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Exploiting Convolutional Neural Network for Cognizance of Diseases in Potato Plants

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Abstract: -

Numerous plant diseases are the main cause of the reduction in agricultural yield. Early disease identification and crop prevention are the most difficult aspects of increasing crop output and eradicating disease-induced losses in plants throughout growth. Pest-infested plants and crops have an effect on the nation's agricultural output. To find and recognize illnesses, farmers and other experts typically monitor the plants closely. But this process is often expensive, time-consuming, and inaccurate. Therefore, it is a wise choice that the villagers or farmers can make to prevent more losses. The study focuses on image processing methods for diagnosing different plant diseases. Here, we employ an effective convolutional neural network (CNN) approach that can identify the different types of leaf illnesses. The implementation procedures in our suggested study involve obtaining datasets, training, segmenting, extracting features, testing, and classifying using CNN to classify the leaves which are diseased or healthy based on data. This work implemented in giving the input leaf in real-time from the source of Google or dataset is trained under the system helps in disease detection and represents remedies for overcoming the deficiency. The way to identify a plant illness is to search for a spot on the leaves of the affected plant. This research aims to develop a disease recognition model backed by categorization of leaf images. We are using image processing with a convolution neural network (CNN) to identify plant illnesses. Convolutional neural networks, or CNNs, are a type of artificial neural network used in image recognition that are designed particularly to analyze pixel input. Convolutional neural networks, or CNNs, are a valuable tool in the identification of diseases affecting potato plants. By analyzing images of potato plant leaves or stems, CNNs can accurately detect and classify various diseases, giving farmers early warnings and precise diagnostic information. This technology allows farmers to implement targeted treatments and interventions, reducing the need for broad-spectrum chemical applications. Consequently, CNNs contribute to sustainable agriculture practices, protect crop yields, and promote efficient resource management in the farming industry.

Keywords: -

Image Processing, Feature Extraction, Classification, Disease Detection, CNN.

I. INTRODUCTION

Producing food through agriculture is a very old method of acquiring food. It is an essential source of income for people everywhere. Without food, no one in our planet could survive. Significant steps are being taken by the government and specialists to improve food production, and these efforts are being effective in the actual world. The ecosystem is impacted when a plant contracts a disease. The plant leaf, and branch, might be impacted by any plant disease. Even the diseases that affect plants can vary, including fungal and bacterial infections. Climate is one aspect that will decide the disease that affects the crops. The number of individuals experiencing food insecurity is high. This happens when food crops don't produce enough. Plant growth is impacted by climatic changes. Large-scale agricultural losses can be avoided by detecting plant diseases early. The right pesticides must be used by farmers for their crops. Farmland and crops are harmed by the overuse of pesticides. Seeking professional guidance will assist in preventing chemical overuse on plants. Many academics have focused on plants in an effort to support farmers and other agriculture-related professionals. It is easy to identify an illness when it is readily apparent to the unaided eye. If the farmer has enough knowledge and regularly checks on the crops, the sickness could be identified and treated early. But this stage only occurs in cases of severe illness or low crop yield. The adoption of computerized disease detection systems will be advantageous to farmers. Results from this method can be used in small- and large-scale agricultural production. The fact that the problems are identified quickly and with precision is noteworthy. The functionality of these technologies is mostly dependent on deep learning and neural networks.

