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Potato Disease Detection Using Machine Learning

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Abstract: ***Production within the agricultural sector was a major factor in the Indian economy. It increased the GDP of our nation by over 17–18%. In India, farming is among the most common profession. The economy of our nation is heavily reliant on farming and the goods that are produced there. With the largest net cropped territory in the entire world, India was ranked #1, next to the US and China. Another of the main crops is the potato. Throughout the past few years, potato farming has become increasingly popular. However, several illnesses are impeding potato output, raising the cost of potato cultivation for farmers. Nonetheless, a few potato illnesses are impeding potato yield, raising farmers' expenses. These machine-learning techniques are highly helpful for quickly monitoring huge fields. In this study, we employed potato leaves to identify disease-causing factors such as late and early-onset blight, as well as to determine the region of the leaf that was affected. Our primary objective is to use cutting-edge machine learning technology to identify potato infection from leaf photos. To identify leaf diseases and attain up to 95.0% efficiency for the machine learning approach, we are going to use a hybrid model that combines SVM and Decision Trees.***

Keywords: Support vector machine (SVM), Decision Tree (DS), Conventional Neural Network (CNN), Healthy leaf, early blight, late blight, accuracy, Machine learning model.

I. INTRODUCTION

In nations like India, where farming either directly or indirectly drives economic growth, it is a vital industry [1]. It suggests that plants must be cared for from seedlings till the desired crop is produced. For the crop to yield the desired results, it must successfully navigate numerous stages along this process, including weather, disease resistance, and animal resistance. Of these key stages, agricultural products can be shielded from different animals by giving the land adequate defence, and this problem can be resolved. The next significant problem is the the environment which is beyond human control; all that humans can do is hope for favourable conditions The climate is another major problem, and it's beyond our control. All that mankind can do is hope for favourable conditions in order to produce higher quality crops. And lastly, the main concern that is vital to safeguard the crop against different illnesses. since these illnesses may affect the crop's development and output. Plants can be maintained with the right fertilisers if these pests can be identified in a timely manner. The amount of time it takes to identify infections and the accuracy with which they are classified can be reduced if the method for disease recognition and classification can be digitalized, which will benefit farmers [2]. India is home to many major agricultural products, the potato being a few of them. In addition to being one of the most widely grown crops in India, potatoes are consumed daily by over three-fourths of the people of the nation. However, a number of diseases, including both late and early blight, can reduce the output of the crop of potatoes. In terms of science, these illnesses are also known as Alternaria Solani and Phytophthora Infestans, correspondingly. Early detection and categorization of these illnesses will prevent economic damage and illness [3]. The use of the human eye has been a common method for years to identify these disorders. However, there are certain issues with this system, such as the need for extra for analysing data and a lack of specialists in specific subjects in remote regions. As a result, image interpretation proved to be a successful technique that will be essential for both tracking and accurately identifying diseased plant situations.

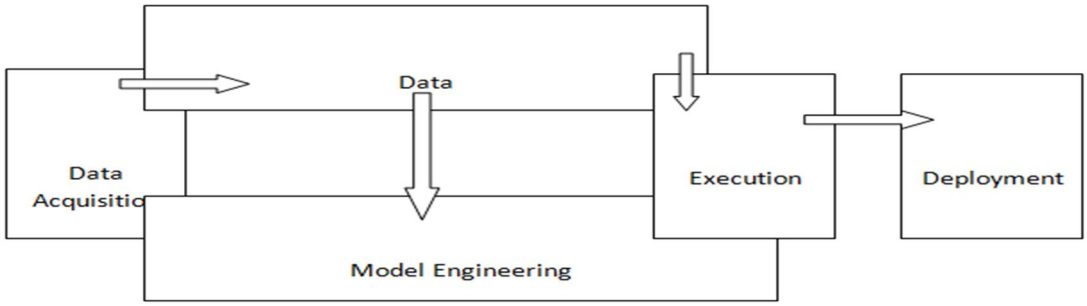

Figure 1. Architecture of Machine Learning

II. LITERATURE SURVEY

The percentage of light at all electromagnetic frequencies that a vegetative leaf absorbs, transmits, or reflects depends on the physiological science, the field of biochemistry and architecture of the leaf. It is potential to identify, differentiate, and diagnose diseases of plants using non-invasive study of the light emitted from leaves of plants because these factors are changed by pests, infectious agents, and diseases that they cause. The present research investigated the use of part least squares and back transmission neural network spectral calibration prototypes to analyse light across the ultraviolet and near-infrared (400–1000 nm) portion of the wavelengths for the purpose of detecting and differentiating across a few potato infections that are significant to the agricultural industry.[1] Plant disease identification and contemporary phenol typing offer encouraging steps in the direction of sustainable agriculture and food security.[2]

