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DATA SCIENCE: PLANT LEAF DISEASE DETECTION AND CLASSIFICATION USING CNN AND GAN

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ABSTRACT

Deep learning is a type of artificial intelligence. Deep learning offers a number of benefits in terms of autonomous learning and feature extraction. It's frequently utilised in academic and industrial domains like picture, video, and image conversion, as well as image recognition. It can also be used effectively in agricultural fields to detect disease and provide treatment. It might help to avoid the drawbacks of manual disease spot feature selection and aid to extract additional benefits. In today's environment, this evaluation aids the research underlying deep learning technology in the field of agricultural leaf disease detection. In this study, we discuss current trends and limitations in applying deep learning to detect plant leaf diseases and sophisticated imaging techniques. We are hoping that this paper will be helpful for the researchers and those who want to study the detection of plant diseases and implement it in practical.

Keywords: Deep learning, plant leaf disease detection, advanced imaging techniques, visualization, GAN, CNN.

1. INTRODUCTION

The occurrence of plant diseases has a negative impact on agricultural production. If plant diseases are not discovered in time, food insecurity will increase [1], farmers will have to suffer from bad crop and low money yield from the farming and there would be inflation in crop products. Early and precise detection is the only key to avoid such situations and it plays vital role in the management and decision making of agricultural production. In recent years, plant disease identification has been a crucial issue.

Disease-infected plants usually show obvious marks or lesions on leaves, stems, flowers, or fruits. Generally, each disease or pest condition presents a unique visible pattern that can be used to uniquely diagnose abnormalities. Usually, the leaves of plants are the primary source for identifying plant diseases, and most of the symptoms of diseases may begin to appear on the leaves [2].

In most situations, agricultural and forestry specialists or farmers discover fruit tree illnesses and pests on-site based on own experience. This strategy is not only subjective, but also ineffective, time-consuming and arduous. Farmers with less experience may make mistakes during the identification procedure and use medications blindly. Environmental pollution will result from increased quality and output, resulting in unwarranted economic losses. To address these issues, image processing approaches for plant disease detection have become a hot research focus.

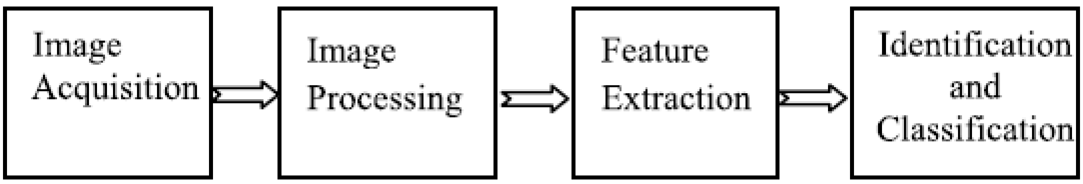

Figure 1: Traditional Image recognition process

The general process of using traditional image recognition processing technology to identify plant diseases is shown in Fig. 1 [3].
This general process was including K- Means clustering and SVM and its classifiacation accuracy reached 93%. But this method needs huge amount of data to give precise output. And it's not possible everytime to have big amount of data to train our model. So our goal is to provide precise output using minimal data.

2. METHODOLOGY

For the prediction of plant leaf disease , we use the deep learning algorithms, data mining and data visualization tools.

We train and test the data after data mining and extracting important information from it, and then use deep learning algorithms to it to anticipate the plant's sickness. Deep learning algorithms such as Heat-sink GAN and CNN are utilised in the prediction of heart disease, and their performance is dependent on the dataset that is given to them.

2.1 Convolutional Neural Network (CNN):-

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning system that can take an input image, assign relevance (learnable weights and biases) to various aspects/objects in the image, and distinguish between them. In comparison to other classification algorithms, ConvNet requires substantially less pre-processing. While basic approaches require hand-engineering of filters, ConvNets can learn these filters/characteristics with enough training.

The architecture of a ConvNet is inspired by the organisation of the Visual Cortex and is akin to the connectivity pattern of Neurons in the Human Brain. Individual neurons can only respond to stimuli in a small area of the visual field called the Receptive Field. Several of these fields intersect to cover the entire visual area.

2.2 GANs:-

GANs (Generative Adversarial Networks) are a type of neural network that can be used for unsupervised learning. Ian J. Goodfellow created and introduced it in 2014. GANs are essentially a system of two competing neural network models that compete for the ability to assess, capture, and copy variations within a dataset.

How do GANs function?

GANs (Generative Adversarial Networks) are divided into three parts:

Generative: To learn a generative model, which is a probabilistic model that specifies how data is generated.

Adversarial: A model is trained in an adversarial environment.

Networks: Deep neural networks are artificial intelligence (AI) systems that can be used for training.

3. MODELING AND ANALYSIS

MODULES

Upload Image: Upload an image of plant's leaf to detect the disease.

Train Dataset: Determine your objective. The first stage is to determine which set of objectives you wish to achieve with a deep learning application. Choose appropriate algorithms. Artificial neural networks can be trained using a variety of algorithms. Create your data set.

Analyze Symptoms: In this module we analysis the parameters of the symptoms value dots, change in color, etc.

