JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

PLANT SPECIES HEALTH DETECTION USING AI

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Abstract: Detecting diseases in rice plants using Convolutional Neural Networks (CNN) and the VGG16 architecture has become a popular research topic in the fields of computer vision and agriculture. The objective of this research is to create a model that can accurately classify different types of rice plant diseases by analyzing images of the plant. CNN is a deep learning architecture that is often utilized for image recognition tasks, and the VGG16 architecture is a variant of CNN that has achieved high accuracy on many image classification tasks.To train a model for rice plant disease detection, a dataset of labeled images of both healthy and diseased rice plants must be obtained. The dataset should have an adequate number of samples of each type of disease to ensure the model can correctly differentiate between them. During the training process, the CNN model uses the VGG16 architecture to learn how to identify disease features in the images and classify the rice plants as healthy or diseased. After the model has been trained, it can be tested using a different set of images to evaluate its performance. The model's accuracy can be assessed using various metrics such as precision, recall, and F1 score.In addition to precision, recall, and F1 score, other evaluation metrics that can be used to assess the performance of the model include accuracy, area under the receiver operating characteristic (ROC) curve, and confusion matrix. The ROC curve indicates the model's ability to differentiate between positive and negative examples, while the confusion matrix gives a more detailed breakdown of the model's performance by showing the number of true positives, false positives, true negatives, and false negatives.The implementation of the Rice plant disease detection method using CNN and VGG16 algorithms presents a promising solution to the issue of detecting diseases in rice plants. By collecting and labeling a dataset of rice plant images, and training a CNN model using the VGG16 architecture, the proposed approach can accurately classify six distinct classes of rice plant diseases. This can aid farmers in detecting and treating diseases early, thereby minimizing crop loss and contributing to food security. In addition, the integration of drone technology and IoT devices can provide a cost-effective solution for crop monitoring, enabling farmers to monitor their crops regularly and detect diseases promptly. This approach can reduce the need for manual inspections, which can be time-consuming and expensive, particularly in large-scale agriculture. The high accuracy achieved by the proposed approach in detecting and classifying rice plant diseases is a significant achievement and highlights the effectiveness of using deep learning techniques in agriculture. Furthermore, the approach's modifications outperform similar approaches reported in the literature, emphasizing its effectiveness in practical applications. Overall, the proposed approach using CNN and VGG16 algorithms, along with the integration of drone technology and IoT devices, has the potential to contribute to food security by enabling early detection and treatment of rice plant diseases.

Keywords: Machine learning; VGG-16; disease detection; convolutional networks; Plant Village; modern farming.

I.INTRODUCTION

The agriculture industry is a vital component of India's economy, employing more than half of the workforce and contributing roughly 18-20% of the country's GDP. Despite its significance, the sector faces various challenges such as ineffective farming practices, inadequate utilization of fertilizers, scarcity of water, and the threat of plant diseases. Plant diseases can have a significant impact on crop yields, causing up to 30% of crop damage. Manual identification of plant diseases is both time-consuming and prone to errors, making it necessary to explore alternative solutions. With the advancements in technology, it is now possible to detect and diagnose plant diseases accurately, leading to better treatment options.

This proposed system aims to detect and identify 14 different types of plant diseases, including apple, blueberry, cherry, corn, grape, orange, peach, pepper, potato, raspberry, soybean, squash, strawberry, and tomato. The system employs deep learning techniques, particularly convolutional neural networks (CNN), to accomplish this task. A statistical model processes input images to classify output tags accurately.

Rice is a significant dietary staple across the world, especially in densely populated regions such as China, India, and Pakistan. Belonging to the Orza family, it is a vital grain that is highly nutritious and serves as an essential part of billions of people's diets. However, there are various types of rice with different cultivation methods, and they all go through similar developmental phases before harvest. Rice farming accounts for around 15% of agricultural land worldwide, primarily concentrated in eastern India and Pakistan. Nevertheless, rice production has suffered a significant decrease in recent years due to the prevalence of plant diseases such as sheath blight, leaf blasts, and brown spots. These diseases can significantly reduce grain quality and yield. Early detection is critical, but it is a challenge for farmers to monitor crops constantly due to the large size of the farms and the inability to check each plant individually. Furthermore, routine manual checks by farmers would be both expensive and prone to human error, making it difficult to diagnose and classify agricultural issues that are affected by various factors such as the environment and growing conditions.

