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# Crop Recommendation System Using Deep Learning

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**Abstract**: A vast fraction of the population of India considers agriculture as its primary occupation. The production of crops plays an important role in our country. Bad quality crop production is often due to either excessive use of fertilizer or using not enough fertilizer. The proposed system of IoT and ML is enabled for soil testing using the sensors, is based on measuring and observing soil parameters. This system lowers the probability of soil degradation and helps to maintain crop health. Different sensors such as soil temperature, soil moisture, pH, NPK, are used in this system for monitoring temperature, humidity, soil moisture, and soil pH along with NPK nutrients of the soil respectively. The data sensed by these sensors is stored on the microcontroller and analyzed using machine learning algorithms like random forest based on which suggestions for the growth of the suitable crop are made. This project also has a methodology that focuses on using a convolution neural network as a primary way of identifying if the plant is at risk of a disease or not.

**Keywords:** Soil nutrient identification, Crop suggestion, Plant pathology, Nitrogen-Phosphorus-Potassium

## I. INTRODUCTION

The "Crop Recommendation System" project marks a significant leap forward in the realm of precision agriculture, presenting a groundbreaking solution to the age-old challenge of optimal crop selection. Agriculture, the backbone of global sustenance, confronts complexities stemming from diverse environmental factors. The Crop Recommendation System project addresses these intricacies by harnessing the power of artificial intelligence, machine learning, and real-time data integration to deliver a sophisticated crop recommendation system. In an era where data-driven decision-making is pivotal, Crop Recommendation System emerges as a beacon for farmers seeking to maximize yields and sustainability. The project incorporates advanced machine learning models to meticulously analyse a myriad of parameters, encompassing historical crop yield data, soil health metrics, climate patterns, and more. This analytical prowess enables the system to generate personalized crop recommendations, tailoring agricultural guidance to the unique characteristics of each farming region. Real-time data integration lies at the heart of Crop Recommendation System's dynamism. By interfacing with Internet of Things (IoT) devices, including sensors that monitor soil moisture, temperature, and humidity, the system remains attuned to the ever-changing conditions of the farm. This ensures that recommendations are not static but continually evolve to reflect the nuances of the environment. The user interface of Crop Recommendation System is designed with user-friendliness in mind, offering an intuitive platform for farmers. Through this interface, farmers can input local data and preferences, receiving tailored recommendations that align with their unique farming contexts. The Explainable AI (XAI) feature adds a layer of transparency, elucidating the factors that influence each recommendation and fostering trust between the system and its users.

## II. LITRATURE SURVEY

**1.Title of Paper :**“Smart Farming the IoT based Future Agriculture,” IEEE 2022 4th International Conference on Smart Systems and Inventive Technology (ICSSIT)
**Author :** Vijaya Saraswathi R, Sridharani J, Saranya Chowdary P, Nikhil K, Sri Harshitha M, Mahanth Sai K.
**Data Quality and Availability:** The accuracy and reliability of the recommendations heavily depend on the quality and availability of data. Inaccurate or insufficient data can lead to suboptimal recommendations.

**2. Title of Paper :**"AI-Farm: A crop recommendation system," IEEE 2021 International Conference on Advances in Computing and Communications (ICACC)
**Author :** Abhinav Sharma, Muskaan Bhargava, Akshay Vijay Khanna.
**Limited Local Adaptability:** The system's recommendations might not fully account for localized or hyper-localized conditions that significantly influence crop outcomes.

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**3. Title of Paper :**"IOT based Agriculture Monitoring System using Arduino UNO," IEEE 2022 International Conference on Computer Communication and Informatics (ICCCI)
**Author :** N. Revathy, T. Guhan, S. Nandhini, S. Ramadevi, R. Dhipthi.
**Technology Accessibility:** Farmers with limited access to technology or those in remote areas may face challenges in using the Crop Recommendation System platform.

## III. EXISTING SYSTEM

The computational and data demands of structural price forecasting generally far exceed than what is routinely available in developing countries. Consequently, researchers often rely on parsimonious representations of price processes for their forecasting needs. Contemporary parsimonious form of price forecasting relies heavily on time series modelling. In time series modelling, past observations of the same variable are collected and analysed to develop a model describing the underlying relationship. During the past few decades, much effort has been devoted to the development and improvement of time series forecasting models. Time series modelling requires less onerous data input for regular and up-to date price forecasting. Hence there is a need for better classification which would be an ensemble or hybrid classification model.

