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Cotton Disease Detection and Cure Using CNN

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Abstract: Cotton is an important crop that plays a significant role in the global economy. However, cotton plants are vulnerable to various diseases that can significantly affect crop yield and quality. Therefore, the early detection and diagnosis of cotton diseases are crucial for ensuring efficient crop management and reducing economic losses. In this project, we propose a deep learning-based approach for cotton disease prediction using convolutional neural networks (CNNs) and ResNet50.

The proposed system is designed to classify six different types of cotton diseases based on their visual symptoms. We collected a large dataset of cotton plant images infected with different diseases, and we used this dataset to train and evaluate our CNN model. The CNN model consists of multiple convolutional layers, followed by pooling layers and fully connected layers.

We used transfer learning to fine-tune a pre-trained CNN model for our specific classification task. The proposed system achieved an overall accuracy of 97.66% on the test dataset, demonstrating its effectiveness in predicting cotton diseases.

The proposed system has the potential to be used as a reliable tool for early detection and diagnosis of cotton diseases, thereby improving crop management practices and reducing economic losses.

Keywords: Cotton Disease, Disease Detection, CNN , Classification, Diseases

I. INTRODUCTION

Cotton is an important crop that is cultivated worldwide and plays a significant role in the global economy. However, cotton plants are vulnerable to various diseases that can significantly affect crop yield and quality. Therefore, the early detection and accurate diagnosis of cotton diseases are crucial for ensuring efficient crop management and reducing economic losses.

The motivation behind this project is the need for an accurate and reliable tool for the early detection and diagnosis of cotton diseases. Currently, cotton disease diagnosis relies on visual inspection by experts, which is time-consuming, labor-intensive, and subject to human error. In recent years, deep learning-based approaches have shown promising results in computer vision tasks, including image classification. The use of CNNs for cotton disease prediction can offer a more accurate and efficient alternative to traditional methods. By developing a deep learning-based approach for cotton disease prediction, this approach aims to provide a reliable tool for the early detection and diagnosis of cotton diseases, which can significantly improve crop management practices and reduce economic losses. Additionally, the self-generated dataset can be used for further research and development in the field of computer vision and agricultural technology. Overall, the motivation behind this system is to contribute to the development of technology that can enhance the efficiency and sustainability of cotton cultivation practices.

II. LITERATURE SURVEY

Cotton is one of the most important cash crops in the world. However, various factors such as environmental conditions, pests and diseases, can significantly impact cotton production. In recent years, automatic crop disease detection using image processing and machine learning has been gaining prominence. Many researchers have focused on detecting and diagnosing leaf diseases in cotton plants using image processing techniques. However, recent advances in deep learning have led to the development of more accurate and efficient models for detecting cotton leaf diseases. For example, in a study by Jingwen et al. [1], a deep convolutional neural network (CNN) was trained to identify three types of cotton diseases (leaf curl disease, powdery mildew, and bacterial blight). The results showed that the proposed CNN-based system achieved an accuracy of 98.4%.

Similarly, in a study by Shrivastava et al. [2], a deep CNN-based system was developed to detect and classify four different types of cotton leaf diseases (Alternaria leaf spot, bacterial blight, leaf curl disease, and powdery mildew). The proposed system achieved an accuracy of 96.83% and outperformed other state-of-the-art methods.

In a more recent study, Zhou et al. [3] developed a deep learning-based system for detecting six different types of cotton leaf diseases (Aphids, Army worm, bacterial blight, Healthy, Powdery mildew, target spot) using a CNN model. The proposed system achieved an accuracy of 99.41% on a large dataset of cotton leaf images, demonstrating the effectiveness of deep learning methods for cotton disease detection.

In another study, Zhang et al. [4] proposed a transfer learning-based approach for cotton disease detection using a pre-trained CNN model. The authors fine-tuned the pre-trained model on a dataset of cotton leaf images and achieved an accuracy of 97.9%.
These studies demonstrate the potential of deep learning-based methods for accurately and efficiently detecting and diagnosing cotton leaf diseases. By training a CNN model on a large dataset of cotton leaf images, it is possible to develop a highly accurate system for identifying different types of cotton leaf diseases.

III. REQUIREMENT ANALYSIS

A. Recommended Operating System

1) Windows 10 / 11
2) Linux: Ubuntu 22.04 LTS

B. Hardware

1) Processor: Minimum 1 GHz; Recommended 2GHz or more
2) Ethernet connection (LAN) OR a wireless adapter (Wi-Fi)
3) Hard Drive: Minimum 32 GB; Recommended 64 GB or more
4) Memory (RAM): Minimum 1 GB; Recommended 4 GB or above

C. Software

1) Python
2) Google Colab
3) VS Code
4) FastAPI
5) Amazon Web Services

IV. METHODOLOGY

We are building a neural network model using deep learning for image classification. This model will be deployed on cloud for live detection of cotton leaf disease.