However, technology has provided solutions, such as the use of Artificial Intelligence (AI) and Machine Learning (ML), to assist farmers in early detection and diagnosis of rice plant diseases. Advancements in digital image processing and recognition have made it feasible to detect infected crops and classify diseases accurately. Researchers are continuously looking for the most optimal ML solution for plant disease detection and diagnosis, with some proposing the use of drone technology, the Internet of Things (IoT), and cloud computing to complement AI and ML. The development of a system that can assist rice farmers in detecting rice disease early is essential, as it will increase production, improve quality, and reduce costs for both farmers and consumers. With rice being a staple food for over three billion people globally, research in this field is crucial. Therefore, the objective of this work is to develop a system that utilizes advanced optimized ML and deep learning techniques to automatically detect, classify, and diagnose rice disease without the need for human intervention.

II.RELATED WORK

Various machine learning techniques have been proposed by researchers for detecting and classifying plant leaf diseases. For instance, Hossain et al. [1] used the K-nearest neighbor (KNN) classifier to extract features from diseased leaf images, achieving an accuracy of 96.76% for several common plant diseases. Sammy et al. [2] employed a convolutional neural network (CNN) to classify nine different types of leaf diseases from tomato, grape, corn, apple, and sugarcane with an accuracy of 96.5%. On the other hand, Kumari et al. [3] combined K-means clustering and artificial neural network (ANN) to compute several image features and classify four different diseases but achieved a relatively low average accuracy. Merecelin et al. [4] utilized a CNN to identify disease in plant leaves, achieving an accuracy of 87% after training on a dataset of 3663 images for apple and tomato plants.

Numerous studies have explored the use of deep learning models for detecting tomato fruit and leaf diseases. For example, Jiayue et al. [5] achieved a high mean average precision of about 97% using the YOLOv2 CNN technique for recognizing tomato fruits with disease. Robert G et al. [6] proposed a CNN-based system for detecting tomato leaf diseases, achieving 80% confidence score with the F-RCNN trained model, and an impressive 95.75% accuracy with the Transfer Learning model. Halil et al. [7] employed two different deep learning models, Alex Net and Squeeze Net architectures, and achieved accuracies of 95.6% and 94.3%, respectively. Sabrol et al. [8] utilized a simple mechanism for classifying different types of diseases that occur in tomato leaves, achieving high accuracy with the supervised learning method, although decision trees have some disadvantages such as overfitting with noisy data. On the other hand, Ch Usha Kumari et al. [3] reported relatively low accuracy in their system that used K-Means clustering and Artificial Neural Network methods. One major limitation of Jiayue et al. [5] was the need to perform different tuning for images..

III.PROPOSED SYSTEM

Currently, rice plant disease detection relies heavily on manual observation by farmers, which is a time-consuming and costly process that requires specialized knowledge. This often results in delayed detection and can cause significant annual production losses of up to 40%. In contrast, the proposed system based on CNN and VGG16 algorithms offers a more efficient and cost-effective solution to detect rice plant diseases with high accuracy, achieving a 96.08% accuracy rate using a non-normalized augmented dataset, with precise precision, recall, specificity, and F1-score. The system can also be integrated with drone and IoT technology for real-time disease diagnosis in large farmlands, potentially saving farmers time and money while reducing the cost of rice for consumers. Overall, this approach can significantly improve the efficiency and effectiveness of rice plant disease detection and contribute to increased production and higher quality rice.

Key Technologies:

CNN and VGG16 are two deep learning techniques that can be utilized for rice plant disease detection. To improve the performance of these techniques, several other deep learning techniques can be employed. Transfer learning is a technique where a pre-trained model can be fine-tuned for a specific task, such as rice plant disease detection. Data augmentation can also be used to artificially create more training examples, which can improve the model's ability to recognize different angles, lighting conditions, and backgrounds. Dropout is a regularization technique that can be used to prevent overfitting, while batch normalization can help improve the speed and stability of training. Additionally, gradient descent optimization can be used to minimize the loss function during training, with the Adam optimizer commonly used in deep learning. All these techniques can be adapted and combined to suit the specific requirements of rice plant disease detection using CNN and VGG16.