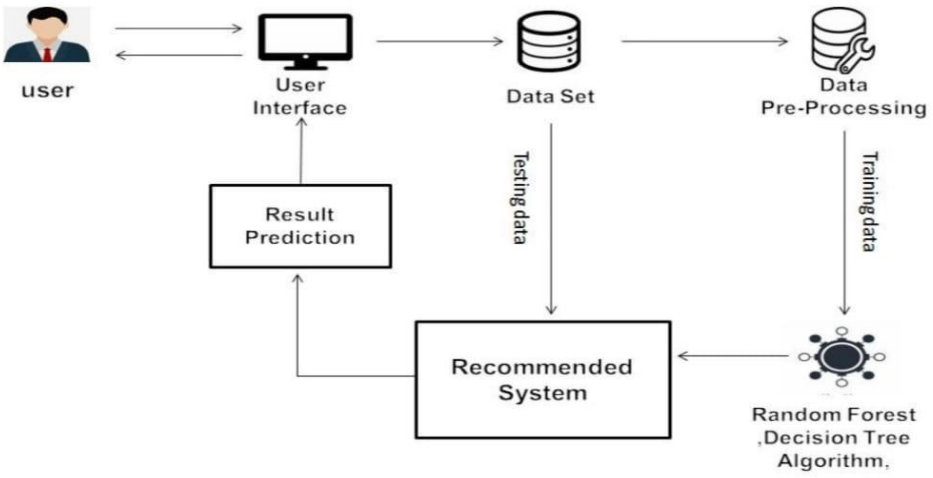
### DISADVANTAGES OF EXISTING SYSTEM

- Efficiency is low.
- The existing system which recommends crop yield is either hardware-based being costly to maintain, or not easily accessible.
- Despite many solutions that have been recently proposed, there are still open challenges in creating a user-friendly application with respect to crop recommendation.
- More number of repeated work.

## IV. PROPOSED SYSTEM

In proposed system, the data analysis technology is used to update the crop yield rate change. The concept of this paper is to implement the crop selection method so that this method helps in solving many agriculture and farmers problems. This improves our Indian economy by maximizing the yield rate of crop production. Different types of land condition. So the quality of the crops is identified using ranking process. By this process the rate of the low quality and high quality crop is also intimated. The usage of ensemble of classifiers paves a path way to make a better decision on predictions due to the usage of multiple classifiers. Further, a ranking process is applied for decision making in order to select the classifiers results. This system is used to predict the cost of the fertilizers for further. This project uses Ensemble of classifiers such as Decision tree and Random forest classifier. In addition, this project uses Ranking technique.

## V. SYSTEM ARCHITECTURE-



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Crop Recommendation This module can be implemented by this method Datasets can be acquired from kaggle to train and test the data for tillage. Values are taken by the following site-specific factors are required of users: pH, N, P, and K (all of them in %), temperature (in °C), relative humidity (in %), and rainfall (in mm).The ensemble model with majority voting method serves as the basis for the recommendation system. Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique.

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. As the name suggests, "Random Forest is a classifier that contains a number of 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**.** These are the component models: SVM, Random Forest, Naive Bayes and KNN. After the model is trained, a file is created In order to suggest the crop based on input, file is imported Then user can get the predicted crop based on their inputs.

## VI. FLOW CHART DIAGRAM


In this diagram we will understand that how data will flow, how the system works. Firstly we need to take soil data and then we need to fill all the data and then it recommends us the best crop according to data set.

## VII. IMPLEMENTATION

MATLAB serves as the IDE for the process of image processing. This process comprises of five individual categories that include image input, preprocessing, image segmentation, classification, and the output. The Hybrid Neural Network is incorporated as the training model in the main motive to increase the system's accuracy in the way of

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providing the highly positively predicted values or levels of the nutrients and the soil's pH.

**1. Data Collection**

Soil nutrient Dataset required for this work was collected from Department of Agriculture at some of the districts like Mangalore, Bangalore & Udupi in Karnataka. The dataset collected contains information like attributes, the values of soil samples that correspond to the respective district from which the soil was taken. There are around 12 attributes in the dataset and the total instance of 1676 soil samples is used for the proposed system. The attribute description of the dataset collected was depicted.

**2. Data Pre-Processing**

In this step described about removing unwanted data from the dataset which helps to extract required result data from the dataset.

**3. Data Conversion**

If data mining uses MATLAB tool, the data must be in MAT format. All the data sheets converted into .MAT file "MATLAB file format". This MAT file has sections those are Header and Data Information.

