becomes important to make advancement in this field. The paper proposes development of an ontology-based recommendation system for crop fertilizers recommendation. It bridges the gap between farmers and technology. The system predicts suitable crop for the field under consideration based on region in Maharashtra state of India and type of soil. It provides recommendation of fertilizers to the farmers. Fertilizer recommendation is done based nitrogen, phosphorus, and potassium (NPK) contents of soil and using past years research data that is stored in ontology. Along with fertilizer recommendation system also provides suggestions about crop suitability region. Recommendation system uses random forest algorithm and k-means clustering algorithm.

[1]. Machine learning can be used to increase the crop yield and quality of crops in the agriculture sector. In this project we propose a machine learning based solution for the analysis of the important soil properties and based on that we are dealing with the Grading of the Soil and Prediction of Crops suitable to the land. The various soil nutrient EC (Electrical Conductivity), pH (Power of Hydrogen), OC (Organic Carbon), etc. are the feature variables, whereas the grade of the soil based on its nutrient content is the target variable. Dataset is preprocessed and regression algorithm is applied and RMSE (Root Mean Square Error) is calculated for predicting rank of soil and we applied various Classification Algorithm for crop recommendation and found that Random Forest has the highest accuracy score.

[2]. Soil is an important ingredient of agriculture. There are several kinds of soil. Each type of soil can have different kinds of features and different kinds of crops grow on different types of soils. We need to know the features and characteristics of various soil types to understand which crops grow better in certain soil types. Machine learning techniques can be helpful in this case. In recent years, it is progressed a lot. Machine learning is still an emerging and challenging research field in agricultural data analysis. In this paper, we have proposed a model that can predict soil series with land type and according to prediction it can suggest suitable crops. Several machine learning algorithms such as weighted k-Nearest Neighbor (k-NN), Bagged Trees, and Gaussian kernel-based Support Vector Machines (SVM) are used for soil classification. Experimental results show that the proposed SVM based method performs better than many existing methods.

[3]. Agriculture is a major contributor to the Indian economy. The mainstream Indian population depends either explicitly or implicitly on agriculture for their

livelihood. It is, thus, irrefutable that agriculture plays a vital role in the country. A vast majority of the Indian farmers believe in depending on their intuition to decide which crop to sow in a particular season. They find comfort in simply following the ancestral farming patterns and norms without realizing the fact that crop output is circumstantial, depending heavily on the present-day weather and soil conditions. However, a single farmer cannot be expected to consider all the innumerable factors that contribute to crop growth before reaching a consensus about which one to grow. A single misguided or imprudent decision by the farmer can have undesirable ramifications for both himself and the agriculture.

[4]. Recommender systems are widely used in many web applications, such as e-commerce, news, agriculture, and other fields. Agricultural in formalization is an important driving force for the development of agricultural modernization. With the further improvement of agricultural in formalization infrastructure construction, the use of modern information technology to achieve personalized agricultural information resource recommendation services and provide users with timely and effective information has become an effective solution.

[5]. This technology has protected the crop yield from various factors like the climate changes, population growth, employment issues and the food security problems. The main concern of this paper is to audit the various applications of Artificial intelligence in agriculture such as for irrigation, weeding, spraying with the help of sensors and other means embedded in robots and drones.

## III. METHODOLOGY

### *A. Deep learning:*

DEEP LEARNIG is a sub-discipline of Machine Learning. The main idea that characterizes DL inside ML is the Neural Network, a model that can detect and extract the best features for the target task automatically, without the necessity to involve a previous step to the model training of feature extraction. In Deep Learning, the feature extraction process is merged with the learning process. Therefore, the selection is trainable, and the model itself can decide which features to use without having to choose which attributes should be extracted.

### *B. Convolutional Neural Network:*

A Convolutional Neural Network is a class of neural networks specialized in dealing with grid-like topological data with close spatial relations, such as images or sequences. The principal difference between a vanilla ANN and a CNN is the limited connectivity and shared weights among the filters of the CNNs, as usually, only the last part of a CNN is a fully connected network. The main drawback that causes the vanilla ANN not to be suitable for image tasks is that the network size leads to an easy over-fitting, while CNN's do not, as the neurons are not connected to all other neurons in the previous layers but connected only to a small region of neurons, which results in less trainable parameters.

