Smart Agriculture

Satyam V Purohit, Vikram M Bharadwaj, Renuka M
Student, Dept. of CSE,
Vemana Institute of Technology,
Bangalore, INDIA
Naveen H S, Mary Vidhya John
Asst. Professor, Dept. of CSE
Vemana Institute of Technology,
Bangalore, INDIA

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Abstract: Agriculture is the primary main stay of the economy in our country. In recent years, because of uncertain trends in climate and policy making this has attributed to the price of crops becoming highly volatile. Farmers remain oblivious of these uncertainties, which attribute a degradation of the farmers' mental and financial wellbeing. The excessive use of chemicals in the soil have caused the soil to lose its organic properties ultimately causing the soil to be exothermic in nature, hence requiring large amounts of water for maintenance of the farm land with an unhealthy quality of production causing wide spread devastation to the overall economy and health of a country. This inspired us to create a system which is handy, easy-to-use and breaks the farmers from the shackles of the large chemical fertilizer corporations, to detect the plant disease early and the harvest optimal crop for better productivity. This system provides accurate results in predicting the optimum crop according to the location and soil conditions. The system frame work in corporate disease detection and fertilizer recommendation all with a custom dataset of organic remedies for the relevant diseases detected

Keywords: agriculture, random forest, naïve bayes, disease detection, fertilizer, machine learning

I. INTRODUCTION

Agriculture is the most important sector that influences the economy of India. It contributes to 18 percent of India's Gross Domestic Product. Despite agriculture being a major economic stimulant for India, the results are never satisfying due to various factors that affect the crop yield. To fulfill the needs of around 1.2 billion people, it is very important to have a good yield of crops. Due to factors like soil type, rainfall, temperature lack of technical facilities etc. the crop yield is directly influenced. Agriculture is an extremely risky industry and our farmers are at the fore front of the industry. Farmers face several problems which include crops getting affected by diseases, the soil in not being nutritious enough due to excessive chemical usage on for the plant to grow un-naturally. All these factors reduce the overall yield. More than 15% of the crops in India get wasted due to diseases and hence it has become one of the major concerns to be resolved. Crop diseases remain a major threat to crops, but their rapid identification remains difficult in many parts of the world due to lack of necessary infrastructure. The combination of increasing global smart phone penetration in rural areas and recent advances in computer vision made possible by deep learning has paved the way for web-assisted diseases diagnosis.

In addition, selecting optimum organic fertilizers and crops according to soil is of great importance as it helps increase the crop yield, and improve the overall financial condition of the farmer. The three macro-nutrients used by plants are Nitrogen (N), Phosphorous (P) and Potassium (K). N is responsible for growth of leaved in a plant, P for root, flower and fruit, and K helps the overall arterial functioning of the plant. Knowing NPK values of the fertilizer can help the farmer to select a fertilizer that is appropriate for the type of plant they are growing. In this project, we propose a system which helps farmers detect plant disease, recommend the ideal crop for their soil, and recommend organic fertilizers for them to get the best yield possible. We use the CNN based models for the purpose of disease detection, decision tree algorithms for the purpose of crop recommendation and a rule-based system for fertilizer recommendation.

II. LITERATURE SURVEY

Mansi Jadhavet al.,[1] proposed "Farming Made Easy Using Machine Learning" This framework utilizes Machine Learning's Decision Tree Regression Algorithm to predict crop price. The attributes considered for prediction are rainfall, wholesale price index, month, and year. Consequently, the system gives an advance forecast to the farmers' which grows the speed of profit to them and consequently the country's economy. This system also in corporate other modules like weather forecast, crop recommendation, fertilizer recommendation, and shop, chat portal ,and guide are also implemented.

This project is under taken using machine learning and evaluates the performance by using KNN, Naive Bayes, and Decision Tree algorithms. In our proposed model among the entire three algorithm Decision Tree gives the better yield prediction as compared to other algorithms As most extreme sorts of harvests will be secured under this system, farmers may become more acquainted with the yield which may never have been developed. The work exhibited the expected utilization of machine learning methods in foreseeing the harvest cost dependent on the given attributes.