II. LITERATURE REVIEW`

Higher system requirements were used in the development of the implementation model. Users are required to provide leaf photos in this instance, and the model stipulates that users must install a number of packages, including TensorFlow, OpenCV, Kera's, etc. The illnesses that are present in plant leaves have been identified by the users of the current system. However, it doesn't offer any solutions for getting over the short fall. Several techniques for the automated diagnosis of plant diseases were presented in paper [1]. The illness may show up in the plant's fruit, leaves, roots, stem, and other sections. As previously mentioned, this work focuses especially on leaves. The detection of healthy and damaged leaves from generated data sets is presented in Paper [2]. These are constructed using a variety of feature extraction techniques, such as the oriented gradient histogram (HOG) Paper [3] Mr. Ashish Nage and Prof V.R Raut discussed with identification of diseases in leaves. They suggest an android application that helps farmers for identifying plant diseases by uploading images on the computer. This program builds with a set of algorithms that identifies the disease type. User-given input undergoes several processing steps to detect the disease and results are returned to the user with the android application Paper [4] uses image processing to identify unhealthiness in plantsand detect downsides in the tomato leaves from images. For detection here consider the features like color, bound and textureto give the brisk and decrease the losses for farmers and ensure productivity. Here, KNN (K- nearest neighbors) algorithm is used for classification. Which is guided and implemented to find solutions for classification and regression problems. Paper [5] focus on finding plant diseases and reducing losses.For building the model here using deep learning techniques for leaf identification and important hierarchy of neural networks like Faster region basis convolution neural network(Faster R-CNN), region-based fully CNN(R-CNN), and single-shot multibook detector (SSD). After validation, itproduces the results consisting with an accuracy of 94.6% which depicts feasibility on the CNN and finding deep learning solutions. Paper [6] aims to rice leaf identification model using machine learning approaches. The algorithm used for this purpose is KNN (K Nearest Neighbor), J48(decision tree), Naïve Bayes and Decision tree algorithm, Logistic Regression, etc. are some of the algorithms used.

III. PROPOSED WORK

3.1 SYSTEM ARCHITECTURE

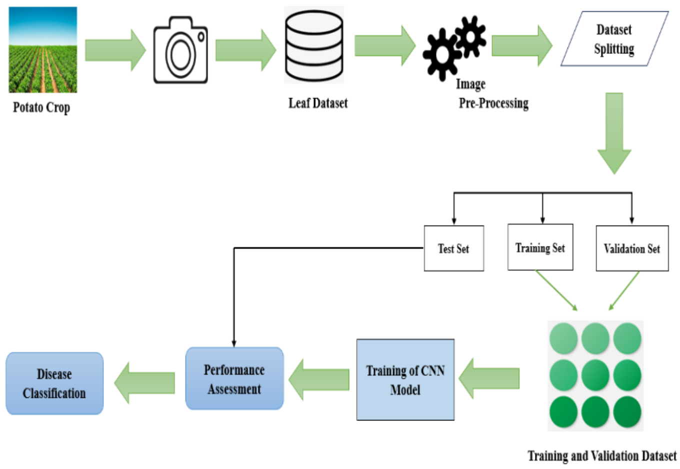

Fig. 1 System Architecture

Figure 1 shows system architecture for a plant disease detection project based on Convolutional Neural Networks (CNNs) which comprises several interconnected components. It begins with data collection and storage, where a diverse dataset of plant images, both healthy and diseased, is gathered and organized. Following this, data preprocessing steps, such as resizing and normalization, areapplied to ensure that the input data is suitable for the CNNmodel. The core of the system is the CNN model itself, which can be designed from scratch or built upon pre-trained architectures. Transfer learning is often employed to leverage knowledge from existing models. During training, the CNN model learns to distinguish between healthy and diseased plants by adjusting its internal parameters based on thetraining data. Model evaluation on a validation dataset is crucialto assess its performance