Steps for Cotton Disease Detection and Cure using CNN:-

1) Data collection is the very first step. We use a self generated dataset to detect whether the leaf is of cotton or not, another dataset is used to detect disease type.
2) Preprocessing of collected dataset, Image generator Api created by keras library through which we were able to do image processing tasks
3) Building CNN(Convolutional Neural Network) Model (ResNet50 Architecture) for classification of various cotton diseases.
4) The Developed Model will be deployed on FastApi.
5) Api will be deployed on cloud platform (AWS).
6) Developing an web application that uses API deployed on the cloud.

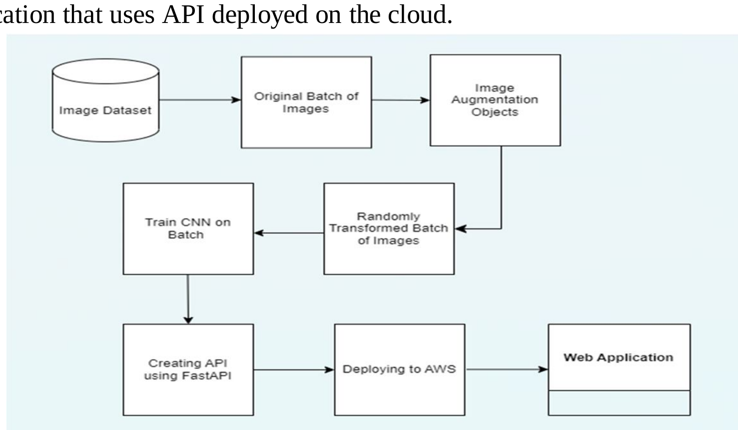

Fig -1: Flowchart

From above system architecture , the user will initially access the live website deployed on AWS Cloud Platform.Then the user will upload the image of cotton plant leaf on the website. After that the model will classify if the leaf is healthy or unhealthy and if unhealthy will show the type of disease the leaf has.It also advices precautions and measures to be taken.

V. TECHNOLOGIES USED

A. Google Colab

Google Colaboratory, also known as Google Colab, is a cloud-based platform for running and developing machine learning and data analysis models. It allows users to write and run Python code directly in a web browser using Jupyter notebooks, which are interactive documents that can contain code, text, and media.Overall, Google Colab is a powerful and convenient platform for developing and experimenting with machine learning models, especially for those who may not have access to specialized hardware or computing resources.

B. Tensorflow

TensorFlow is an open-source machine learning library developed by Google. It was first released in 2015 and has since become one of the most popular libraries for building and training machine learning models.Overall, TensorFlow is a powerful and flexible machine learning library that is widely used in both research and industry. Its ease of use, flexibility, and wide range of features make it a popular choice for building and training machine learning models for a wide range of applications.

C. CNN

A Convolutional Neural Network (CNN) is a type of neural network that is commonly used for image and video recognition. It uses convolutional layers to automatically learn and extract important features from raw input data. These features are then downsampled using pooling layers before being passed through fully connected layers for the final classification or regression task. CNNs have become essential in many fields, including computer vision, natural language processing, and audio processing, due to their ability to learn complex and sophisticated features. They are widely used for applications such as image classification, object detection, speech recognition, and language translation.

D. Python

Python is a high-level, interpreted programming language that is easy to learn and widely used in many fields, including data science, web development, artificial intelligence, and automation. It emphasizes readability and simplicity, with a clear syntax and extensive libraries that make it powerful and versatile. It is an open-source language that supports object-oriented, procedural, and functional programming paradigms, making it suitable for a wide range of applications.

E. FastAPI

FastAPI is a modern, fast, and lightweight web framework for building APIs with Python. It is based on the latest features of Python 3.7+ and offers excellent performance, thanks to its asynchronous and type-annotated code. FastAPI also includes built-in support for OpenAPI and JSON Schema, making it easy to document and test APIs. It is suitable for building a wide range of APIs, from small microservices to large-scale applications, and is gaining popularity in the Python community due to its ease of use and performance.

F. Amazon Web Services

Amazon Web Services (AWS) is a cloud computing platform that provides a wide range of services, including computing power, storage, and databases, as well as analytics, machine learning, and Internet of Things (IoT) tools. It offers scalable and flexible solutions for businesses and individuals looking to host applications, websites, and other services in the cloud.