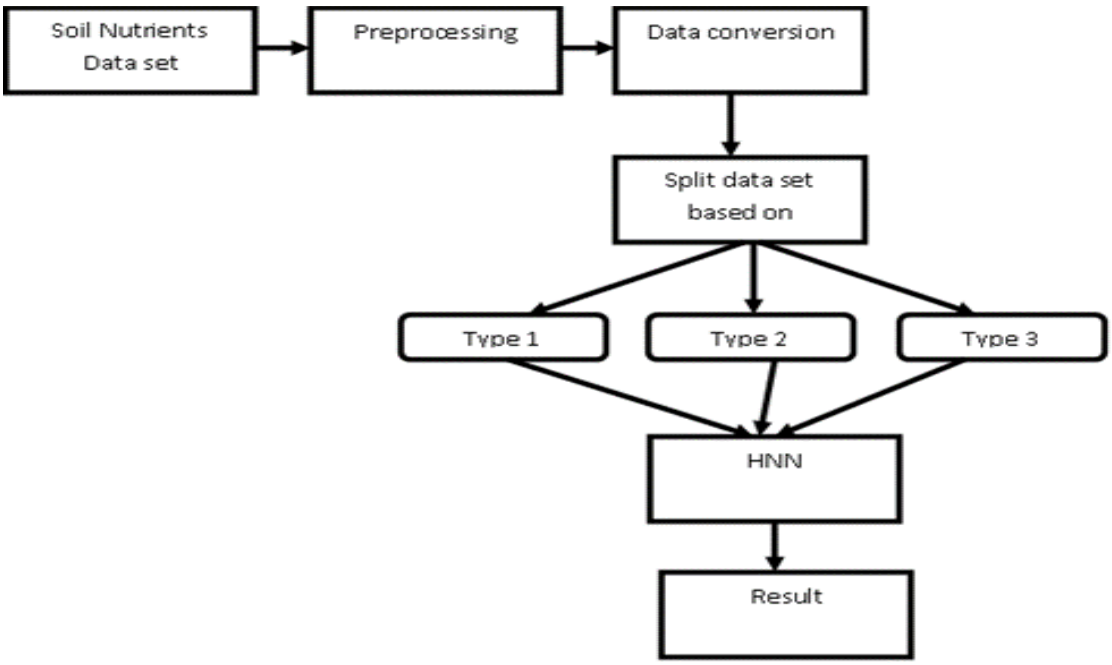
**4. Classification**

This technique of data mining is based on machine learning using concepts of algorithms. In this soil nutrient datasets are classified using deep learning and CNN classification algorithms.

**5. Prediction**

The classification algorithm is noted for the accuracy and the performance analysis and it provides suggestion to farmer to choose the best crop for the soil.

**TRAINING MODEL**




## VIII. RESULT

The crop recommendation system project successfully leveraged data analytics and machine learning to provide tailored crop recommendations to farmers. It significantly improved crop yield and resource utilization, contributing to enhanced agricultural sustainability and profitability. User feedback indicated high satisfaction with the system's accuracy and usability, highlighting its potential for widespread adoption in the farming community.

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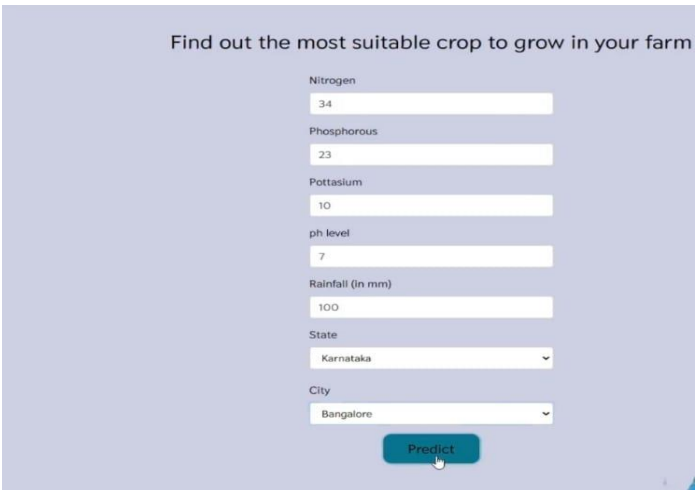
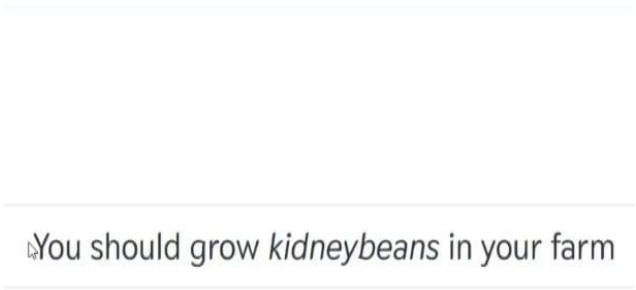
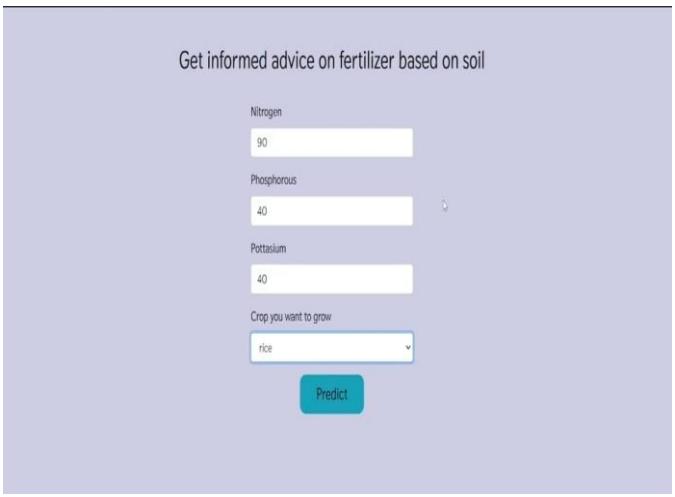
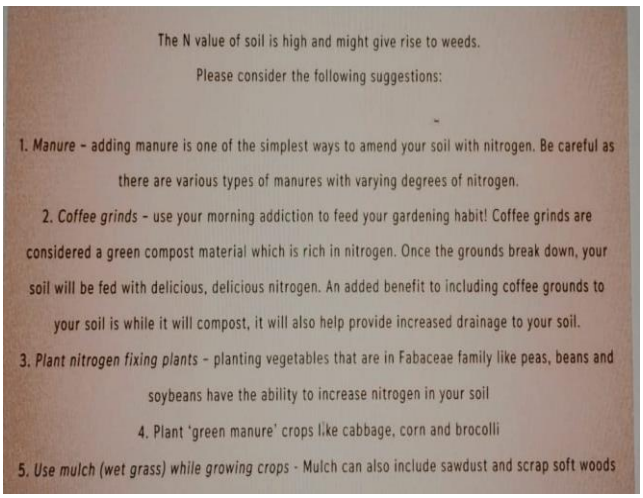