The created web application is easy to understand and the testing accuracy is over 90%. Pawan Kumar et al., [2] "Smart Farming Using Machine Learning and IoT" IoT-based Smart Farming will help to improve the whole Agriculture system by monitoring the sphere in real time. It keeps variety of variables in restraint, like humidity, temperature, and soil, and delivers a crystal-clear real- time image. Machine Learning is employed with in the agriculture business to enhance crop yield and quality. Crop recommendations are often aided by applying appropriate algorithms to sensing data. The technique is designed to assist farmers in making informed decisions on crop forecasting. In addition to current data, historical data for temperature and humidity is obtained and saved from the government website to increase accuracy. Rainfall data from previous years is also collected and stored. To be confident and precise in crop forecasting, the project analyses the temperature and humidity of the field – live data captured using a DHT-22 sensor and historical data taken from government websites and/or Google Weather API –, type of soil – used by the farmer, and past rainfall data. This may be accomplished using either unsupervised or supervised machine learning methods

Devdatta A Bondreet al., [3] presented a paper titled "Prediction of crop yield and fertilizer recommendation using machine learning algorithms" describing the different Machine learning techniques that are used and evaluated in agriculture for estimating the upcoming crop production. This paper proposes and implements a system to predict crop yield from previous data. This is achieved by applying supervised machine learning algorithms like Support Vector Machine and Random Forest on agriculture data and recommends fertilizer suitable for every particular crop. The paper focuses on creation of a prediction model which may be used for future prediction of crop yield. It presents a brief analysis of crop yield prediction using machine learning techniques.

Marion Olubunmi Adebiyi et al.,[4] demonstrated "Machine learning-based predictive farm land optimization crop monitoring system " In this work, machine learning applied what had been used to set parameters and embedded it into a dataset on a mobile application. &e machine learning algorithm was designed to maximize and proportion. & data set contains parameters of some inputs that are critical for plant growth & machine learning algorithm defines the relationship between these input parameters and certain internally stored prediction parameters and provides a solution for the output. &e values in the database have been converted to a range system of 0 to1; the need for conversion to the same range is due to data incoherence; data was derived from different sources and was therefore in consistent, thus requiring a specific conversion.

Shima Ramesh et al.,[5] proposed "Plant disease detection using machine learning" on To find out whether the leaf is diseased or healthy, certain steps must be followed .i.e., Preprocessing, Feature extraction, Training of classifier and Classification. Preprocessing of image is bringing all the images size to a reduced uniform size. Then comes extracting features of a preprocessed image which is done with the help of HOG. HoG [6] is a featured escriptor used for object detection. In this feature descriptor the appearance of the object and the outline of the image are described by its intensity gradients. One of the advantages of HoG feature extraction is that it operates on the cells created. The algorithm here is implemented using random forests classifier. They are flexible in nature and can be used for both classification and regression techniques. Compared to other machine learning techniques like SVM, Gaussian Naïve bayes, logistic regression, linear discriminate analysis, Random forests gave more accuracy with less number of image data set Therefore, energy examine has been by the consumer becomes much easier and controllable. This system also helps in detecting energy loss. Thus, this smart meter helps in home automation using IoT.

III. EXISTINGSYSTEM

In reference to the literature survey conducted, we reviewed a set of papers and few observations were drawn, out of which the main observation we find a system implementation were we find either crop recommendation, crop price prediction, fertilizer recommendation or plant disease detection. We can find the proposed papers that implement either the combination of either of the functionality or a single functionality but, we don't find a system were all the three functionalities like crop recommendation, plant disease detection and fertilizer recommendation is implemented, another main observation found is a fertilizer recommendation software's exist in markets predict a fertilizer which promotes the brand or company manufacturing the fertilizer rather than the organic alternatives which is necessary for the soil conditions and appropriate Nitrogen (N), Phosphorous (P) and Potassium (K) levels and overall soil health. The last observation considered is a smaller number of attributes been considered to recommend the crop and systems being limited to one class of diseases detection which is restricted to the limited species of plants

IV. PROPOSED SYSTEM

The proposed system is built by considering the drawbacks observed in the existing system. We have aimed to develop a single platform where the farmers can access crop recommendation, plant disease detection and fertilizer recommendation system which is more helpful to the farmers. We used the customized datasets in our system. In fertilizer recommendation system we predict the organic fertilizers which are optimal for the existing soil conditions and other external parameters considered. The system aims to help farmers to cultivate optimal crop for better yield. To be precise and accurate in predicting crops, the project analyzes the nutrients present in the soil and the crop productivity based on location.