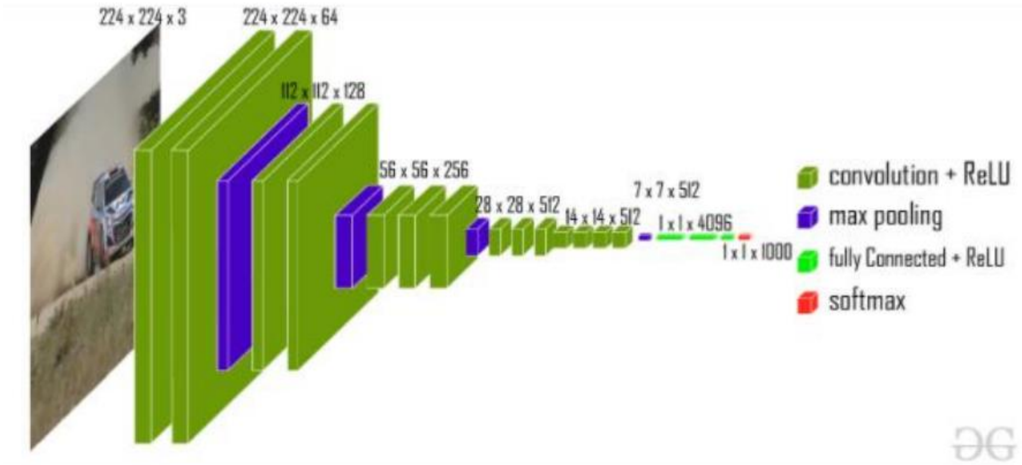

Fig1: VGG16 Model

IV.STEPS FOR PROPOSED MODEL

To detect rice plant diseases using CNN and VGG16 algorithms, a proposed model is presented that involves several stages. Firstly, a dataset of labeled images of healthy and diseased rice plants is collected, and data preprocessing is applied to resize, normalize, and augment the images. The dataset is then split into training, validation, and test sets. Next, the VGG16 architecture is selected as the base model for the CNN, and fine-tuning is applied by adding custom layers for disease classification. The model is trained on the training set using the Adam optimizer and categorical cross-entropy loss function. Performance evaluation is conducted on the test set, measuring metrics such as accuracy, precision, recall, and F1 score. Finally, the trained model is deployed for real-world applications, such as a mobile app for farmers to identify rice plant diseases. This proposed model has the potential to enhance the detection and treatment of rice plant diseases, resulting in improved crop yields and food security for communities.