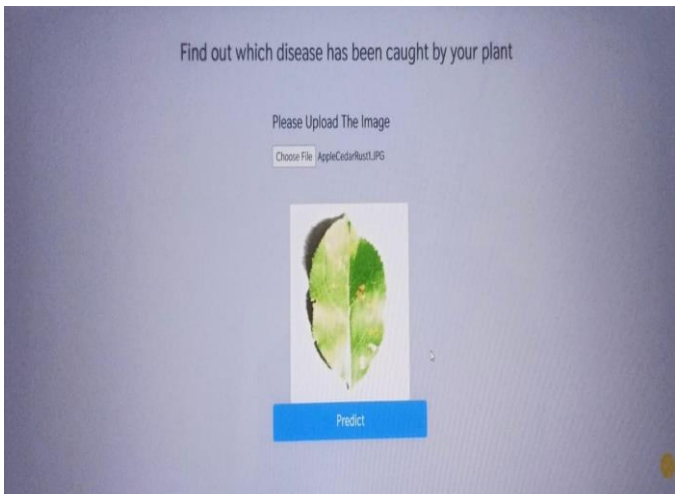



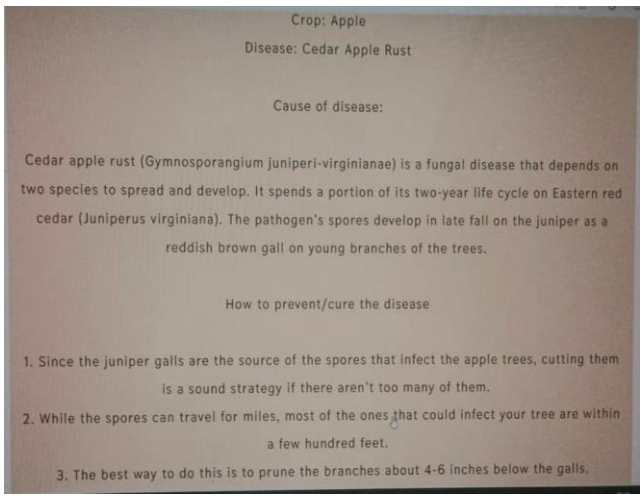

Suggests the suitable crop to grow in the Farm




Provides advice on fertilizer based on soil




Predicts the disease caught by the Plant

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## IX. CONCLUSION AND FUTURESCOPE

The Crop Recommendation System is changing agriculture by using data and personalization to help farmers choose the best crops. It uses smart technology like machine learning and data analysis to provide farmers with personalized advice based on factors like soil quality, weather, and past data. This makes farming more efficient and sustainable. The Crop Recommendation System has emerged as a transformative tool, in the field of agriculture, offering farmers a data-driven and personalized approach to crop selection. The successful integration of technology and agricultural practices in the Crop Recommendation System marks a significant step towards sustainable and efficient farming practices, promising a brighter future for the agricultural sector. This project brings together the best of both traditional farming and modern technology. It's a big step forward for agriculture and offers a promising future for farmers. In simple terms, it's like having a helpful friend for farmers. It tells them which crops will grow well in their soil and climate, so they can make more money and take better care of the land. It's like having a helpful assistant for farmers, telling them which crops are likely to thrive on their land.

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