The system will also be used for disease detection on the existing crop of the farmer as well as providing organic remedies for the farmer to eliminate the disease altogether. This can be achieved using unsupervised and supervised learning algorithms. A machine learning model is developed considering the various, different sets of data to obtain the output. The system takes input from various sources and uses Random Forest to predict the best suitable crop for any given area. The developed user interface is flexible and highly interactive which will encourage the farmers to use it frequently.

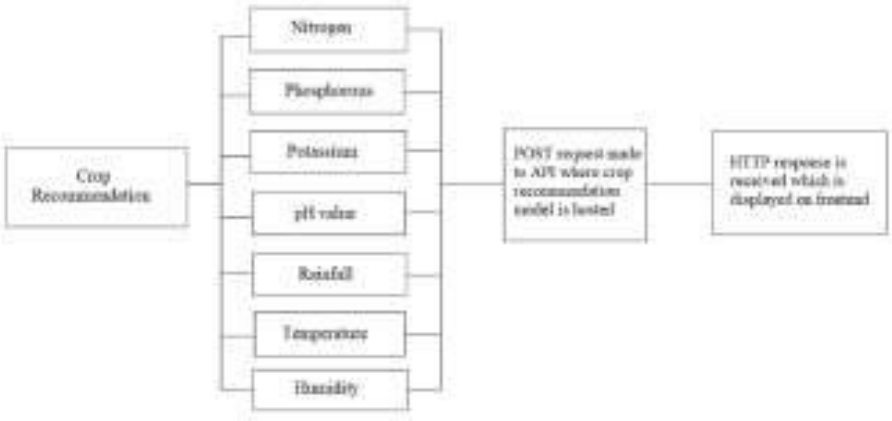

Fig1: System Architecture

The above figured epicts the system architecture composed of crop recommendation system, fertilizer recommendation system and plant disease detection system. The system is divided into three domains where the inputs are provided by the farmers to each of the domains. The crop recommendation system takes Nitrogen, Phosphorus, Pottasium, pH level, rainfall, location, which is provided to the crop recommendation model, were the data is tested against the trained model and predicts the optimal crop according to the external conditions. Similarly, user input such as NPK levels and the crop selected to grow is provided for the model which recommends the best organic fertilizer suitable for the soil conditions and crop selected. The leaf image which is considered as the evident part of the disease affected to the plant is uploaded to the system through the user interface and the model predicts the correct disease affected to the plant so that appropriate measures can be taken. The above figured epicts, data flow diagram for crop recommendation system. The farmer enters the parameters and after that data is passed on to the trained model and optimum crop is recommended and displayed to farmer's user interface.

The above figure depicts, data flow diagram for fertilizer disease detection system. The disease of the pre-existing crop disease is detected from the disease detection model and then the disease data is passed onto the fertilizer recommendation model, where the relevant fertilizer is recommended based on the disease data received. A response containing the fertilizer data is present which is then displayed on the frontend. The proposed system consists some modules of following steps to interpret the disease using deep learning method and the classification of crop recommendation using different machine learning algorithms.

The working method consists of main stages. These are respectively, loading the dataset, the design of the convolutional neural network, configuration of training options, training of the Resnet object detector with images of leaves, evaluation of trained detector and then training the classification model of crop and fertilizer recommendation with respect to various crop parameters. Various recent studies have provided methods to produce categorical independent zone recommendations. These methods have examples such as the objectness of image windows, selective Search for Object Recognition, category independent object proposals, object segmentation using constrained parametric min-cuts, Multiscale combinatorial grouping and soon. These methods establish cells by implementing convolution neural network with square cuts. Crop recommendation and fertilizer recommendation According to our testing, Random Forest algorithm has shown to be more accurate compared to other algorithms like Decision Tree, Naïve Bayes, XG Boost, Support Vector Machine and Logistic Regression for recommending crop and fertilizer based on the input parameters that are entered by the user. Random Forest is a popular ensemble learning algorithm used for classification and regression tasks in machine learning. It is a collection of decision trees where each tree is trained on a random subset of the training data and a random subset of the features. The final prediction is made by taking a majority vote over all the trees in the forest. Random Forest is a powerful algorithm because it overcomes the problem of over fitting that can occur with individual decision trees.

