CROP DISEASE PREDICTION AND SOLUTION

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Abstract -Indian economy greatly depends on agriculture. Nowadays detection of crop disease is very important topic for analysis. It is one of the issues that cause reduction in quality and quantity of crop. So detection and classification of crop disease is necessary task to increase crop productivity and economic process. The proposed research work is to analyze various machine learning and image processing techniques applied to detect crop disease. In this paper we will review, different machine learning techniques, such as Random Forest, Decision tree, Multilayer Regressor, Regression algorithms, image processing techniques, Extreme Machine Learning to get better accuracy for system. Here, crop leaf images are taken as input and after processing that image, it will detect whether there is any disease or not. If disease is detected, then it will tell what type of disease it is and will provide solutions such as pesticides or chemicals to cure that disease. It will increase the productivity and economic process.

Key Words: Machine Learning, Image processing, Decision Tree, Random Forest, Naive Bayes, Crop disease detection, Extreme Learning Machine, K-means Clustering

INTRODUCTION

Agriculture is main occupation of India. It contributes about sixteen percent (16%) of total GDP and ten percent (10%) of total exports in India. Either directly or indirectly around 60% of people in India depends agriculture for livelihood. It falls under primary sector of Indian economy. It is main source of food, fodder and fuel. Over 60 % of India's land area is arable making it the second largest country in terms of total arable land. But due to various diseases the quantity and quality of the agricultural product are reducing. Some crop diseases do not have visibility throughout the early stage which results in the damage of whole crop. Nowadays automatic detection of plant diseases is very important analysis topic that detects the diseases from the symptoms that seem on the plant leaves. Plant disease is one of the issues that cause reduction in the quality and amount of plant production. This can lead to starvation of peoples. To increase plant productivity and economic process, detection and classification of plant diseases are necessary tasks. It is necessary to detect disease and spray pesticides properly on crops. When they are infected by diseases, there is a change in shape, size and color. These symptoms can be checked manually but not in the proper amount. Hence various image processing methods detect diseases on plant leaf and stems. Using image processing techniques exact level of disease can be identify based on color, texture or shape change of plants. And then using machine learning algorithms we can classify these diseases and provide a solution for that disease.

This paper is organized as follows: Section 2 consists of literature survey. In section 3, proposed methodology is defined and Section 4 contains algorithms that can be used to detect crop disease. System architecture is explained in Section 5 and conclusion is present in Section 6.

Literature Survey

Food demand is increasing due to rise in population. To produce food more sustainably farmers are using new technologies such as temperature and moisture sensors, drones, smart irrigation, self-driving and GPS enabled tractors. According to "The Economist", farmers are being "teched up" when it comes to growing crops more sustainable and profitable. It is often heard that diseases and pets attack crops and therefore food gradually reduces due to these attacks. By 2050, population of earth is expected to grow 9.7 billion. Since, a clear graph of rise in food demand is visible. Agriculture requires a continuous and sustainable increase in productivity, while resources like water, energy, fertilizers etc. need to be used thoughtfully in order to protect and sustain the environment and the soil quality of thearable land.

In [2], firstly they introduced a brief review of ELM, describing the principle and algorithm of ELM. Then, they have put variants of ELM, especially on incremental ELM, pruning ELM, error-minimized ELM, two-stage ELM, online sequential ELM, evolutionary ELM, voting-based ELM,ordinal ELM, fully complex ELM, and symmetric ELM. After that, they have summarized the applications of ELM on classification, regression, function approximation, pattern recognition, forecasting and diagnosis, and so on. At last, they have discussed several open issues of ELM, which may be worthy of exploring in the future

In paper [5] author have used decision tree classifier to classify the diseases of cotton crop. Environmental and soil temperature data is collected through input sensor and then send to server. Server then authenticates the data and transfers it to Temperature Repository i.e. database, where the user input values are compared with available training dataset. This data is retrieved in csv format to Decision Tree Classifier, Which predicts the relevant result and provide it to the user. In [1], they have taken a dataset with 11 attributes and 310 rows for prediction of crop disease. With the help of different techniques like decision tree, Naive Bayes, Neural network they have performed crop disease prediction. By performing these techniques they concluded that, the accuracy of given data in Decision tree, Naive Bayes, SVM, Neural Network.

Paper [3] In this paper we proposed the system which works on, reprocessing, feature extraction of leaf images from plant village dataset followed by convolution neural network for classification of disease and recommending Pesticides using Tensor flow technology. The main two processes that we use in our system is android application with Java Web Services and Deep Learning. We have use Convolution Neural Network with different layers five, four & three to train our model and android application as a user interface with JWS for interaction between these systems. Our results how that the highest accuracy achieved for 5-layer model with 95.05% for 15 epochs and highest validation accuracy achieved is for 5layer model with 89.67% for 20 epochs using tensor flow.

In paper [6] author have used feature selection algorithm to identify best response variable in terms of climatic parameter to identify the incidence of pests on cotton plant. For Chosen response variables, clustering are deployed to find the pattern for low and high infestations. AICRP has conducted an experimental setup to study the incidence of pests related to climatic conditions. Authors have used this Pest data along with meteorological data for each sucking pests which is collected for 5 years. The data is analyzed by using the analytical tool. Author have proposed a wrapper selection method called Recursive Feature Elimination (RFE) which construct disjoint decision tree to select the best feature. The significant parameters which are identified by the feature selection are clustered by using the clustering algorithm. The Correlation, Random Forest are the feature selection algorithms implemented and k-means clustering is applied to predict at what range of values the pest will start affecting the plant.

