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Crop Pest Identification Model Using CNN Techniques

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Abstract
The paper provides the description behind the idea of crop pest identification system that classifies between a benifitical and a harmful pest that may effect the crop, this paper provides a detailed description of the methods and techniques available for the crop pest identification system along with their strengths and weakness of the identified pest. Based on the research the model proposed in this paper is developed using convolutional neural network(CNN). This trained model consist of a data set of 9,000 images of Nine different pests each of 1000 images , the system has been tested across a large amount of data and verified across other traditional models , The accuracy provided by the proposed model is measured by 90% which is the highest compared to other cnn methods

Keywords—pest classification, CNN, AlexNet, InceptionNet ,DenseNet, Crops, Pest names

I. INTRODUCTION

This paper focuses on the impact of pests on agriculture, which is directly or indirectly related to the economy of a country. Agricultural production is influenced by various factors such as fertilizers, pests, and water, with pests having a significant impact on production. To address this issue, the paper proposes identifying and classifying pests into two categories: beneficial and harmful. Due to the lack of knowledge among farmers about these categories, they often attempt to eradicate both types of pests, which leads to a decrease in production rates. Experts have been working on this problem for decades, using various techniques to educate farmers about pest identification and control

The emergence of deep learning has led to advancements in solving problems related to crop pest identification. The most notable benefit of deep learning is that it can learn from the dataset without human intervention. Deep learning has revolutionized image recognition and classification by enabling the model to learn from a trained dataset and recognize objects accordingly. This paper proposes a fully automated crop pest identification system using deep learning . For that a number of pest images are collected from the fields directly and use techniques like denseNet,inseption v3, Alex net and five other conventional techniques like lr , knn, svm used for understanding the efficiency of the classification of different that are proposed.
.The proposed model classifies the beneficial and the harmful pests effecting the crop using machine learning with the proposed model.
The proposed model achieves a reduction in complexity by decreasing the number of hidden layers, resulting in lower time complexity and improved accuracy.

II. RELATED WORKS

Due to many manmade and natural reasons leading to the decline of agricultural products, one of the main ones is the incidence of pests and diseases affecting the harvest, so expert have developed specialized techniques to classify and detect pests even before agricultural production. The harvest were done. , sometimes farmers kill pests without knowing whether the resulting pests are beneficial

or harmful, so experts have devised a model to classify these beneficial and harmful pests.

In 2015, a genetic algorithm is developed for image segmentation, detection and classification of diseased plants, using deep learning to automatically identify pests from collected images, with less manpower work, and obtained promising results, in 2017 In 2018, an integrated approach to identify leaf diseases from image processing images and machine learning showed 95% accuracy, 300 sets of images.

2018 dataset processed using 38 different classes of health and diseasewas further refined using VGG19 to extract leaf feature data and apply multiple classifiers for logistic regression with an accuracy rate of 97.8%.
But in the realm of pest detection, CNN has made steady progress**.**

III. MATERIALS AND METHODS

a) DATASET:

In Bangladesh, a dataset was developed to identify various pests in crops, including harmful and beneficial species. The dataset comprises 10 harmful and 10 beneficial species, with cutworms, aphids, black bean and lady beetles being among the most common harmful pests, while big-eyed bugs and damsel bugs being among the most common beneficial pests..

Fig. 1. Beneficial Pests

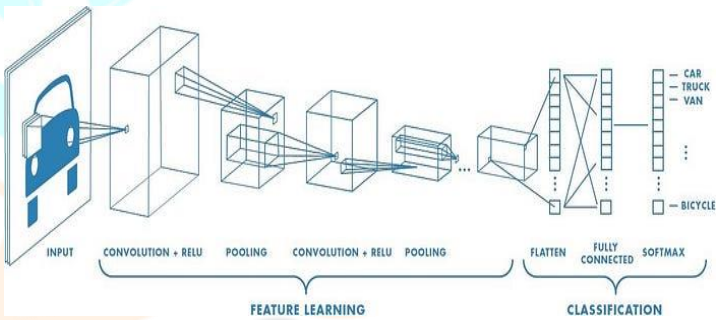
fig. 2. Harmful Pests

B. CNN

- A CNN is a specifically designed for network used in deep learning algorithms for tasks likes image recognition and pixel data processing. Although there are different forms of deep learning neural networks, CNN remains the network architecture of choice for recognizing and Identifying things.
- The number of layers that make up the hidden layers of a CNN varies by model and consists of several layers: fully connected layers, Convolution layers, and aggregation layers Colleague

- Use SVM to identify, retract, and detect outliers.

