REAL TIME DETECTION AND IDENTIFICATION OF CROP DISEASE USING CONVOLUTION NEURAL NETWORK

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Abstract: Leaf infections are a common threat to production, affecting many farmers over the world. Early detection and treatment of leaf infection is critical to promote healthy growth of the plant and ensure adequate nutrition for a rapidly growing population. Computer diagnosis of leaf blight is difficult due to strong image background. The popular convolutional neural network (CNN) architecture extracts feature from images and diagnoses disease to solve the above problems. However, this method is best suited for segmented images and provides low accuracy for real-time images. In this case, the Internet of Things is a paradigm shift that collects agrometeorological data to effectively diagnose diseases. Motivated by the usefulness of CNN models and IoT in agriculture, a new multimodal data fusion framework is proposed for plant disease diagnosis. The diagnosis of plant disease based on a single method may not be accurate, and therefore the fusion of heterogeneous methods is essential for a definite and reliable diagnosis of the disease. This gives a new dimension to the diagnosis of diseases in plant. Data were collected manually for 3200 plant health category samples using two methods namely agrometeorological sensors and a camera. The Plant-Fusion framework initially extracts numerical features from sensor-collected agrometeorological data. Then, it extracts visual features from the captured plant images. These extracted features are further combined using a concatenation layer

Keyword: Plant disease diagnosis, convolutional neural network, multi-layer perceptron, plant-fusion, multimodal data fusion etc.

1. INTRODUCTION

According to statistical analysis, the two main causes of reducing food availability are crop diseases and plant pests that attack crops and thus cause serious damage to agricultural production. The most common causes are poor water supply, insufficient soil nutrients, unstable climatic conditions, which lead to plant diseases and finally reduced yields. The right decisions can be made by developing decision support systems that help farmers take the right actions, and achieving a higher yield of. Therefore, automatic, and accurate diagnosis of plant diseases plays a key role in ensuring high yield and quality. Manual identification of plant diseases in the field is also avoided. Automatic detection and analysis of plant diseases using image processing techniques is currently a challenging topic that is actively researched in applications such as early disease diagnosis, disease forecasting, pesticide recommendations, etc. Multispectral, hyperspectral, and digital images are widely used literature. Using digital photos is the most common approach of these. Crop diseases and plant pests that attack crops and damage agricultural production are, according to statistical study, the two biggest factors lowering food supply. The most frequent causes include poor water availability, a lack of nutrients in the soil, and unstable weather conditions, which result in plant illnesses and ultimately lower yields. By creating mechanisms that assist decision-making and guide farmers towards the best course of action, the appropriate decisions may be made, and producing a higher yield. Thus, ensuring high yield and quality relies heavily on the automatic and precise diagnosis of plant diseases.
Moreover, manual diagnosis of plant diseases in the field is avoided. A difficult area that is currently being extensively investigated in applications is the automatic identification and diagnosis of plant diseases using image processing techniques.

1.1 Objectives

Detecting crop disease at an early stage. To monitor such a system capable of accurately detecting crop disease and pest. To provide treatment for the disease that has been identified. To monitor such a system that can classify images of diseased leaves based on defect pattern.

1.2 Problem Statement

Air pollution, toxin production impacting crops or plants, ecological damage, resource shortages, reduced disease management efficiency, and costs associated with meeting minimum chemical residues on produce are all major risks of plant disease management. Monitoring automated system to detect the Crop disease by using Convolution Neural Network.

2. LITERATURE SURVEY

Author [1] provided a thorough assessment of recent research on the use of deep learning to identify plant leaf diseases in this study, including the fundamentals of deep learning. The importance of small sample plant leaf disease detection and the significance of hyper-spectral imaging for early detection of plant disease have been discussed. These techniques include data augmentation, transfer learning, visual analytics of CNN activation maps, and large datasets with high variability.