Throughout the suggested model, the CNN algorithm—which has seven classes of potato illnesses and a 99% accuracy rate—is used to identify different types of potato diseases. CNN considers each image component individually. CNN refers to these stories as highlights. CNNs are better at detecting proximity than whole picture coordination schemes when it comes to identifying the harsh element matches in two images that are in similar places. Every element has the appearance of a smaller-than-normal photograph, a tiny two-dimensional collection of attributes. This project's primary goal is to use machine learning (CNN) to identify potato diseases on every surface.

The results suggest that people can make better choices regarding the variables influencing crop development by evaluating a wide range of data gathered from fields and integrating online IoT sensor data that has been collected in instantaneously. In the long run, combining these advances can revolutionise modern agriculture by raising yields of crops and reducing waste. To determine which algorithms are best for usage in farming, fifteen different approaches were examined. A newly developed characteristic combining scheme-enhanced method is also provided. Based on the findings, we can obtain an accuracy for classification of 99.46% through the Naïve Bayes Classifier and Hoeffding Tree algorithms, and 99.59% with the Bayes Net technique. This research will point to higher rates of yield and lower farms' functional costs, which will ultimately result in more robust equipment. [3]

III. PROPOSED SYSTEM

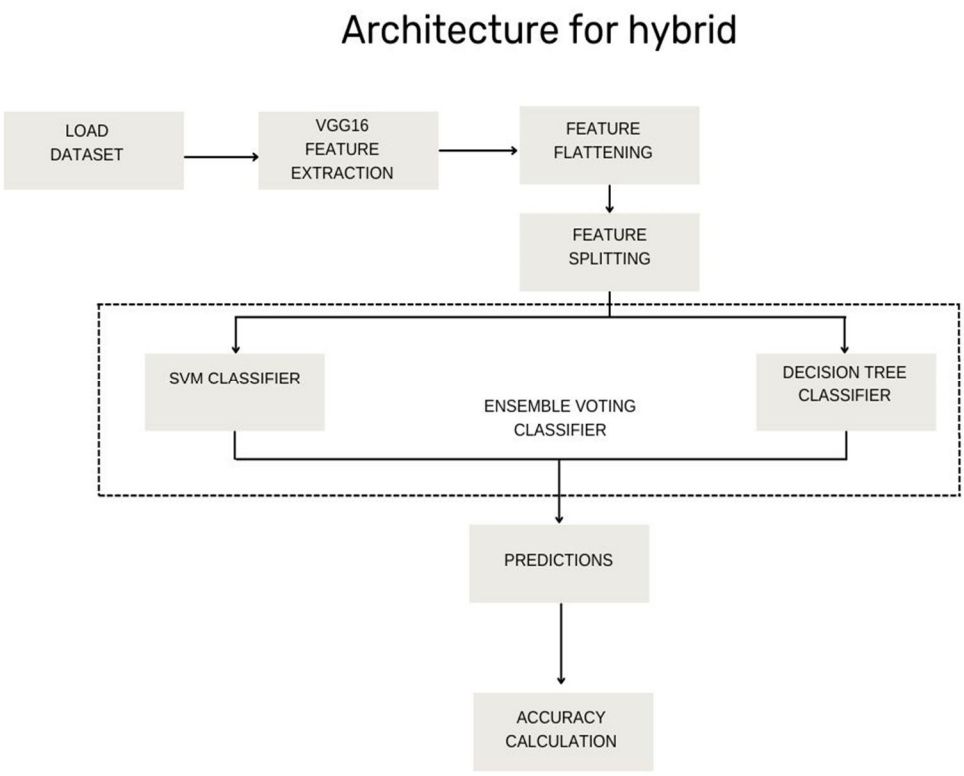

Figure 2. Hybrid Model of Machine Learning

1) *Input Images:* The original images from the dataset.
2) *VGG16 Model (Feature Extractor):* A pre-trained Convolutional Neural Network (CNN) used to extract high-level features from the input images.
3) *Flattened Features:* The features extracted by VGG16 are flattened into a one-dimensional array to serve as input to the classifiers.
4) *SVM Classifier (SVC):* A Support Vector Machine classifier trained on the flattened features.
5) *Decision Tree Classifier:* A Decision Tree classifier trained on the flattened features.
6) *SVM Predictions / Decision Tree Predictions:* The predicted class labels from the SVM and Decision Tree classifiers, respectively.
7) *Hybrid Predictions:* The final predictions generated by combining the predictions from both SVM and Decision Tree classifiers (e.g., using a voting scheme).
8) *Accuracy:* The accuracy of the hybrid model, calculated by comparing the hybrid predictions with the ground truth labels from the dataset.