  The fundamental goal is to create a linear discriminate function that uses a hyper planar decisionsurface to separate the two groups. It is a boundary that more effectively separates the two group by setting boundaries for decision-making.
- Large space, memory performance, and low data requirements are all areas where SVMs excel.



C) Logestic Regression:

Logistic Regression (LR): Logistic regression is a statistical technique that employs a binary dependent variable.
Probit regression describes the relationship between a dependent variable and an independent variable. The result of the dependent variable can be "0" or "1". The LR is easy to use, understand and train. They can also detect new data very quickly.

D) 1)ALEXNET

- Alexnet is a convolutional neural network that is made up of eight trainable layers. The first five layers use ReLU activations, except for the output layer. Following the fifth layer, the model uses maximum pooling, and then three fully connected layers. The ReLU activation function is employed to add nonlinearity to the model, which has proven to be beneficial in deep learning models. The fully connected layers enable the model to learn complicated patterns and relationships between the features extracted by the convolutional layers. The combination of these layers and activation functions makes Alexnet a potent tool for image classification and object recognition tasks.
- One method to increase the amount of available data for training a neural network is random cropping of the original image. This technique generates additional data by shifting the original image. In Alex Net, random crops of size 227 x 227 are selected from within the 256 x 256 frame boundaries for input to the network. This strategy is employed to expand the data size by a factor of 2048. By utilizing this technique, the model can learn to generalize to different regions of the image and improve its ability to classify objects in diverse settings

- As observed we got highest accuracy and lowest loss for INCEPTIONNET V2, we will use this model to develop an application

- **Accuracy: 0.9289(i.e 92%)**

E) **Dense net:**

- The convolutional neural network of this type utilizes dense blocks which link all layers to one another directly, only if their feature map sizes match. In this design, the first layer's output is fed into the second layer by applying a composite function operation, which is composed of convolutional layers, clustering layers, batch normalization, and nonlinear activation layers

- Using dense blocks in convolutional neural networks provides significant benefits over traditional architectures. Directly connecting all layers in dense blocks allows the network to learn complex features, a crucial aspect for image classification tasks. Furthermore, this architecture requires fewer parameters and can be computationally efficient, making it a favorable choice compared to networks without dense blocks. The clustering layers in the composite operation help reduce the dimensionality of feature maps, improving overall performance and minimizing overfitting. The inclusion of batch normalization and nonlinear activation layers also plays a crucial role in enhancing the network's effectiveness in image analysis and classification. As a result, the combination of these elements creates a potent tool for image processing and analysis

As observed we got accuracy rate is 0.3600(i.e 36**%)**

F).***Inception Net:***

- The ImageNet collection of over a million photos was utilized to train a CNN, specifically the Inception-ResNetv2 [1]. This network is composed of 164 layers and has the capability to classify photos into 1,000 different object classes, including but not limited to keyboards, mice, pencils, and various animals.

- Another revolutionary 48layer deep neural network architecture that can pretrain over a million networks is the ImageNet database development. [10] photos at a time.
- The original GoogleNet should be InceptionV1, InceptionV2 and InceptionV3 are almost identical, withonly minor differences. And Szeged used it in the ILSVRC competition and incorporated some crafting ideas into third version, named InceptionV3.
- During verification, we obtained an accuracy numb er of 0.8800 (I.E88%)

G . PROPOSED MODEL

Existing system:

The existing proposed model utilizes image segmentation technology to automatically detect and classify plant leaf diseases with the help of a genetic algorithm. It aims to identify pests from photos captured during field trips without relying on pest control engineering. The model uses image processing and machine learning techniques, including segmentation methods and support vector machines, to identify leaf diseases from images. However, the model has some drawbacks, such as low precision, and it faces challenges in distinguishing beneficial pests from harmful one

Cons:

- Has low precision. .
- Distinguishing Useful pests from pests is a major challenge.