According to the author [2], neural networks and deep neural network models performed standard machine learning algorithms in the agriculture when it came to detecting healthy crop growth and identifying abnormalities. The fusion of multiple sensor data from aerial vehicles, multiple resolution satellite data, and the fusion of satellite and UAV images are a few sources of the fusion methods applied in agriculture.

The article [3] indicated that too much uncertainty and risk are present in farming because of the biological basis of agriculture. So, by supporting farmers in reducing farming uncertainty and increasing production, our technology offers a solution to the identified problem. Accuracy, sensitivity, specificity, false positive rate (FPR), F1 score, MCC, and kappa are some of the factors that determine how well the CNN VGG16 model detects plant diseases. In the study, CNN was the classifier parameter and the one Vs. all method was applied.

The author [4] claimed that he provided a thorough explanation of the significance of disease detection for both plants and people. A thoughtful consideration of the appropriate input is required to have a meaningful influence on plant diseases & practices in the field of agriculture. Here's a list of research questions that are intended to help pathologists and farmers identify plant diseases and establish a systematic method for doing so. The report illustrates the value of image processing in the agricultural sector and takes into account the type of disease for future research.

Author [5] stated that study has been conducted to identify various machine learning and deep learning models that can perform better in different challenging real-time farming scenarios. The manuscript also attempts to investigate the numerous studies, and reliable models for plant disease detection, their classification, and various possible infections found in different types of plants. Various challenges in the pathway of using machine learning models that has the effect on the performance of these automated plant disease detection systems are also identified. Among deep learning techniques, CNN has shown remarkable performance.
3. EXISTING SYSTEM AND OPEN ISSUES

Existing system and open issues when image modality is considered, the limitation of plant disease misclassification can occur as there is a similarity between the geometrical features of the plant diseases. Hence to overcome this barrier, more image datasets corresponding to the environmental dataset with similar geometrical properties should be necessary to train the network. It is also recommended to use a deep learning approach that can efficiently classify plant diseases even with tiny feature dissimilarities.

4. METHODOLOGY

Image acquisition, image pre-processing, image feature extraction, and leaf disease classification based on image features, such as color features, shape features, and texture features, are all part of the methodology for diagnosing leaf diseases. The first phase is image acquisition. The second phase is image pre-processing. The third stage is the extraction of image features. After that, classify the features. Finally, the classification result and fertilizer recommendation.

![Convolution Neural Network](image)

**Fig-1:** Convolution Neural Network

4.1 Convolution Layer

The first layer used to extract features from an input image is convolution (leaf image). Convolution uses small squares of input data to learn image features and preserves the relationship between pixels. Convolution of an image with various filters can perform operations such as edge detection, blur, and sharpening by using filters such as the identity filter, edge detection, sharpen, box blur, and Gaussian blur filter.

4.2 Pooling Layer

There are usually two types of pooling layers in CNNs, they are as follows Max pooling and Average pooling. The existence of this global variants is present. Pooling layers reduces the number of parameters when images are too large. Spatial pooling, also referred to as subsampling or down sampling, reduces the dimension of every map while retaining important data.

4.3 Fully Connected Layer

The feature map matrix will be transformed to a vector in this layer (x1, x2, x3,...). We assembled these features into a model using the fully connected layers.

4.4 Softmax Classifier

Finally, to categorized the outputs, such as identify leaf illness, we use an activation function like softmax or sigmoid.
5. CONCLUSIONS
Detecting disease in crops is critical for minimizing crop loss and rising yield by using suitable pesticides. This system will be used to not only detect different types of crop diseases, but also to provide information about certain diseases so that users can receive better treatment and prevention. The proposed Plant-Fusion framework is an AI-based multimodal data fusion model in the field of agriculture, which is used for the automatic diagnosis of different plant diseases. The study looks at three infection classes such as brown spot, Plant blast, bacterial plague and one whole class infection type. The collected data is unique because it contains 3,600 samples of both modes, images, and environmental features. These two modes are combined using fusion models such as the early and late fusion approaches.

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