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Literature Survey of Plant Disease Detection using CNN

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Abstract: ***Modern farming practises have the potential to feed the world's 7.6 billion inhabitants. Despite the availability of sufficient food, individuals continue to suffer from malnutrition. Plant diseases reduce both the amount and the quality of total production. Building an image processing model for prediction or classification applications presents several obstacles. We present a deep learning model for illness detection that makes use of CNN and Capsule Network (CapsNet). The backbone of image processing is a convolutional neural network (CNN). The new architecture called as CapsNet is suggested to reduce the limitations and to achieve greater performance than standard neural networks. In this project, we analyze CNN and CapsNet for tomato plant disease datasets. The performance of both the models are measured and analysed. As a result, this approach may be used to a variety of plants and on a huge scale.***
Keywords: Leaf disease detection; Convolutional Neural Network (CNN); Capsule Network (CapsNet); Performance Evaluation

I. INTRODUCTION

In recent years, the use of computer vision techniques for image processing in precision agriculture has grown dramatically. Tomatoes are one of India's most extensively grown crops. Tomatoes are a crucial vegetable crop in terms of both income and nutrition. Tomatoes are often grown in the summer, although they may be grown all year. Most farmers are depended on tomato crop. Tomato crops, however, are plagued by diseases. Pests and diseases damage more than half of all vegetation, according to surveys. Climate change, a shortage of organic fertilisers, and other factors all contribute to plant disease. Small-scale farmers undertake the majority of farming, and they are often uninformed of several plant diseases.

Computer vision and image recognition tasks have come a long way in the last few years. As a result, a convolutional neural network is the ideal option for a task like plant disease diagnosis. Convolutional neural networks (CNN) are one of the most popular models used today. But, the spatial link between an object's lower and upper level properties is ignored by CNN architecture functions. That is, they have a tendency to lose information in the data intake, regarding feature positions, spatial relationships between features, and feature orientations. As a result, a deep learning model capable of performing classification tasks with greater performance on small datasets is required. CNN architectures also fail to describe an object's equivariance, which is why proposed a new deep learning model called Capsule Network (CapsNet), which is a neuronal network that designs the hierarchical connections of characteristics or attributes. The pose (position, size) and other features of this item are among them.

II. LITERATURE SURVEY

1) This system proposed an automated leaf disease diagnosis of banana plant. Plant disease detection and classification have been successfully researched through Convolution Neural Networks (CNN); nevertheless, CNN fails to capture the posture and orientation of objects due to the inherent incapacity of the max pooling layer in CNN. In view of these drawbacks, they used a new model called Capsule Network (CapsNet). With a test accuracy of 95%, the constructed model correctly detected banana bacterial wilt, black sigatoka, and healthy leaves. In terms of rotation invariance, it beat three kinds of CNN architectures: installed a trained CNN model from scratch, LeNet5, and ResNet50. The test dataset without rotation using the ResNet50 architecture, on the other hand, outperforms the suggested model. But with rotation the proposed model gives the best result.

2) The suggested survey article describes and summarises important contemporary Capsule Network designs and implementations. The introduction of DL has reduced the difficult feature engineering effort that had previously resulted in excessive dimensionality. In this discipline, deep learning models such as CNNs have done well, but they require a lot of data and computational capacity to run. Capsules were created to overcome the issues experienced by CNNs, and they have functioned effectively so far. This article examined the state of the art in Capsule networks and provided further information on existing designs and implementations. The computer vision community hopes to construct strong machine vision algorithms by exploiting the strengths and mistakes of CapsNets via more research in the domain.

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3) For leaf disease identification in plants, the authors suggested an enhanced feature computation technique based on Squeeze and Excitation (SE) Networks before processing by the original Capsule networks. With a 64X64 picture size, SE-Alex-CapsNet obtains the maximum accuracy of 92.1%, compared to 85.53% for Capsule Network. The suggested approach may be used to develop a mobile application with low processing requirements that can be put on low-cost smartphones and used by farmers. For comparison, the classification accuracies of six cutting-edge CNN models are presented: AlexNet, SqueezeNet, ResNet50, VGG16, VGG19, and Inception V3.

4) Plant disease identification is critical for a comprehensive knowledge of their growth and healthA deep learning architecture model known as CapsNet is suggested in this study that uses plant photos to determine if it is healthy or has a disease. The suggested architecture is put to the test using the PlantVillage dataset, which includes over 50,000 images of sick and healthy plants. Capsules outperform CNN models because they integrate orientation and relative spatial connections between distinct components in an entity. When compared to previous plant disease classification models, the CapsNet model has shown to be much more accurate in terms of prediction accuracy.

5) The classification of tomato plant disease is done in this work utilising an Extreme Learning Machine (ELM) model to analyse photos of plant leaves. In ELM, classification is performed using a single layer feed forward neural network with little input weight adjustment. HSV colour space is used for image processing, as well as Haralick textures, the Hue-Saturation-Value Histogram, and colour moments. The collected features are then utilised to test and train the model, as well as to calculate accuracy, which is higher than that of other models such as support vector machines and decision trees.