Preprocessing: Pre-processing refers to operations on datasets in which the input and output are both plain text at the lowest level of abstraction. Which has previously been used to improve text data by eliminating unwanted distortions or increasing particular text properties that are important for further processing.

Feature Extraction: Feature extraction is a step in the dimensionality cutting process, which divides and reduces a large set of raw data into smaller groupings. As a result, processing will be simpler.

Cluster Cluster : A collection of items. For instance, dividing data into distinct groups of similarity inside a single cluster divides the data set into cluster classes. Every close item is a neighbourhood object. Cluster has two objectives. The first is a bury class, followed by an intra class. Cluster distance is maximal in an inter-class cluster. Cluster distances are kept to a minimum within each cluster.

Classification: The act of categorising a set of data into classes is known as classification. Target, label, and categories are all terms used to describe the classes. In classification predictive modelling, input instances are given a class label. Then, in garding, where we utilise our CNN algorithm to classify and forecast, we pass these geometry-based plant disease features to the classification algorithm for classification and prediction, and it predicts plant disease on that basis.

Result: Predict the Plant Disease detected or Not.

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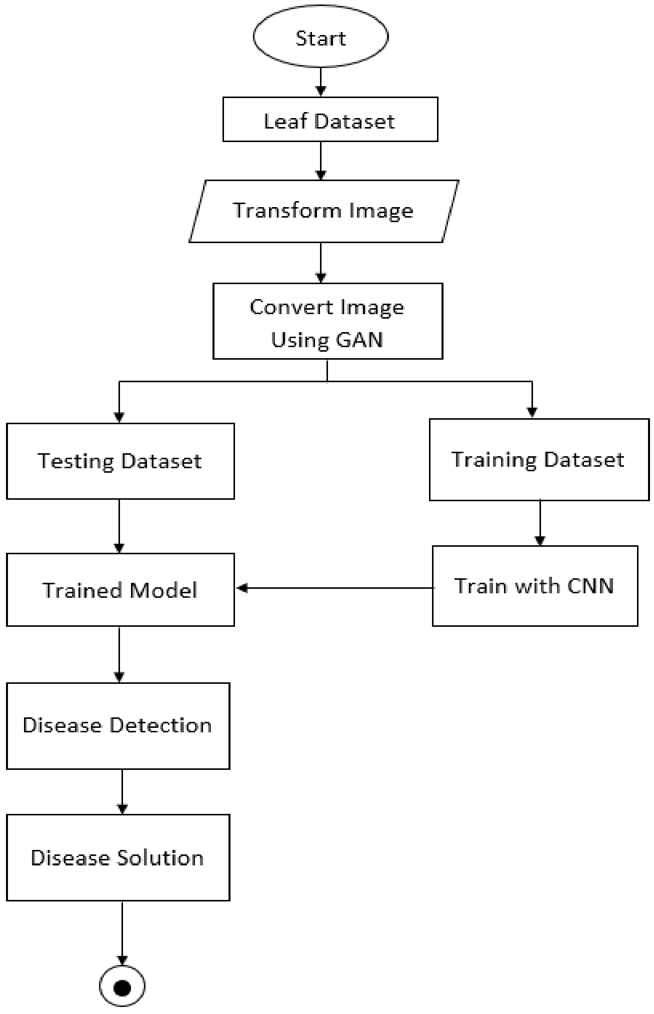

Fig : Activity Diagram

Figure 2: Activity Diagram

4. RESULTS AND DISCUSSION

Below table shows accuracy of some machine learning algorithms and from that accuracy check we can say that GAN is the most efficient way to implement the system for detection of plants as it is showing accuracy of 98.42% which is the highest in comparison with other algorithms.

Table 1. Comparison of algorithms on the basis of accuracy

SN.	Algorithm	Accuracy(%)
1	GAN	98.42
2	Decision Tree	97.37
3	Random forest	98.25
4	Naïve Bayes	89.45
5	ANN	98.00

5. CONCLUSION

We developed a web-based programme that can accurately detect diseases in plants and crops. We currently have a few programmes that serve the same goal, but reliable results require a large amount of data. The detection effects of most of the DL frameworks proposed in the literature are good on their datasets, but they are not good on other datasets, indicating that the model is not robust. As a result, more robust DL models are required to adapt to the various illness datasets. The Plant Village dataset was utilised to evaluate the performance of the DL models in the majority of the studies. Although there are many photos of various plant species with their illnesses in this dataset, they were all captured in the lab.

As a result, a big dataset of plant diseases under real-world situations is expected. Although some research use hyperspectral pictures of damaged leaves and various DL frameworks for early identification of plant diseases, there are still issues that need to be addressed before HSI can be widely used in the early detection of plant diseases. That is, it is difficult to get labelled datasets for early plant disease detection, and even experienced specialists cannot highlight where invisible disease symptoms are located and dene completely invisible illness pixels, which is critical for HSI to detect plant disease.

So, in order to improve the correctness of our project, we tried various strategies. In our research, we used the CNN and GAN Heatsink models. Hence, we have reached the accuracy of 98.42%.

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