Proposed system:

The model that was created and suggested was implemented using a powerful Python library called Tensor Flow. It consists of three layers: the input layer, the hidden layer, and the output layer, which is similar to other CNN architectures. The proposed model has four convolutions and four activation functions. The model also includes four best-fit layers, a flattening layer, and a fully connected layer that is linked to the output layer. The predictive model has a A total of 48x48x32, 22x22x64, 9x9x128, 2x2x200, and 1x1x64 neurons were used in the model.

Pros:

The aim of this project is to identify and categorize pests by utilizing CNN-based methods.

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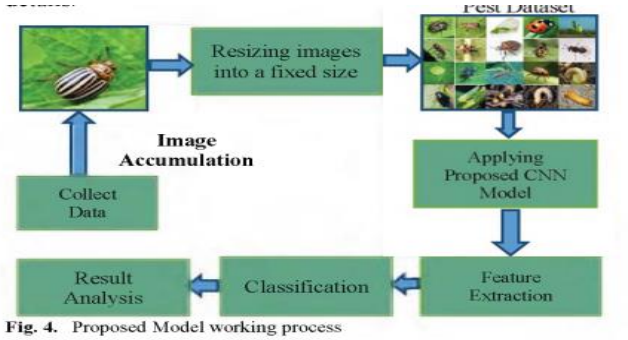

Fig. 4. Proposed Model working process

Fig. 4 illustrates the whole working process of the proposed CNN model.

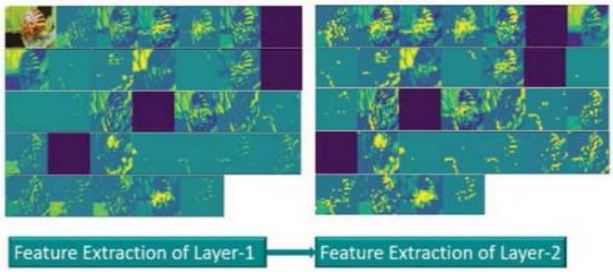

Fig. 5. Feature map of the proposed model

IV. EXPERIMENTAL RESULT

To run experiment with various classification model use test data files to test this system For the same use various classifies are used and transfer learning experiments are performed with classification accuracy of various levels ,with this proposed CNN gives the best outcum with a result of 90%. As Compared with the previous classifications, the KNN model has achieved a classifications Of up to81%

When using the same data files and kernels (with RBF set to 1), the SVM classification method yielded unsatisfactory results with an average accuracy rate of 64%. However, by using the "Mgs" solver and the Logistic Regression classification technique, a more accurate test was performed, with a 67% accuracy rate. Despite this, the recommended CNN model surpassed expectations in the first two aspects of the accuracy test. "The KNN model with m=3 neighbors and Minkowski metrics outperformed other methods in the study.

The sensitivity of various classification models was then visualized using an ROC curve.

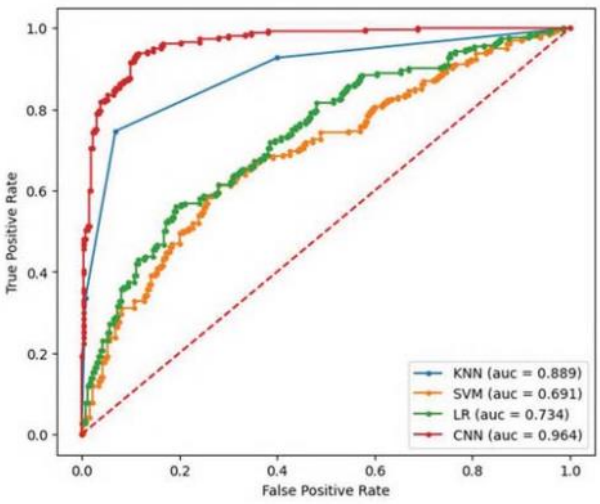

Fig. 7. ROC curve of different classifiers

Also in CNN we have different types of models. The 3 best technologies were selected for comparison. Adopt Dense Net, Inception Resnet V2 and AlexNet, and use these 3 techniques to train and test the dataset. Draw the Performance matrix of loss, accuracy, etc., and list the values in the table below, and the curve shown is between the accuracy..