### *C. Random Forest:*

Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. Random forest is a Supervised Machine Learning Algorithm that is used widely in Classification and Regression problems. It builds decision trees on different samples and takes their majority vote for classification and average in case of regression. It can be used for both Classification and Regression problems in ML. It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the performance of the model. Random Forest is a classifier that contains several decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset. Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output. The greater number of trees in the forest leads to higher accuracy and prevents the problem of over fitting. Random Forest works in two-phase first is to create the random forest by combining N decision tree, and second is to make predictions for each tree created in the first phase. Random Forest is an ensemble technique capable of performing both regression and classification tasks with the use of multiple decision trees and a technique called Bootstrap and Aggregation, commonly known as bagging.

Random forest algorithm starts with the selection of random samples from a given dataset. It contains a few decision trees on various subsets of the given dataset.

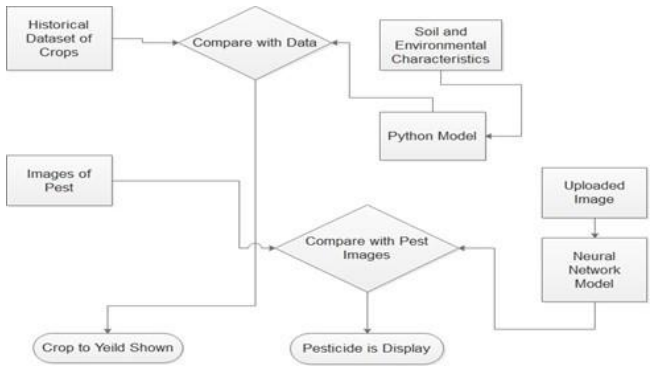



Fig.1 Block diagram.

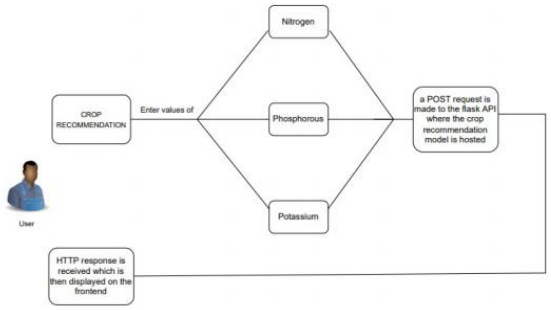



Fig.2 Flow diagram.

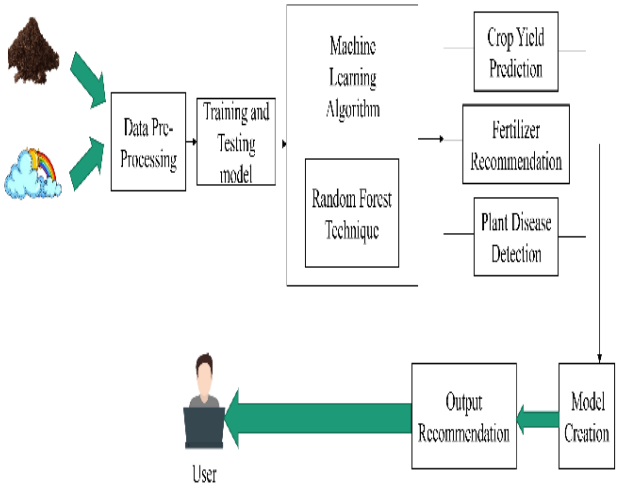
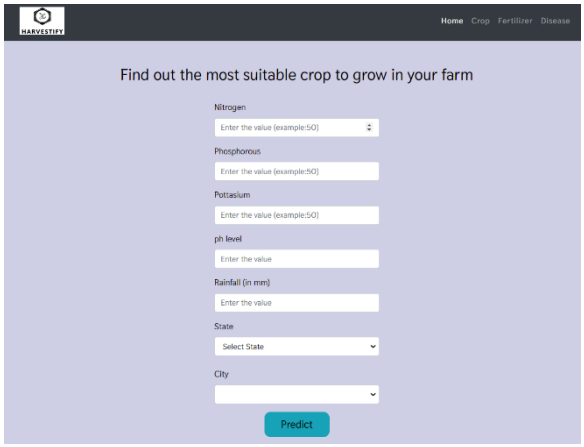


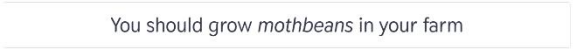

Fig.3 Architecture Diagram.