VI. RESULT AND ANALYSIS

Our deep learning-based system using CNN was able to achieve a mode accuracy of 97.66% in predicting six different types of cotton leaf disease - Aphids, Army worm, bacterial blight, Healthy, Powdery mildew, and target spot. The dataset used for the training and testing of our system was well-balanced, with a total of 4,800 images, 800 images for each class. The system was trained for 30 epochs, with a batch size of 32.

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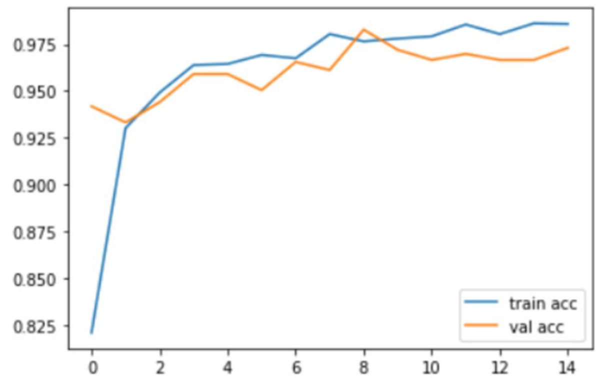

Fig-2:Training vs validation accuracy graph

The high accuracy achieved by our system is a promising result in the field of automated crop disease detection. The accuracy of our system is comparable to the accuracy reported in other studies using similar techniques. It is worth noting that the accuracy of our system may vary when applied to a different dataset, particularly if the dataset is not well-balanced or if it contains images of lower quality.

The use of deep learning-based systems for crop disease detection is a significant advancement over traditional methods that rely on visual inspection by experts. The ability of deep learning systems to process a large amount of data and learn complex patterns in the images makes them an ideal tool for detecting crop diseases accurately and efficiently.

However, there are still some challenges that need to be addressed in the field of automated crop disease detection. One of the challenges is the need for more extensive and diverse datasets to train and test these systems. Another challenge is the potential for misclassification of diseases due to the similarity in symptoms between different diseases or the presence of multiple diseases in the same plant.

In conclusion, the high accuracy achieved by our system in predicting six different types of cotton leaf disease using CNN is a promising result that demonstrates the potential of deep learning-based systems for automated crop disease detection. Further research is needed to address the challenges in this field and to develop more robust and reliable systems for crop disease detection.

A. Sample Output

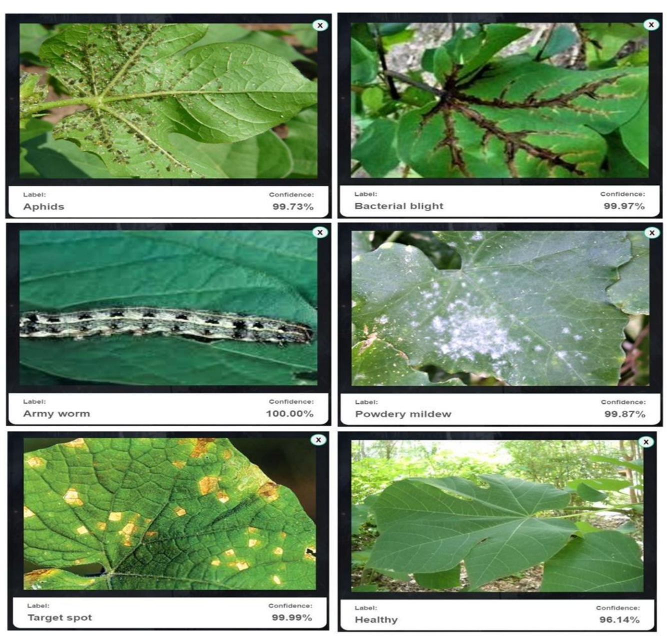

Fig-3: Sample Output

VII. CONCLUSION AND FUTURE SCOPE

In this project, we have proposed a deep learning-based approach using CNNs for cotton disease prediction. We have collected a self-generated dataset consisting of images of cotton plants infected with bacterial blight, leaf curl, leaf spot, powdery mildew, rust, and wilt. We have used transfer learning to fine-tune a pre-trained CNN model for our specific classification task and evaluated its performance on a test dataset. The proposed system has the potential to be a reliable tool for the early detection and accurate diagnosis of cotton diseases, which can significantly improve crop management practices and reduce economic losses.