V.RESULT AND DISCUSSION

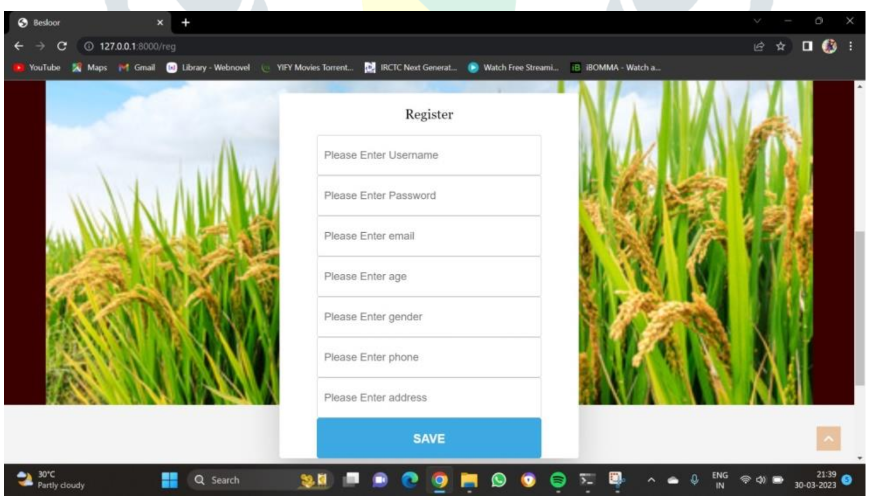

Fig2: Registration Page

Fig3: Upload Dataset

Fig4: Train Model

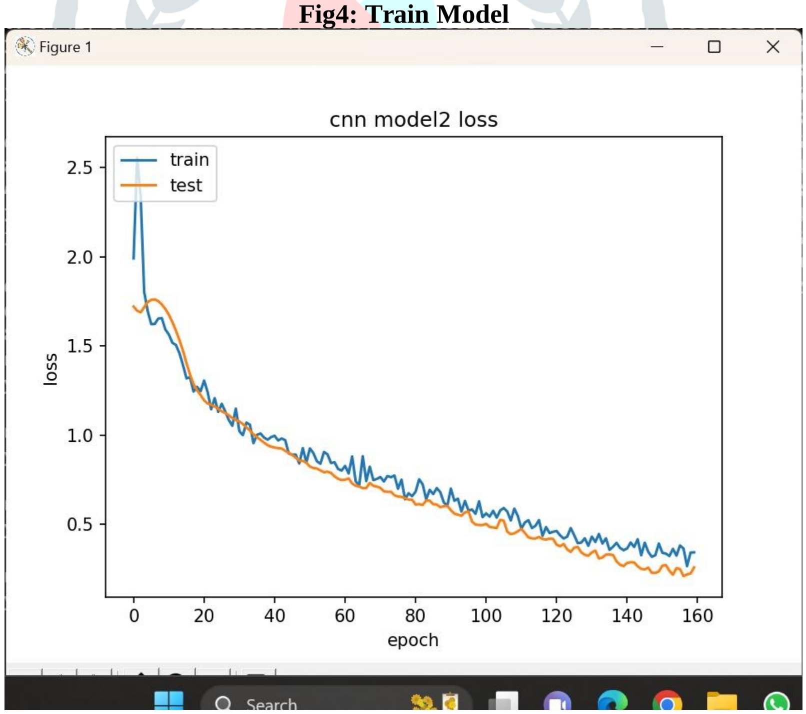

Fig5: CNN Model

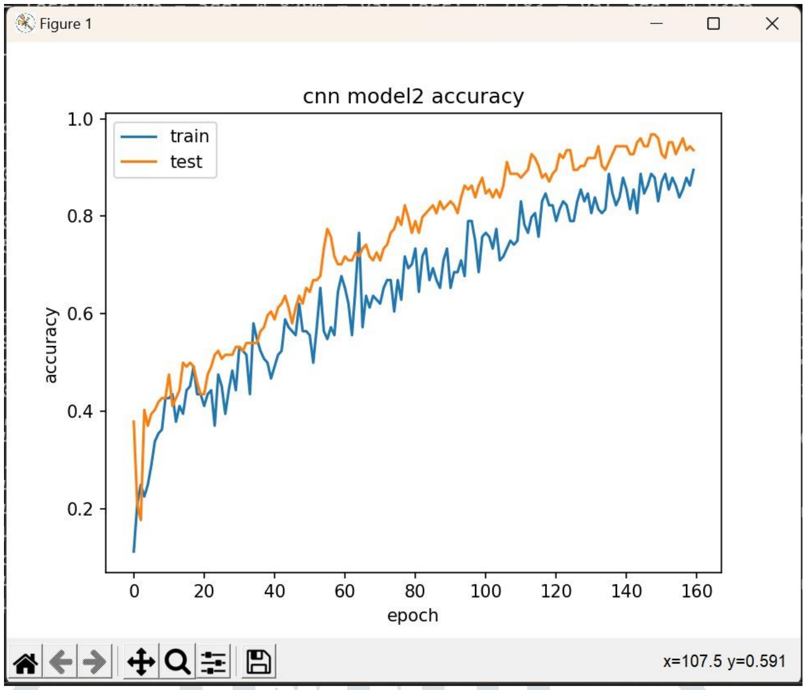

Fig6: CNN Model accuracy.