6) A mixture of two models is utilised to classify plant leaf disease in this study. The new CapsNet and support vector machine (CapsNet-SVM) classification model combines the capsule network (CapsNet) and the support vector machine (SVM). The feature extraction is done with CapsNet, and the classification is done with the SVM model. It has been discovered that this model extracts features from images automatically and performs the final classification. The model has been trained and assessed, and its accuracy is 93.41 percent, which is impressive when compared to other models.

7) Deep convolutional neural network (CNN) models are employed in this study to identify and diagnose problems in plants by looking at their leaves. CNN models necessitate a huge number of parameters and a high cost of computation. The typical CNN model is substituted in this study by four distinct deep learning models: InceptionV3, InceptionResnetV2, MobileNetV2, and EfficientNetB0. The models are trained and tested using a plant dataset of 53,407 photos. When compared to a standard CNN model, these models are more accurate and take less time to train.

8) This paper discusses approximately diverse frameworks proposed for participation the board utilising various advancements. CNN is extensively utilized in problems regarding picture statistics and tremendous overall performance is attained in such issues, the implementation set of rules of CNN has two most important shortcomings. CNN makes use of pooling layers for records routing which reasons statistics loss and the second drawback is its incapability in expressing standpoint invariance a new set of neural community representations referred to as capsule network turned into proposed which addressed the drawbacks of CNN implementation structure. Capsule Network (CapsNet) uses a unique method inside the implementation of an image captioning answer using CapsNet because the picture function extractor. The BLEU-1 rating of CapsNet based solution is 0.536 as compared to 0.534 of the CNN based answer

9) This research provides a deep learning model for plant disease identification based on capsulenet. The accuracy of the crop-disease pair prediction is used to assess the performance of the supplied model. The network is made up of layers that map inputs into outputs. The core of image processing is the convolutional neural network (CNN), yet traditional CNN has a number of limitations. A dynamic model called capsulenet is suggested to outperform traditional neural networks. In this paper, two scenarios, plant image diagnosis and plant leaf classification, are used to demonstrate the importance of CNN's new design.

10) The Gabor Capsule network is used to recognize blurred, distorted, and undetected tomato and citrus disease photos in this study. For comparing the results GoogleNet, AlexNet and capsule models are also used. The datasets were divided into 80% for training and 20% for testing for all models. Extensive preprocessing, including as rotation, deformation, and Gaussian blur, was applied to some parts of the test set and utilised to evaluate each of the models to establish their resilience. In this work, existing methods are used by improving the flexibility and robustness of CapsNets on spatially rotated, distorted and blurred images. The results suggest that Gabor Capsules can be used to detect plant diseases under less-than-ideal conditions. The Gabor CapsNet achieved high accuracy, flexibility and robustness compared to the other models on the two datasets. For the tomato and citrus datasets, the Gabor Capsule network model had accuracy of 98.13 percent and 93.33 percent, respectively. On the tomato dataset, GoogleNet scored 97.60 percent, CapsNet scored 95.29 percent, and AlexNet scored 94.40 percent accuracy.

Capsule Networks appear to outperform other deep learning approaches on difficult real-world datasets, according to the obtained results.

11) For plant disease diagnosis, this paper introduces a new deep learning method termed multi-channel capsule network ensemble. five-channel capsule network supplied from five independent data sources are used in the suggested method. The suggested method's purpose is to combine the strengths of several channels with the ensemble learning algorithm to provide superior outcomes. The developed model has a higher accuracy than other models, although it takes longer to infer. CNN-based models work faster than the proposed model. The increased computation time is related to the suggested method's multi-level features, which raise the model's complexity. This is where the suggested model falls short, and it will need to be modified in the future. By sharing parameters between capsule levels, the network's complexity can be minimized.

12) The primary technique used in practise for disease detection is an eye examination by a trained plant pathologist. Developments in computer vision provide an opportunity to broaden and improve the practise of detailed plant safety, as well as to expand the market for computer vision applications in the areas of precision agriculture. One of the pillars of agricultural field is the timely and accurate diagnosis of plant diseases. Neural networks, also known as connectionist systems, are a computational technique utilised in computing and other fields of study. They are based on a vast collection of neural units (artificial neurons), which are roughly modelled after how a biological brain solves issues. Each neural unit may have a summing function that combines the values of all of its inputs. Dynamic neural networks are the most advanced since they can establish new connections and even new brain units while inhibiting others dynamically, based on criteria.

III. RELATED WORKS

We cover relevant efforts in classification challenges using deep learning architectures in this part. In general, deep learning approaches have been intensively investigated for object identification and picture classification applications. Convolutional Neural Networks (CNNs) are a deep learning technique that has attained state-of-the-art performance in image classification when applied to recognition and classification problems. The tomato disease dataset was used to assess the first CNN architecture termed MobileNet for object identification. The implementation of pre-trained CNN architectures namely VGG16, MobileNet, and ResNet50, to diagnose the tomato leaf disease severity from Tomato leaf images, and the performance is increased by extracting the features of ResNet50 to the classical CNN model. CNN architectures are inefficient for geometric transformations and do not take into account the spatial relationships between the image's components. The max-pooling layer in CNN has a propensity to lose information while routing features from one layer to another. They are unable to model an object's rotation invariance. The section introduces a Capsule Network with Dynamic Routing algorithm to address the drawbacks of CNN architecture. The studies have employed capsule networks on medical imaging for illness categorization, and they have obtained higher accuracy than traditional CNN.