3.2 FLOWCHART

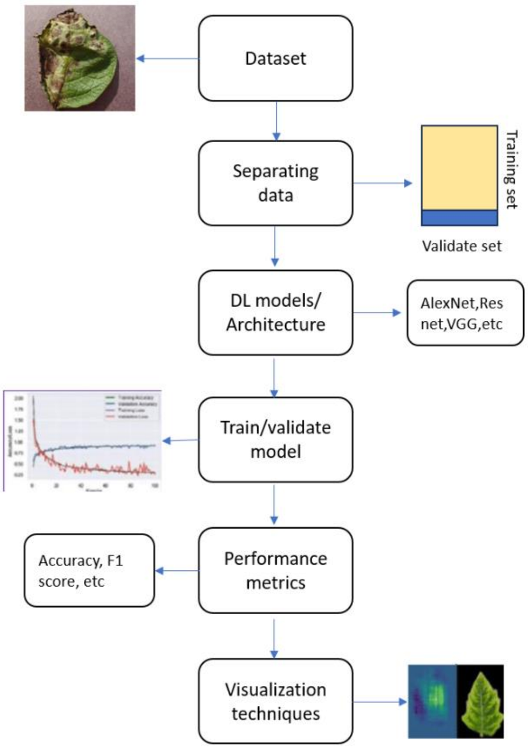

Fig. 2 Flowchart of System

Fig. 2 seems to be a flowchart or diagram showing the steps in a data analysis or machine learning process. The process's principal elements are: The raw data used for the analysis is referred to as the dataset. Data separation is the process of dividing the data into sets, usually for training and validation. DL models/Architecture: These are the architectures or models for deep learning that will be used to the analysis. The process of training and validating a machine learning model is known as "train/validate model. "Performance metrics: These are the measurements that are used to assess how well the trained model performs. Visualization approaches: In the last stage, the results are presented using visualization techniques. Additionally, the diagram has a few sample graphs and pictures that are probably connected to the dataset or the analysis process.

3.3 MODULES OF SYSTEM

1) Module 1: Data Gathering and Preparation

Gather a comprehensive dataset of high-resolution images of potato plant leaves. These images should cover a diverse range of healthy leaves as well as leaves affected by various diseases, including fungal, bacterial, andviral infections. Accurately label each image in the dataset with the corresponding disease category or a "healthy" label.

2) Module 2: Data Wrangling

Data wrangling involves collectinglabeled images of healthy and diseased potato plants, cleaning the dataset by removing duplicates and low-quality images, augmenting data for diversity ensuring overall data quality and integrity to prepare it for machine learning model training.

3) Module 3: Data Analysis

The aim of this step is to build a modelto analyze the data using various analytical techniques and review the outcome. The model building phase involves defining a Convolutional Neural Network (CNN) architecture, configuring layers, specifying activation functions, compiling the model with loss and optimization settings, initializing weights, adding regularization techniques.

4) Module 4: Model Training and Testing

Now the next step is totrain the model, in this step we train our model to improve its performance for better outcome of the problem. Training a model isrequired so that it can understand the various patterns, rules, and, features. Evaluate the trained model's performance on the independent testing dataset to estimate its real-world effectiveness

ALGORITHM

Input: Image of Potato Leaf
Output: Classification of Leaf into Late Blight, Early Blight or Healthy

Step 1: Data Collection and Preprocessing
1.1 Gather a dataset of potato plant images categorizing them as a healthy and diseases.
1.2 Preprocess the images

Step 2: Split the Dataset
2.1 Divide the dataset into training, validation and test sets.

Step 3: Build the CNN Model
3.1 Initialize the CNN Model Architecture:
- Convolutional layer with specific filters and kernel size
- Pooing layers to down sample the features.
- Flatten layer to convert 2D matrix to vector

- Fully Connected layers for classification

3.2 Compile the model with specified optimizer, loss functions and evaluation metrics

Step 4: Training The Model

4.1 Loop through the epochs:

a. Train the model on the training data:

- Forword Pass: Input images through the model
- Calculate loss between predicted and actual label
- Backpropagation

b. Validate the model on the validation set to monitor performance

Step 5: Testing and Evaluation:

Evaluate the trained model on the test set.

Step 6: Deployment:

Deploy the model for inference on new, unseen potato plant.

RESULT ANALYSIS: -

Classes	Logistic Regression	CNN Model
Early Blight	91.2%	96.7%
Late Blight	89.4%	97%
Healthy	90%	96.6%
Not Potato Leaf	88%	95%

This table looks to show the classification performance metrics of two separate models, a Convolutional Neural Network (CNN) and Logistic Regression, for different kinds of potato leaf blight and healthy/non-potato leaf samples. Let's examine the details presented:

Classes: The various classes or categories that the models are aiming to categorize are listed in this column. Here, it comprises "Not Potato Leaf," "Early Blight," "Late Blight," and "Healthy."

Logistic Regression: The accuracy with which each class is classified by the Logistic Regression model is displayed in this column. The percentage of correctly classified instances relative accuracy.

CNN Model: In a similar vein, the accuracy that each class's CNN model achieves is shown in this column.