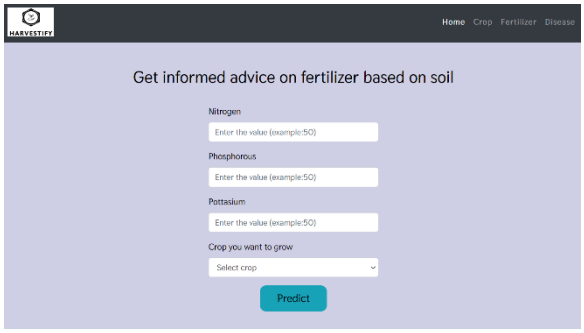
## IV. RESULT AND DISCUSSION

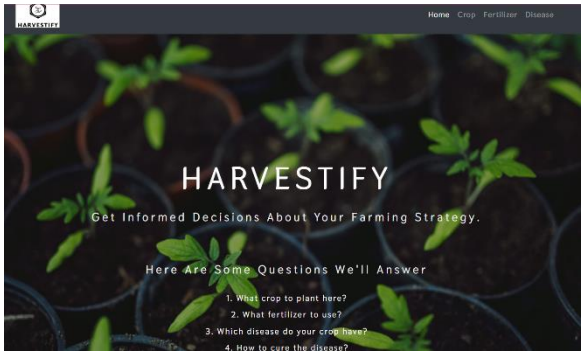
The machine learning and neural network model that was created is so adaptable that it can be used with any platform, such as Web application, Android, IoT and so on. The Django framework is used for web integration. Django is a high-level Python web framework that enables rapid development of secure and maintainable websites. The modules we have created is highly compatible with Android platform, which is the most used smartphone operating system that is compatible with Keras library. The majority of consumers will come via Android. Because the module is opensource and free to download, it is much easier to utilize as an a android application.

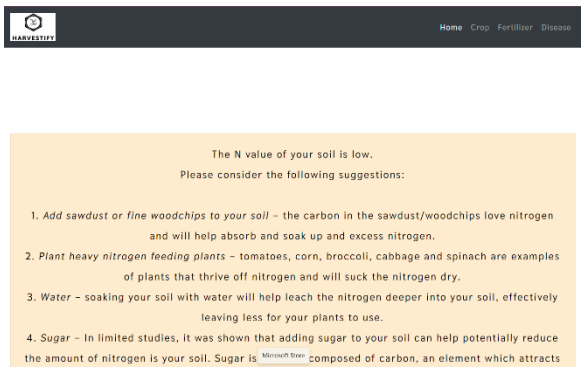
The Internet of Things (IoT) is a popular technology these days. By using Raspberry Pie, Audreno, and N, P, K, pH, and Humidity sensor we can automatize this manual value entering system. The integration of Raspberry Pie, Python libraries and Sensors makes a portable device.








## V. FUTURE SCOPE

The main Machine Learning module that was created is so adaptable that it can be used with any platforms, such as Web Application, Android Application, IoT devices and so on. When we integrate the module on public platforms there will be an issue of privacy and security of the user data.

This data is undoubtfully useful in many areas including medical research, law enforcement and national security, hence the storage of the data and the access of the data should be done efficiently, but security and privacy are very important concerns.

## VI. CONCLUSION

The main goal is to create a intelligent crop and pesticide recommendation system that analyses the user inputs and give the appropriate recommendation. The user is then informed to which crop to cultivate and recommend which pesticide to be used for the pest on the crop. Precision agriculture (PA) is an approach to farm management that uses information technology (IT) to ensure that crops and soil receive exactly what they need for optimum health and productivity. Based on artificial intelligence and machine learning, we propose a intelligent farmers system for Android or web as in this study.

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