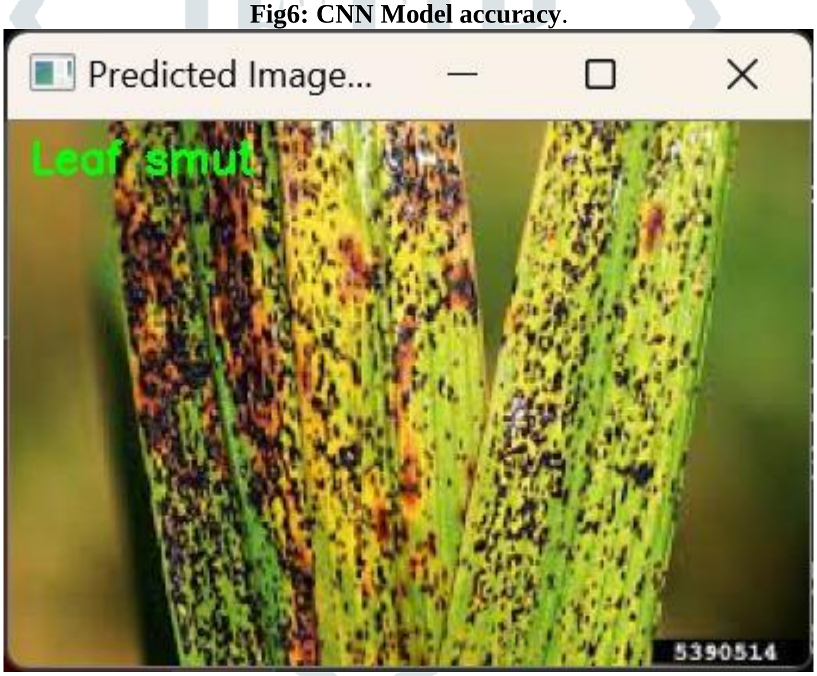

Fig7: Train Model

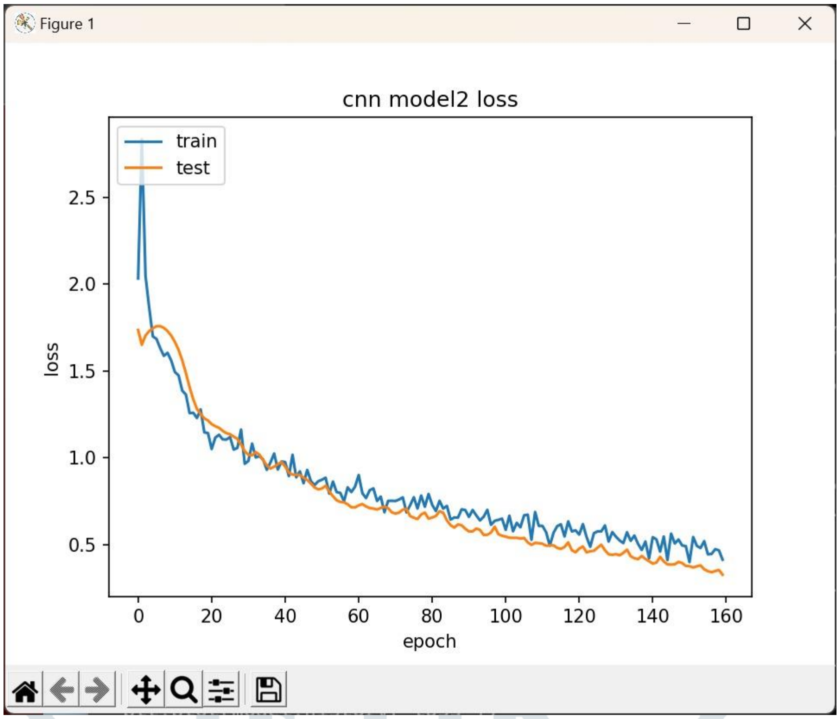