Paper [8] in this paper, we propose a classification method of periodontal disease based on CNN. The data to used were the actual periodontal images and non-periodontal images. Data processing techniques such as resize, crop and zero-centralizing are used to improve data learning efficiency. The CNN Structure proposed in this paper has size image as input data and 4 outputs according to periodontal state. We also use momentum optimization technique for neural network optimization.

In paper [4] author have created a prediction based model to predict diseases for crops such as Wheat, rice and cotton. The dataset used in this paper consists of atmospheric factors i.e. Rainfall, Temperature, Humidity and Pressure. This data is first pre-processed and cleaned. The pre-processed data is fed into a Machine Learning algorithm which outputs a trained model. This trained model is used to output weather forecast of Temperature, Humidity and Pressure for a certain interval. The trained model is used to forecast the rainfall in mm for a certain month. Finally disease prediction module is created in which the place of farming and period is taken as inputs from the farmer. The forecasted weather parameters and some input values from the Soil Report is mapped to the disease correlation data which is then used to output those diseases that are most likely to occur in those atmospheric and edaphic conditions.

For prediction of crop disease using weather data with the help of extreme learning machine they have proposed a new approach [9]. Predicting when a disease will increase to a threshold that causes significant economic loss is important to prevent. Already existing methods and approaches have been surveyed and studied, and it shows that disease manifestation prediction is a linearly inseparable problem and the proposed approach is better for linearly inseparable problem. Experiments were conducted for different activation functions and it could give satisfactory accuracy of 91.5% for radial basis function.

Paper [7] Crop diseases and pests play a key role in reducing crop production and quality. Therefore, the detection is fundamental in precision agriculture task. Manual detection of diseases takes additional time and efforts on the larger area of the farm. Deep learning approach can be used to detect the diseases and pest more accurately on leaves and other parts of the crop. The proposed method is helpful in detecting crop diseases as well as pests. In this paper, the deep learning techniques related to diseases and pest detection has been reviewed and the deep learning model for automatic diagnosis of crop diseases and pests is proposed.

Proposed Methodology

Image pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing. If it is image dataset then we can make array of images and then apply model like CNN, KNN depending upon how much accuracy it gives. After determining disease we can give the solution in the form of chemicals or pesticides depending on disease. Crop disease prediction can be done using "Crop Disease Dataset" which is available on Kaggle.

ALGORITHMS USED

Image pre-processing

The purpose of pre-processing is to improve the image data that is suppressed.
Improves some of the image features that are necessary for further processing.

It also includes noise reduction, edge sharpening and detection, etc. This makes the manual process of disease detection automatic or semi-automatic.

CNN

CNN is Machine Learning algorithm that takes images input, assigns importance of various aspects/objects in image and is able to differentiate one from other.
It works by extracting features from images.

Decision Tree

The decision tree is used to reflect decisions and decision making in a visual and explicit way.
It is a powerful tool for regression and classification.

As it name says it is a tree like structure where each internal node denotes a test on an attribute, each branch represents outcome of test and each leaf node holds a class label.

Random Forest

i. Random Forest adds additional randomness to the model

iii. Instead of searching for the most important feature, it searches for the best feature among a random subset of features.

SYSTEM ARCHITECTURE/WORKFLOW

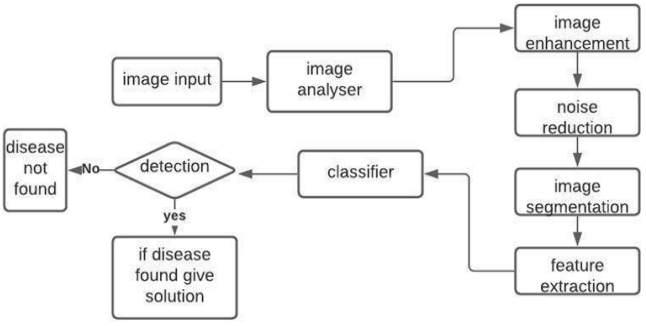

Fig-1: System Architecture

Image is given as an input to the system. Image processing is carried out on the image. Image analyzer consists of 4 phases. Image enhancement is done to improve the interoperability or perception of information in images for human reader and providing better input for other authorized automated image processing technique. Image contains unwanted noises which are needed to be removed to get a clear Image. This process of removing noise is called as Noise Reduction. It is an important step.

After this image segmentation is done on image in which visual image is divided into segments to simplify image analysis. Segments represents object or a part of the object can comprise set of a pixel or super pixel. Image segmentation sorts pixels into large component eliminating need to consider individual pixel as a unit of observation. The next step is feature extraction. Many machine learning practioner believe that properly optimized feature extractions is necessary for effective model construction. Database used in this system contains images of affected crops. Database cleaning is performed on this database to get required data. After this one of the ML algorithms is used to detect the disease of crop which will provide best accuracy and 100% result. Then the features extracted from image are compared with resultant database and this algorithm will help us to detect whether disease is present or not. If crop is affected then appropriate solution will be provided and if crop is not affected with disease message will be displayed.

CONCLUSION

The early detection of diseases on plants is much required as a very small number of diseased crops can spread the infection to the whole crops in the field and thus affects further agricultural sales. The proposed work aims at development of methodology for identification and classification of disease symptoms affected on agriculture crops and detect as early as possible to avoid further loss of crop. The system will also provide its solution and thus prevents future economic losses. This System is useful for the farmers to identify which disease have hit the crop in which season and accordingly decision can be made for farming. We would like to conclude that we are going to develop a project for crop disease prediction system and its solution by using decision tree algorithm.

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