IV. RESULT ANALYSIS

A. Accuracy and Results

By hybridizing Decision tree classifier and SVM classifier using Voting ensemble we get a better accuracy of 83%.

1) *Performance Analysis of ML Algorithms for Accuracy (hybrid Algo)*

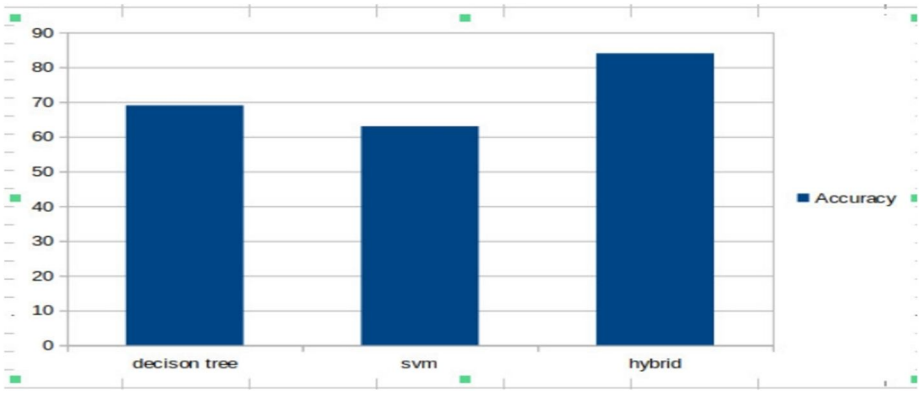

Figure 3. Performance Analysis of ML Algorithms for Accuracy

2) *Distribution Plot*

This is a distinction plot used to distinguish between the Accuracy percentages between Decision tree tress classifier, SVM classifier and Hybridization of both. As we can see the decision tree performs better than SVM but when hybridized with SVM gives the best results.

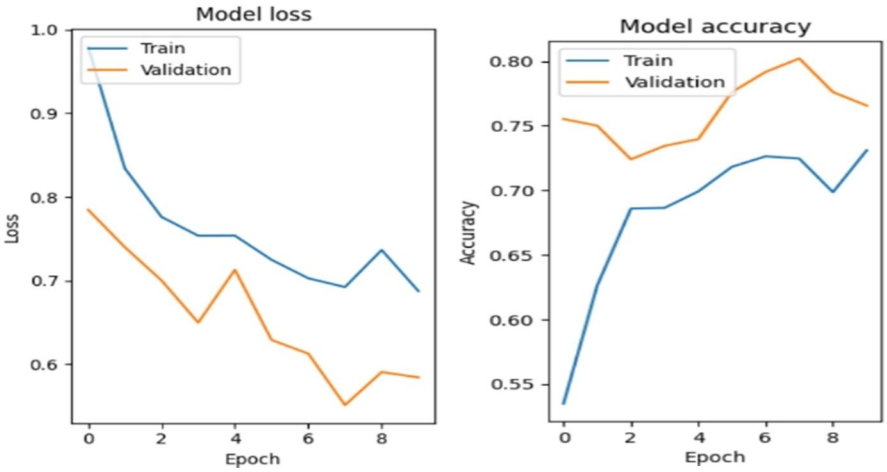

Figure 4. Comparison of Model loss and Accuracy

a) *Model Accuracy:* Model accuracy is a measure of how often the predictions made by the model match the actual labels in the dataset. It is calculated as the ratio of the number of correct predictions to the total number of predictions made by the model
b) *Model Loss:* Model loss, also known as the objective function or cost function, quantifies how well the model is performing. It measures the difference between the predicted values and the actual values in the dataset. The goal during training is to minimize the loss function.