By training each tree on a random subset of the training data and features, it ensures that the trees are diverse and don't rely on the same subset of features. This help stored variance in the model and improve its generalization performance. Another advantage of Random Forest is that it can handle high-dimensional data with a large number of features. It automatically selects the most important features by evaluating the decrease in impurity or information gain a teach split. This helps to eliminate irrelevant features and reduce the computational cost of the algorithm. Random Forest is also robust to missing values and outliers in the data. It can handle categorical and numerical data and doesn't require any pre-processing of the data. It is a fast and scalable algorithm that can handle large datasets with high accuracy.

To train the Random Forest model for crop recommendation, a dataset is first collected that includes information about past crop yields and soil conditions. This dataset can be obtained from agricultural departments or farmers' cooperatives. The dataset should include the following information:

- The type of crop that was plants
- The nitrogen, phosphorous, and potassium levels of the soil
- The pH level of the soil
- The amount of rainfall during the growing season
- The state and city where the crop was grown

In the case of crop recommendation, each decision tree in the Random Forest model will make a prediction about the optimal crop to plant based on the input parameters. The prediction will be based on the past crop yields and soil conditions that are similar to the input parameters. For example, if the input parameters include high levels of nitrogen, phosphorous, and potassium, a high pH level, and high rainfall, the decision trees may predict that corn is the optimal crop to plant based on past yields and soil conditions that are similar to these parameters. In addition to making crop recommendations, the Random Forest model can also be used to identify the most important features that contribute to the prediction. This can help farmers to better understand the factors that affect crop yields and soil conditions in their area. One of the benefits of using Random Forest for crop recommendation is that it can provide insight into the most important features that contribute to the prediction. This can help farmers to better understand the factors that affect crop yield sand soil conditions in their area. For example, the algorithm may identify that rainfall is the most important factor for predicting crop yields, and that certain crops are more susceptible to changes in rainfall than others.

For fertilizer recommendation, the user must first input the NPK value of the soil. Next, the user must input which crop they want to grow. This data is then fed to the algorithm, which then recommends various steps that can be taken by the farmer to make the soil more suitable for the crop they want to grow. So, if N value of the soil is too low in the given input for the selected crop, the system gives advice to the user on how they can increase the N value of the soil to make the soil most suitable for growing that crop. For example, if the input parameters include high levels of nitrogen and phosphorous, and a low level of potassium, the decision trees may predict that chicken manure or compost is the most suitable organic fertilizer to use based on past fertilizer use and crop yields that are similar to these parameters. Only organic fertilizers are recommended to the farmer. Random Forest is a most popular machine learning algorithm that belongs to the supervised machine learning technique where the classification label is defined. It can be used for both Classification and Regression problems but, mostly used for classification problems. It is based on the concept of ensemble learning**,** a framework where a result from multiple models are implemented to solve a complex problem and to improve the performance of the model. Instead of relying on only one decision tree for classifying the data, the random forest takes the prediction from each of the defined trees and based on the majority classifications of predictions, and it predicts the final output. The greater number of trees in the forest leads to higher accuracy to avoid the problem of over fitting. Naïve Bayes algorithm is a supervised machine learning algorithm, which is based on Bayes theorem and mainly used for solving classification problems. It is mainly used in text classification that includes a high-dimensional training dataset. Naïve Bayes Classifier is one of the simple and most effective Classification algorithms which help in constructing a quick prediction models. It uses a probabilistic classifier approach, which means that the prediction is based on the basis of the probability of an object. The following section describes how features are extracted from the image acquired mentioned in Fig.4