Fig8: CNN Model

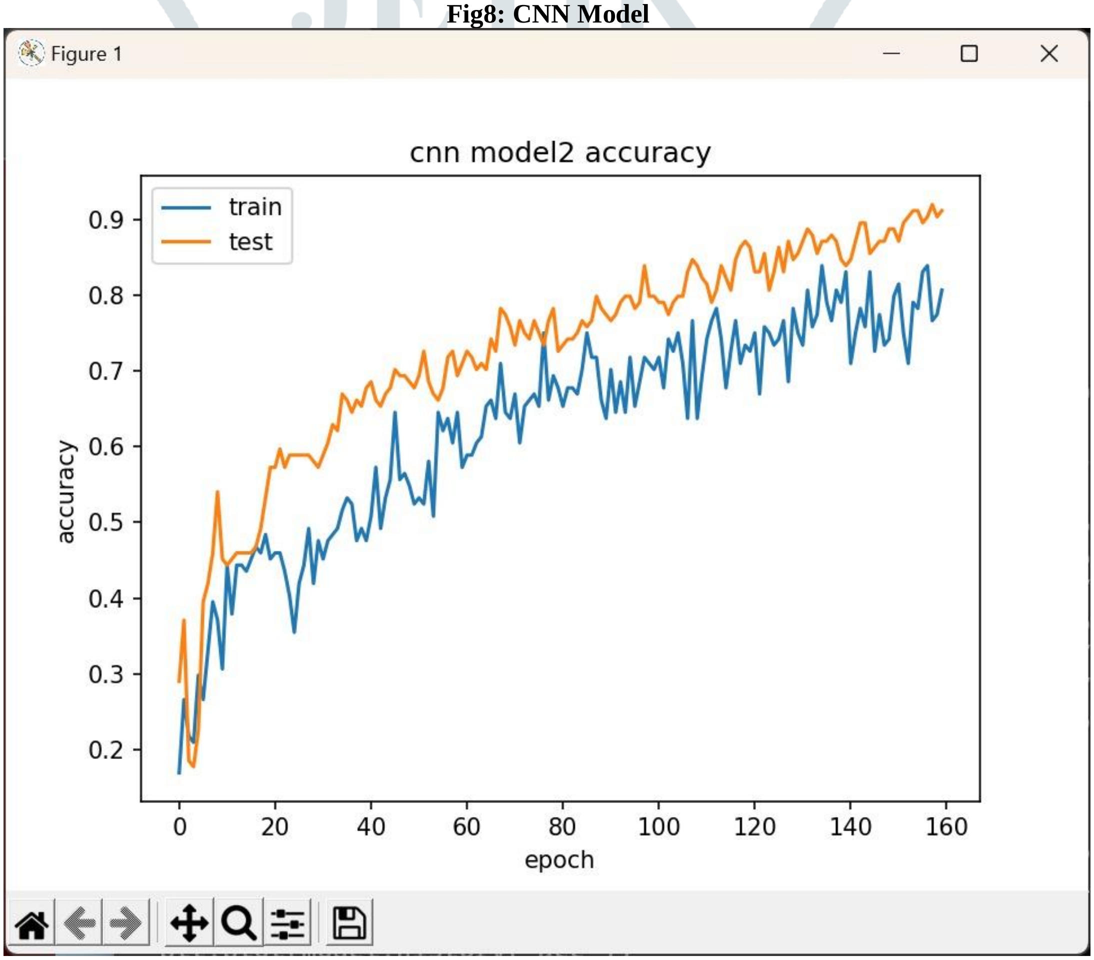

Fig9: CNN Model accuracy.