V. CONCLUSION

Methods for deep learning are particularly helpful in improving efficiency and the quality of products as well as early detection of diseases. In this study, illnesses of potato plant leaves are detected and categorised using a quick & personalised hybrid approach. For our task, such as the hybrid technique's efficiency is close to 90%. Additionally, the entire leaf area affected by the infection is identified by this investigation. In order to improve the development and production security, automation should be incorporated into farming in that it is becoming more and more prevalent in all other areas. With this goal in mind, the suggested approach to identify and categorise potato leaves that are impacted and those that are not is designed to do so. We believe that our initiative has the potential to improve the lot of Indian potato growers.

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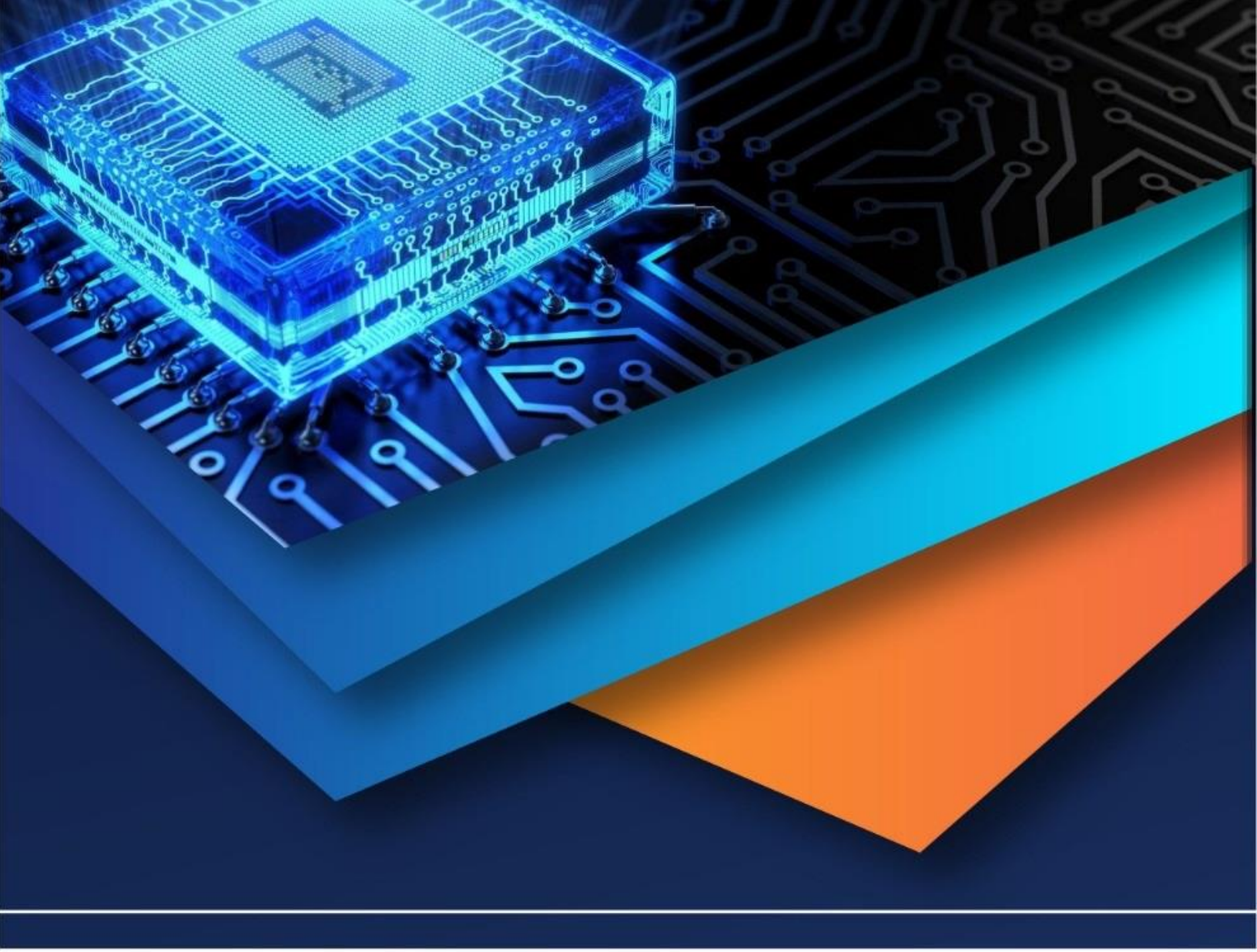

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