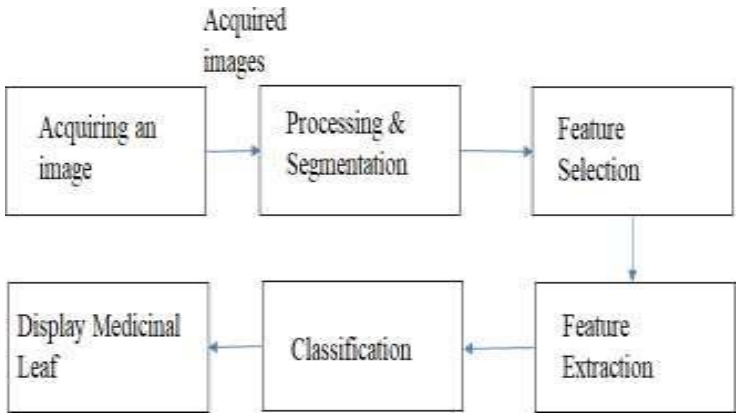

Fig 4: Feature Extraction from Image Acquisition:

The leaf images are detected and retrieved from some source for processing. This is the first step in the workflow sequence because without an image, no processing is possible. The image that is acquired is completely unprocessed.

Preprocessing & Segmentation:

Preprocessing is done to improve the image quality before extraction of the feature is carried out. Images are resized by reducing the original size of captured images. Scaling the images smaller than their original dimensions does not affect the image quality as much. The resulting image is subjected to contrast enhancement and smoothing. A strong on-linear filter called median filter is applied to reduce the amount of intensity difference from one pixel to other pixels. The important factor to choose median filter is that the edges are retained while the noise is eliminated.

Feature Selection:

The Feature Selection also called as variable selection. It is the process which is used for selecting a small set of relevant features for future use. After preprocessing the features or region from the preprocessed image using algorithm which is best in selecting the feature has been identified.

Feature Extraction

Feature extraction is the process which involves for clarifying the amount of resources required from a large set of data accurately. It reduces dimension by which an initial set of raw data is reduced to more manageable groups for processing. A characteristic of these large data sets is many variables that require a lot of computing resources to process. Once features are selected the nit need to be extracted. Image features Extraction stage is an important stage that uses algorithms and techniques to detect various desired portions or shapes. The selected features (affected part) must be extracted. Firstly, create gray-level co-occurrence matrix from image using gray co-matrix function in CNN. AGLCM (gray-level co-occurrence matrix) denote the second order conditional joint Probability densities of each of the pixels, which is the probability of occurrence of grey level i and grey level j within a given distance 'd'.

Classification:

CNN implements deep learning to machine image processing in order to classify pictures of leaf samples. Recent development of hardware and information processing technology has made deep learning a self-learning method that utilizes massive sum of data in a more feasible manner. The CNN initially aims to imitate the visual system of human. The retina identifies edges of an object by strong intensity of light compared to the whole object in the human visual system. This information is sent to later algeniculate nucleus (LGN). Simultaneously, the image information from the retina of the left and the right eyes give depth perception which provides distance information. These data are sent to secondary visual cortex (V2) which recognizes over all shape and color perception of the whole object. Different segments of the image are taken before being transferred to tertiary visual cortex (V3) to interpret the color. A more advanced CN Nuse multiple convolution synchronously in order to procure the required feature vector. Factorizing the convolutional layer would be effective to decrease the number of parameters. Instead of using a single convolution filter, a set of smaller layers is recommended. This technique has been proven to significantly minimize the parameters, while successfully extracting key features. Although the network is connected to all output feature vectors of previous convolutional layers, this classifier manages to give huge decrement to its number of trainable parameters.

V. RESULTS

Web Interface is designed which allows the farmers to enter the input for each of the domain and to receive the accurate and correct results

Fig5: Homepage of the website

The above figure , focus on the home page of the website named AGRI SMART and a brief note on the purpose webpage design is presented in the form of questions which signifies the importance of the system.

Fig 6: Services

The three main services provided by the system namely crop recommendation, fertilizer recommendation and plant disease detection.

Fig7: Fertilizer Page

Fig8: Fertilizer Recommendation

The fertilizer page allow the farmers or the users to enter the inputs such as NPK levels and crop to be grown and on clicking the predict button fertilizer is recommended. The inputs values received by the user, the system identifies the deficiency of nutrient in the soil and provide some suggestions to improve the soil quality and an organic fertilizer to be used to improve the soil quality.