Early Blight: The CNN model marginally outperforms the logistic regression model (96.7% vs. 91.2%), although both models achieve high accuracy in classifying early blight cases. This suggests that the CNN model may do a better job of identifying intricate patterns in the early blight data.

Late Blight: Once more, the CNN model outperforms the logistic regression model by a small margin, with an accuracy of 97% as opposed to 89.4%. This shows that differentiating late blight samples is a stronger suit for the CNN model.

Healthy: With accuracies of 90% and 96.6% for logistic regression and the CNN model, respectively, both methods do a good job of categorizing healthy samples.

Not Potato Leaf: The CNN model outperforms logistic regression once more, obtaining an accuracy of 95% as opposed to 88% for logistic regression.

IV CONCLUSION:

In summary, the use of Convolutional Neural Networks (CNNs) to identify potato plant illnesses offers a viable approach with important ramifications for food security and agricultural management. We have shown via our research that CNNs are capable of correctly diagnosing a number of diseases that impact potato plants, such as common scab, early blight, and late blight. According to our research, CNNs can classify diseases with high degrees of accuracy, frequently beating both human experts and conventional approaches. CNNs can learn complex patterns and features linked to many diseases by utilizing massive datasets of labelled pictures. This allows them to make accurate diagnosis with little assistance from humans. Furthermore, there are a number of useful advantages to creating a strong CNN model for detecting potato plant diseases. It gives farmers and other agricultural experts an economical and effective tool for early disease diagnosis, enabling prompt mitigation and intervention measures. Crop yields may rise as a result, losses may decline, and overall agricultural production rise. Nonetheless, it's critical to recognize a few restrictions and difficulties with CNN-based illness detection systems. These include the necessity of having a sizable and varied collection of training datasets, the risk of overfitting the model, and the need for sufficient computing power. For CNNs to be widely used and put into practical use in agricultural applications, these issues must be resolved. Finally, our study shows how CNNs have a great deal of potential to transform the diagnosis and treatment of potato plant diseases. We can equip farmers with the knowledge and resources they need to protect their crops and maintain global food security in the face of changing agricultural problems by utilizing artificial intelligence and machine learning.

V. REFERENCES:

[1] “Utilizing neural network algorithms, diseased plant leaves”, P. Latha2, R. Pon Selvi1, K. Muthukannan1, and P. Nisha1 1Einstein College of Engineering, Anna University, Tirunelveli, India; Department of ECE 2 Department of Computer Science and Engineering, Government College of Engineering, Anna University, Tirunelveli, India Vol. 10, No. 4, March 2015, ARPN Journal of Engineering and Applied Sciences, ISSN 1819-6608

[2] "Detection and classification of leaf disease using artificial neural network", Ranjan, Malvika, et al. 3.3 (2015): 331-333 in International Journal of Technical Research and Applications.

[3] "Classification of leaf diseases through artificial neural network.", Syafiqah, Ishak, Technologists Journal 77.17 (2015).

[4] "Deep neural networks-based recognition of plant diseases by leaf image classification", Spasojevic, Srdjan, et al. Neuroscience and computational intelligence 2016 (2016).

[5] "Using generative adversarial networks and convolutional networks for plant disease classification", Cortes, Emanuel. (2017).

[6] "Convolutional neural network-based identification of soybean plant diseases.", Cedric Buche, Mihai Ponceau, Sera work, and Whaleling, The 31st International Conference on Flairs. 2018.

[7] "A strong deep learning-based detector for real-time identification of pests and diseases in tomato plants", Alvaro Fuentes,17.9 (2017) Sensors: 2022.

[8] "Multi-attribute decision making based on prioritized aggregation operator under hesitant intuitionistic fuzzy linguistic environment," Liu, Pied, Tahir Mahmood, and Qaisar Khan. 270 in Symmetry 9.11 (2017).

[9] "Image-based plant disease detection using deep learning." Mohanty, Marcel Salathe, Sharada P. Hughes, and David P. Hughes. Plant Science Frontiers 7 (2016): 1419.

[10] "Deep learning-based image-based plant disease detection", Dhakal, Ashwin, and Subarna Shakya 61.1 (2018): 26–29 in International Journal of Computer Trends and Technology.