Fig10: Train Model

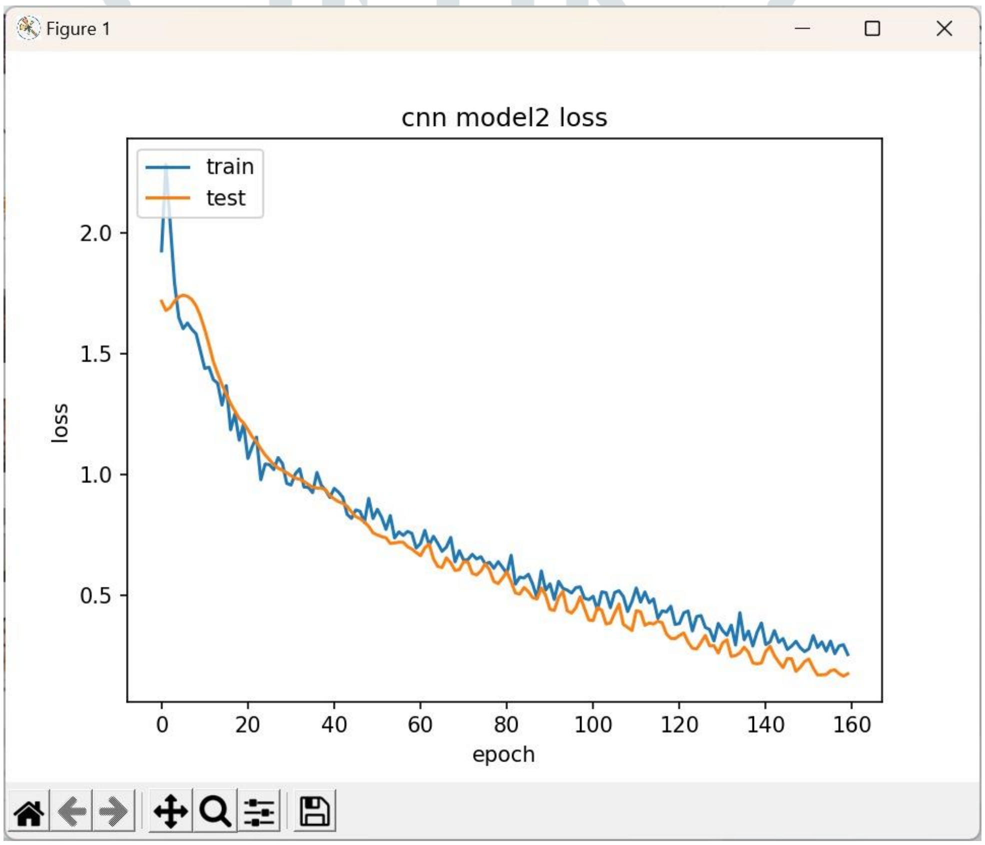

Fig11: CNN Model

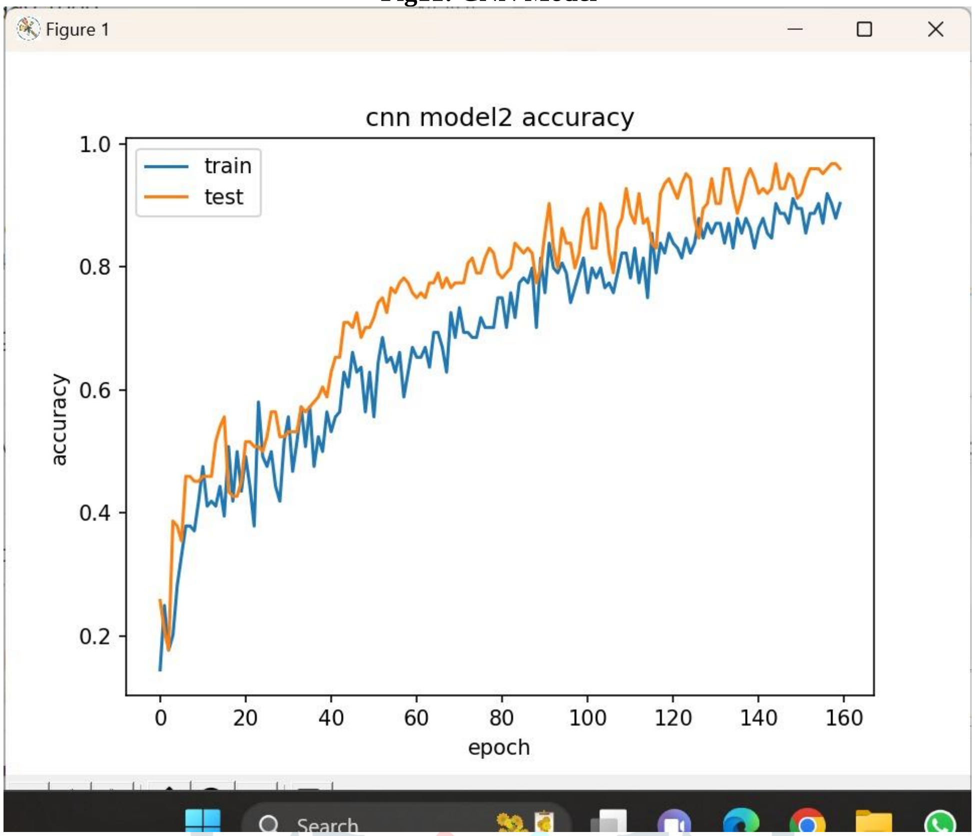

Fig12: CNN Model accuracy.