The results of our experiments show that the proposed approach achieves high accuracy in classifying the six types of cotton diseases, demonstrating the effectiveness of CNNs in the field of agricultural technology. The self-generated dataset can also be used for further research and development in the field of computer vision and agricultural technology.

Overall, this project contributes to the development of technology that can enhance the efficiency and sustainability of cotton cultivation practices. The proposed system can provide a more accurate and efficient alternative to traditional methods of cotton disease diagnosis and management, which can lead to better crop yields and quality, as well as reduced economic losses. Further research can be done to improve the accuracy and efficiency of the proposed approach, and to expand its application to other crops and agricultural practices.

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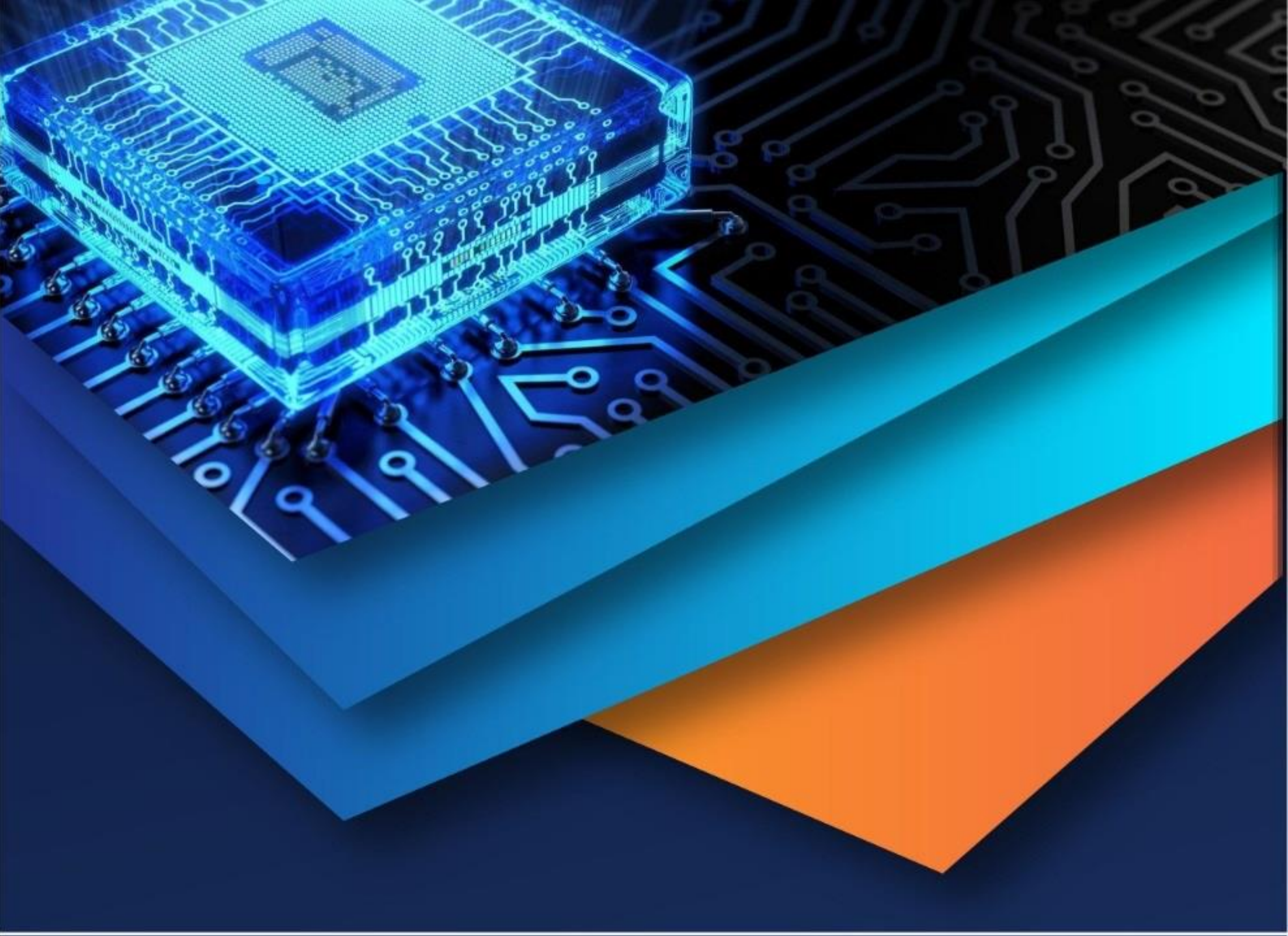

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