IV. CONCLUSION

Even though multiple fertilizers and chemicals are present, due to lack of knowledge and instructions to use, it fails to overcome diseases. Farmers pay a lot of money to hire plant pathologists who manually inspect the crops' leaves for diseases and propose management measures. This approach is prone to ignorance and partiality, necessitating the use of Artificial Intelligence algorithms to diagnose these disorders automatically. The input layer, convolution layer, principal capsule layer, and digitcaps layer are used to justify the Capsule Network model. We're constructing CNN architectural variations (CNN learned from scratch, MobileNet, VGG16, and ResNet50) to see how they compare to the Capsule Network model.

This research is confined to 10 different types of tomato leaf disease, and future work will entail developing a robust capsule network model that can handle diseases from a variety of plant species.

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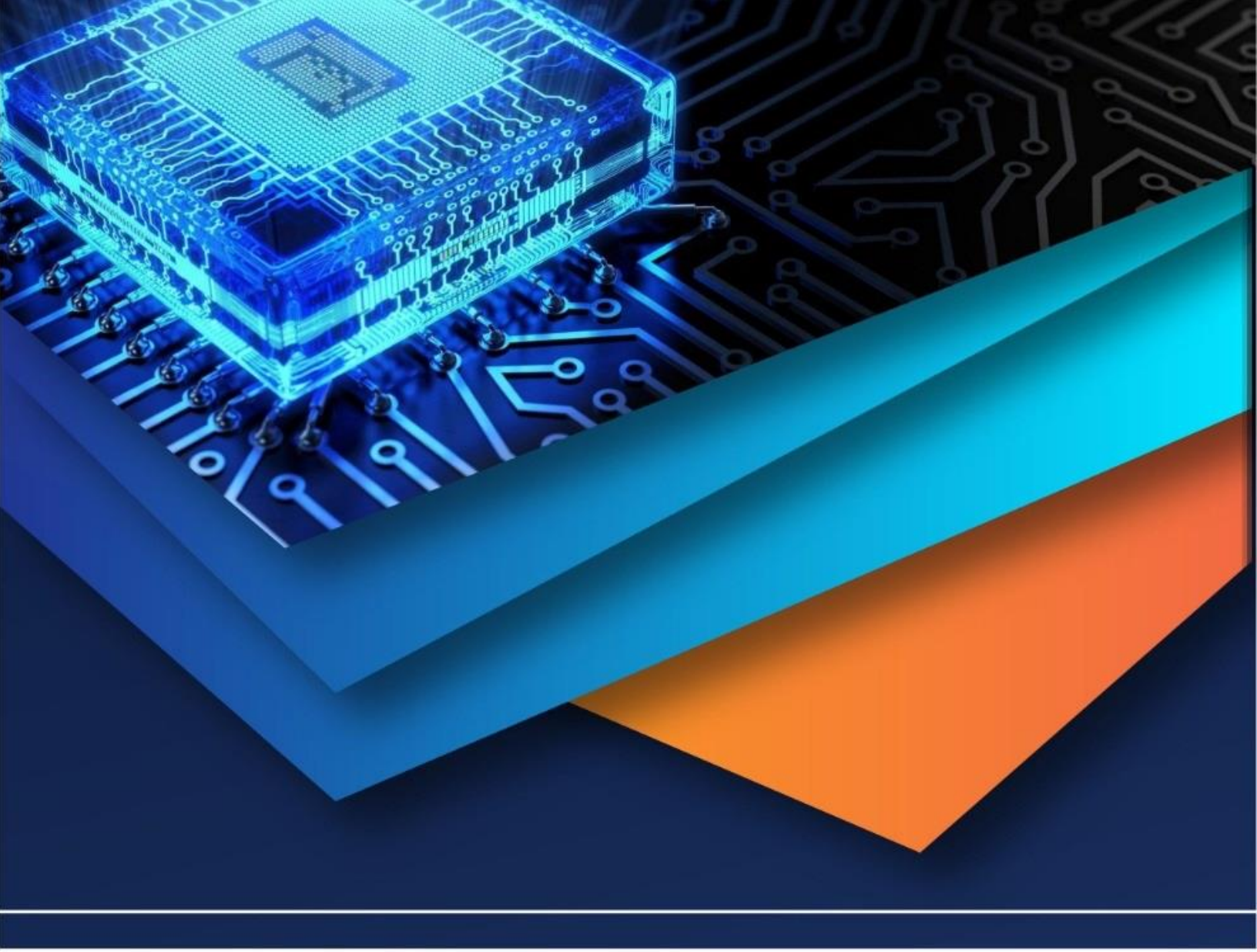
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