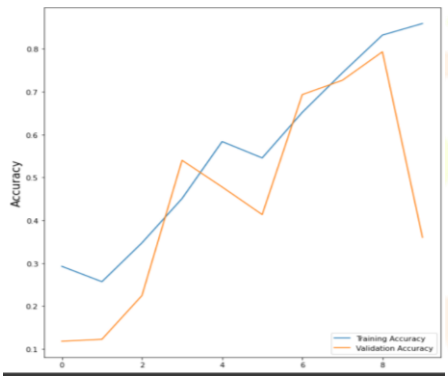

Fig.7 accuracy curve of DenseNet

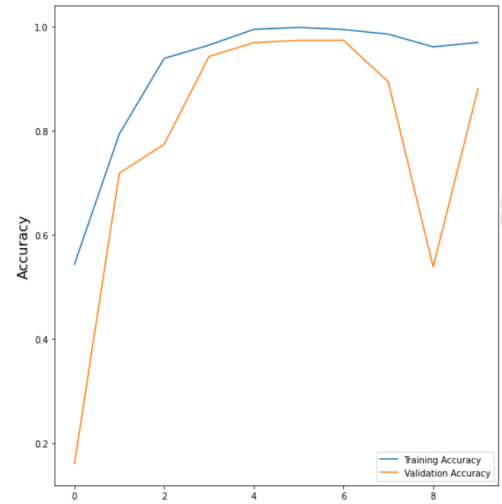

Fig.8 accuracy curve of Inception ResNet

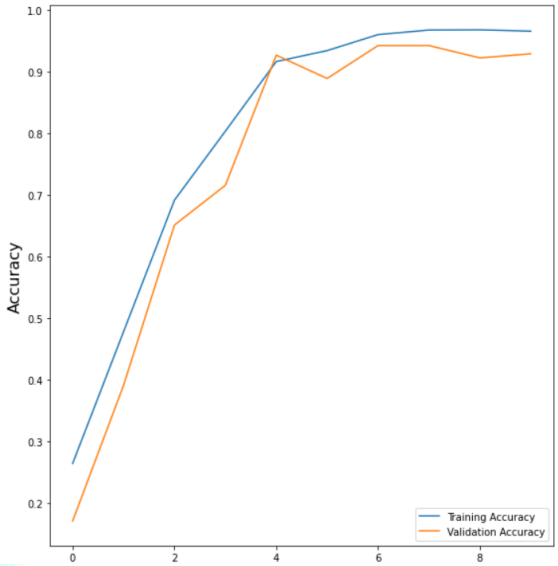

Fig 9. accuracy curve of AlexNet

	LOSS	ACCURACY
DENSENET	326.90	0.36
INCEPTION RESNET	1.1189	0.88
ALEXNET	0.3431	0.9281

Table 1. Comapritive analysis of 3 techniques

On comparision with the Densenet, Inception ResnetV2 and AlexNet, the performance matrices shows that accuracy and AlexNet's validation accuracy is high**,** 0.9281 and **0.3431,** etc

It shows a 92% chance of doing well.

Therefore, AlexNet was used to develop this model. AlexNe t has 8 layers, of which 5 are convolutional layers and 3 are fully connected layers. It is a powerful model capable of ach ieving high accuracy on very complex datasets.

V. CONCLUSION

This project aimed to create a system that enables farmers to monitor plant growth by analyzing pest damage. Different algorithms, such as KNN, SVM, Logistic Regression, and CNN, were used to analyze a dataset of 20 different species, each with 2000 images. After performing various activities on the dataset with these algorithms, conclusions were drawn. The CNN model with three layers yielded the best results and can be helpful for farmers to cultivate their crops without worries

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