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Fungal Disease Detection in Apple Crops Using Random Forest Model

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Abstract: Disease has always been one of the main reasons for the decline of apple quality and yield, which directly harms the development of agricultural economy. Therefore, precise diagnosis of apple diseases and correct decision making are important measures to reduce agricultural losses and promote economic growth. The forecasting of crop disease is a significant and innovative topic; the debasement in both quality and quantity in the yield of crops is due to various conditions, which in turn alters the economy of countries like India, where a majority of the population hinge on crop and cultivation. It is challenging to keep an eye on disease in plants through conventional approaches, which involve a lot of effort, time, and experience. Automated disease identification of plants is a critical research field. In this paper, focus is laid on how machine learning helps in apple disease detection using various prediction algorithms using weather and disease datasets.
Keywords: Machine Learning, Apple Disease Detection, Disease Dataset, Weather Dataset.

I. INTRODUCTION

During the 1950s Machine Learning was originally launched as a unique method for Artificial Intelligence but it shifted its momentum towards the algorithms which are computationally achievable [Khan & Samad, 2017]. The technology of Machine Learning (ML) focuses and involves all the processes that are linked to make a machine able to learn from instructions and experiences to improve its performance[1]. For the disease monitoring of Apple crop, sensors are being employed to measure the environmental changes on a timely basis and many such attempts have been made so far by the researchers with not much success. Due to the availability of cost-effective and application-specific sensors, the task of monitoring parameters like temp., rain, humidity, and leaf wetness which have drastic effects on the development of the Apple Scab has become an easy job. An attempt was made in this work to use WSNs for monitoring and collection of effective data values and then using Machine Learning techniques for possible disease prediction and analytics.

II. RELATED WORK

By 2050, it is expected that the world population will reach 9.8 billion according to a newly launched United Nations report1. Consequently, as the global demand for food and production of agricultural crops elevates, novel and sustainable approaches are needed that employ technologies focusing not only on agricultural activities for crop production but also on the global impacts on the environment [FAO, 2013]. Modern agriculture replaced traditional agricultural ways with the introduction of new techniques, concepts, ways, and technology. This new agricultural system is called Precision Agriculture (PA)[Stafford, 2000]. PA thus is the sustainable agricultural concept. It focuses on the initiatives to maximize crop production from small land areas, low cost, and less damage to the environment [Thakor et al., 2015]. Thus, it is the system that utilizes information-based tools and technologies for agro-processes with each precise action taken to ensure more crop productivity.

III. RANDOM FOREST MODEL

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[3].

A. Functionality

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.

The Working process can be explained in the below steps and diagram:

1) *Step-1:* Select random K data points from the training set.
2) *Step-2:* Build the decision trees associated with the selected data points (Subsets).
3) *Step-3:* Choose the number N for decision trees that you want to build.
4) *Step-4:* Repeat Step 1 & 2.

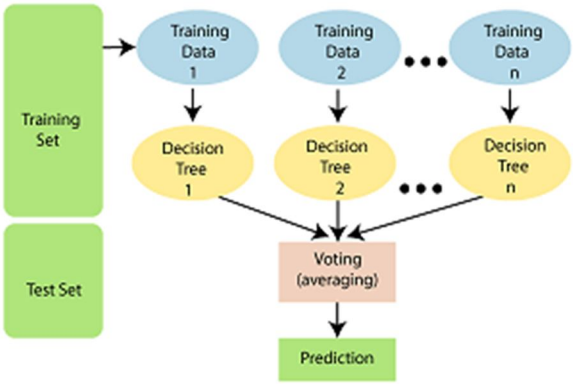

Figure1. Working of Random Forest Algorithm.

B. *Parameters for Feature Extraction*

Multiple parameters affect apple scab diseases as already discussed. Someof them are weather-based, crop-based and some are based on characteristics of the pathogen. The parameters were chosen to be monitored (weather-based) is purely done based on their effectual nature and contributions towards the growth of the disease pathogen. The crop based information like the flowering stage and tree height, number of days from seasons first oil spray have been engineered to partially reflect the crop parameters. Parameters like the type of irrigation, type of farm, and soil fertility have not been taken into account[4,5].

The main parameters for feature extraction are :

1) Rain.
2) Air Temperature
3) Leaf Temperature
4) Humidity
5) Disease Specification
6) Crop Type

IV. METHODOLOGY

A. *Data Collection and Pre-processing*

This is a very important and critical step in the development of every machine learning model. As mentioned above the weather data is collected with the help of hi-tech sensors, which was logged to a data logger located at each experimental site as well as to the Think Speak Cloud. The data is then collected by paying visits to the location at feasible intervals of time. The datasets thus collected are primary and one of its kind and a novel approach for Apple[6].

B. *Weather Based Dataset*

This dataset lists all the parameters related to the surrounding weather of the particular orchard sites[7]

C. *Analysis*

All the weather datasets and the disease datasets are merged to form two (02) major datasets weather & disease including all the years. As the problem of Apple scab is a case of supervised learning therefore class or target label column under the name of infection value is set according to the following criteria:

if infection_value < =70 then Slight Infection
if infection_value >= 71 and <=200 then Medium Infection
if infection_value >= 201 and <=500 then High Infection
if infection_value >=501 then Extreme Infection