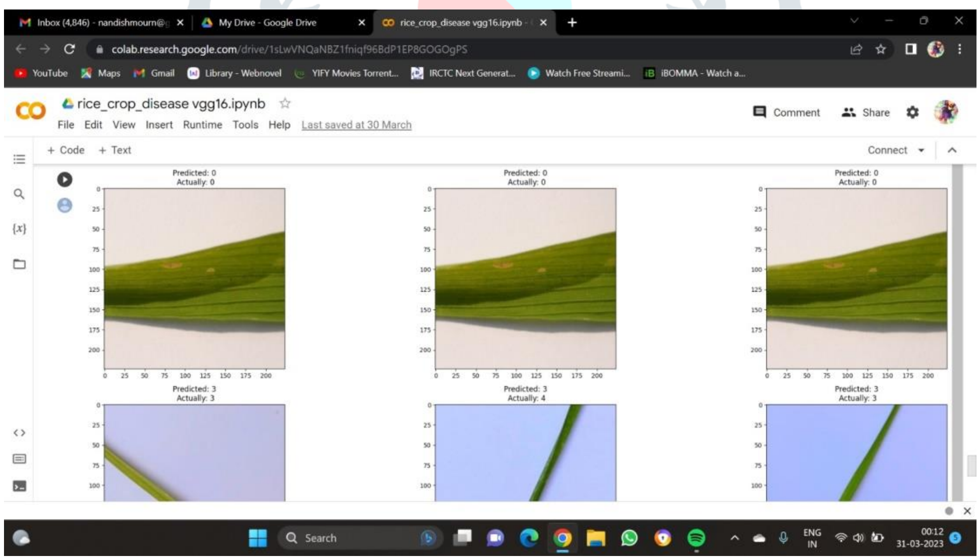

Fig13 VGG16 Model Prediction & Actuality

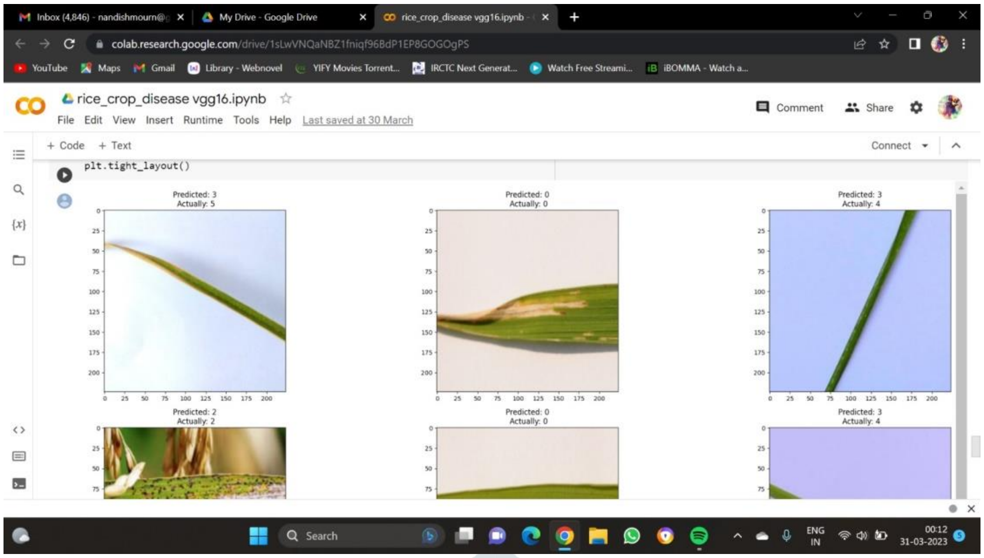

Fig14 VGG16 Model Prediction & Actuality

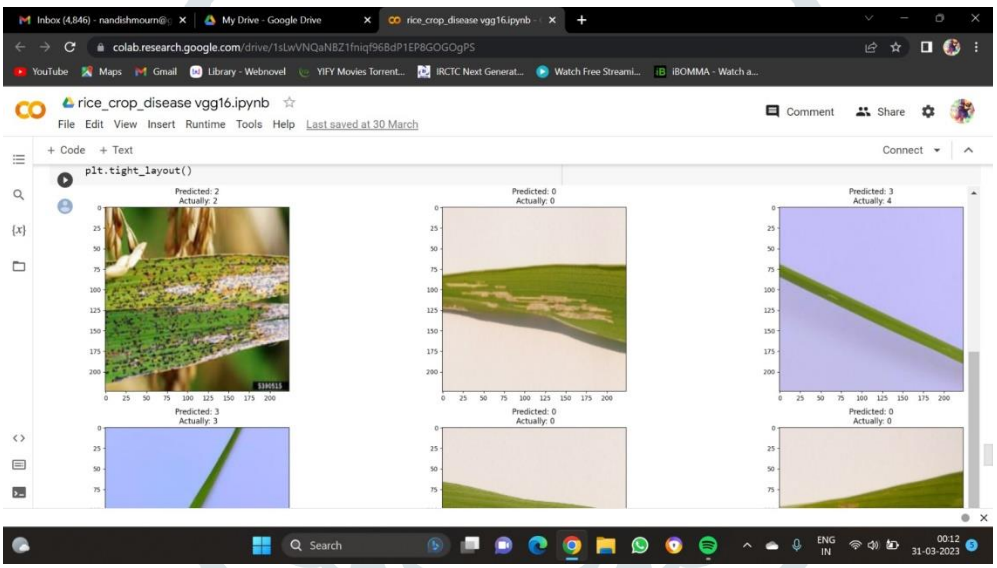

Fig15 VGG16 Model Prediction & Actuality

VI.CONCLUSION

Detecting and diagnosing diseases that affect rice leaves can be a time-consuming and challenging task, leading to significant production losses. However, with advancements in computer vision, automated methods can potentially provide an accurate solution for identifying and diagnosing rice leaf diseases. This study aimed to develop a modified deep learning-based transfer learning approach that utilizes CNN and VGG16 algorithms to achieve an impressive 96.08% accuracy in detecting six classes of rice plant diseases, including healthy leaves and five common diseases. The proposed system can be integrated with drone and IoT technology to enable real-time diagnosis in the field.

Compared to similar approaches reported in the literature, the proposed system showed significantly higher accuracy, making it a promising tool for early detection and intervention, leading to reduced production losses and increased food security. Future work will focus on expanding the system's capability to diagnose additional rice diseases and testing it in real-life scenarios with a complete drone technology-based IoT system. The success of this project highlights the potential of deep learning-based approaches in agriculture and demonstrates their ability to contribute to early detection and diagnosis of plant diseases, leading to significant economic and social impacts.

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