Fig9: Disease Detection page

The disease detection page is to find out which type of disease that has affected the plant. The user can upload the image of the infected plant leaf to the system to detect the disease.

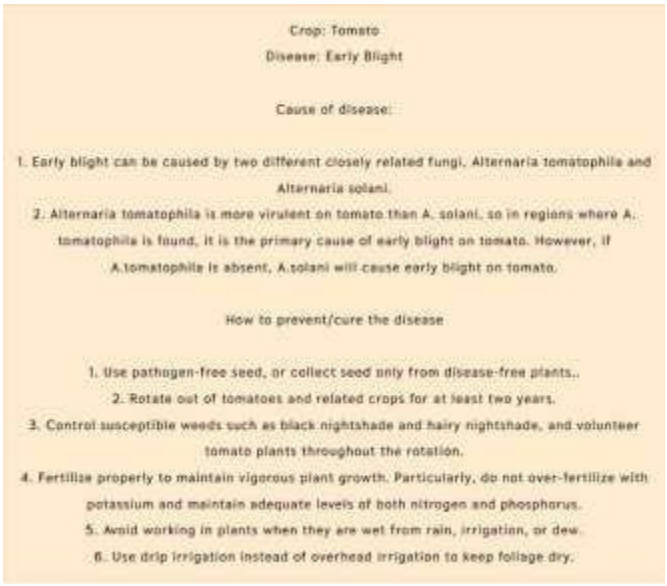

Fig10: Disease Detection

The uploaded image is processed, and the results are displayed which includes the crop, disease detected, its cause and cure.

Fig11: Crop Recommendation Page

The crop recommendation page asks for farmer input about soil conditions and data like rainfall and geographic allocation.

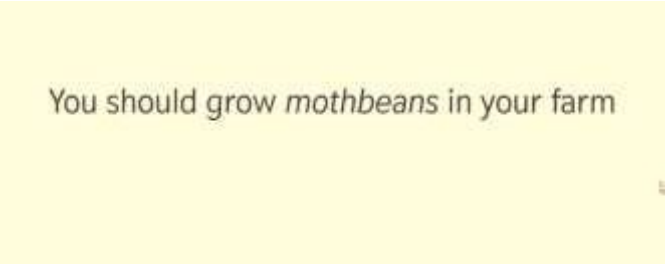

Fig12: Crop Recommendation

The inputs values received by the user, the system identifies the crop which is suitable for the provided soil conditions, external factors and location that provides better yield.

VI. CONCLUSION

In this paper, we propose a user-friendly web application system based on machine learning and called the 'Smart Agriculture'. With our system, the farmer will be able to take informed decisions regarding the management to this farm land with the questions as to Which crop to grow? Which composition of organic fertilizers he must use? And How to fix my disease affected crop organically? The answer to these questions lies with the usage of our system. The farmer can provide the input on our website or application and quickly get their results. Our work will mainly involve the recommendations of organic solutions as the Government is encouraging the adoption of organic technology in farms. With enough outreach we will be able to create a healthy, organic, and chemical free agriculture in the country.

VII. REFERENCES

[1]. MansiJadhav, NehaKolambe, ShreyaJain, Sheetal Chaudhari Farming Made Easy using Machine Learning 202 12nd International Conference for Emerging Technology (INCET) Belgaum, India, May 21-23,2021
[2]. Pawan Kumar, Ashish Kumar Smart Farming Using Machine Learning and IOT Easy Chair Preprint May1,2022
[3]. Devdatta A. Bondre, Santosh Mahaga onkar PREDICTION OF CROP YIELD AND FERTILIZER RECOMMENDATION USING MACHINE LEARNING ALGORITHMS International Journal of Engineering Applied Sciences andTechnology,2019
[4]. Shima Ramesh Maniyath, Hebbar Ram Plant Disease Detection Using Machine Learning 2018 International Conference on Design Innovation Ffor3Cs Compute Communicate Control
[5]. Marion Olubun miAdebiyi, Roseline Oluwaseun Ogundokun, and Aneoghena Amarachi Abokhai Machine Learning–Based Predictive Farmland Optimization and Crop Monitoring System Hindawi Scientifica Published11May2020