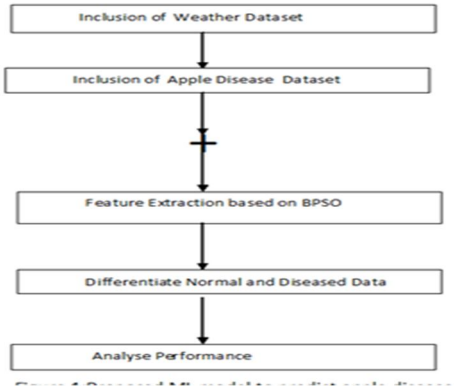

Figure2: Proposed Model to Predict Apple Disease

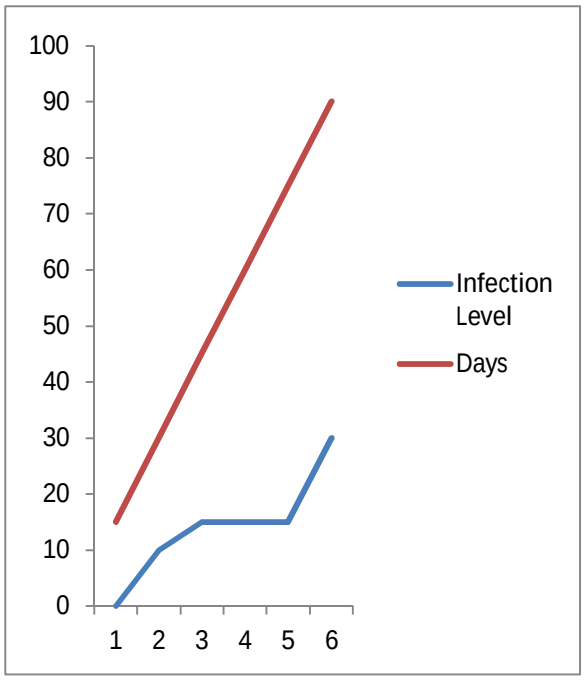

Figure 3: Infection Level based on Change in time

V. CONCLUSION

The proposed work explores the use of traditional machine learning classification algorithms for Apple Scab Prediction. The model performed well in all the evaluation metrics and also managed to satisfy the experts of the subject. Given the widespread application of machine learning in precision farming, this work can be extended for other dangerous diseases of Apple crop as well as other fungal diseases of other important crops.

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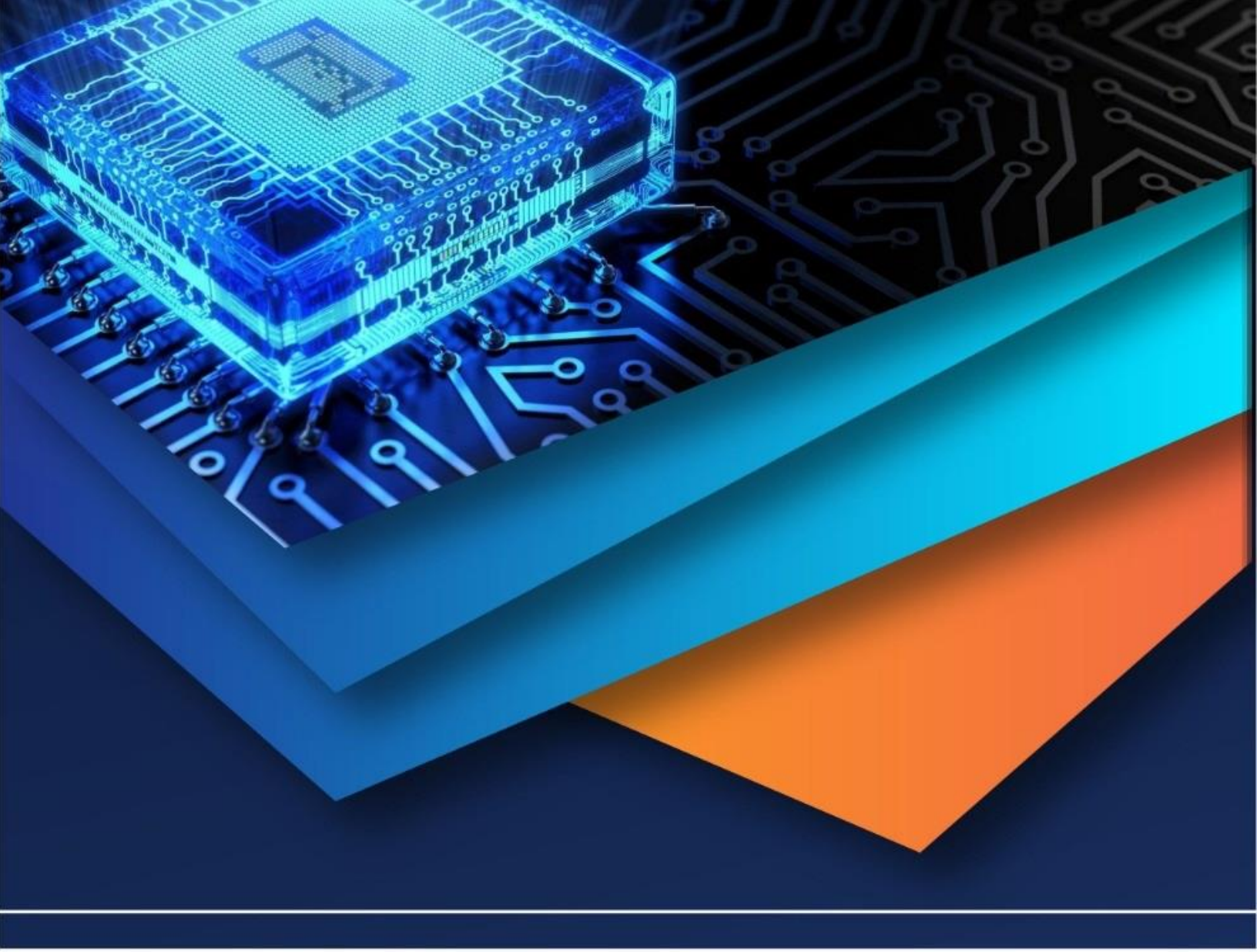

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