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Cotton Leaf Disease Detection

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ABSTRACT

In India, cotton is considered one of the most important cash crops, with many farmers cultivating it in large quantities. However, cotton plants are highly vulnerable to disorders caused bytemperature fluctuations, diseases, and pest attacks. Over the past few decades, these issues have led to significant losses in productivity. Globally, around 10% of cotton yield is lost annually due to leaf diseases, with India alone accounting for about 24% of the world's cotton-growing area. Annually, India experiences an estimated 18% loss in cotton production due to disease outbreaks, translating to financial losses of nearly 900,000 Indian rupees. Manual diagnosis of these diseases is difficult, as symptoms are often hard to detect with the naked eye, even for experts. This results in inaccurate identification and excessive pesticide usage, harming healthy crops. To address this, the proposed system leverages deep learning—specifically Convolutional Neural Networks (CNNs)—to automatically detect and diagnose cotton leaf diseases. The system focuses on extracting critical features such as color and texture from leaf images, using data collected from both primary sources and agricultural forums. Early detection through this method aims to enhance crop management, reduce yield loss, and promote precision agriculture.

1-INTRODUCTION

In India, cotton is considered one of the most important cash crops, with many farmers cultivating it in large quantities. However, cotton plants are highly vulnerable to disorders caused by temperature fluctuations, diseases, and pest attacks. Over the past few decades, these issues have led to significant losses in productivity. Globally, around 10% of cotton yield is lost annually due to leaf diseases, with India alone accounting for about 24% of the world's cotton-growing area. Annually, India experiences an estimated 18% loss in cotton production due to disease outbreaks, translating to financial losses of nearly 900,000 Indian rupees. Manual diagnosis of these diseases is difficult, as symptoms are often hard to detect with the naked eye, even for experts. This results in inaccurate identification and excessive pesticide usage, harming healthy crops. To address this, the proposed system leverages deep learning—specifically Convolutional Neural Networks (CNNs)—to automatically detect and diagnose cotton leaf diseases. The system focuses on extracting critical features such as color and texture from leaf images, using data collected from both primary sources and agricultural forums. Early detection through this method aims to enhance crop management, reduce yield loss, and promote precision agriculture

2-REQUIREMENT ANALYSIS

Functional Requirements

- User:
  - **Input Leaf Image:** Users upload a cotton leaf image for analysis.
  - **View Detection Result:** Displays the disease result with recommendations. Shows "Invalid Image" if the input is not a cotton leaf.

Non-Functional requirements

- **Portability and Usability:** Accessible on various platforms with an intuitive interface.
- **Reliability and Performance:** Provide accurate predictions within 2-5 seconds.
- **Security and Privacy:** Ensure secure data storage and compliance with privacy regulations.
- **Scalability:** Handle increased user loads without performance drops**.**
- **Error Handling:** Display clear error messages and confirm critical actions.

- **Software Architecture**

3. DESIGN

Project architecture represents number of components we are using as a part of our project and the flow of request processing i.e. what components in processing the request and in which order. An architecture description is a formal description and representation of a system organized in a way that supports reasoning about the structure of the system. Architecture is of two types. They are:

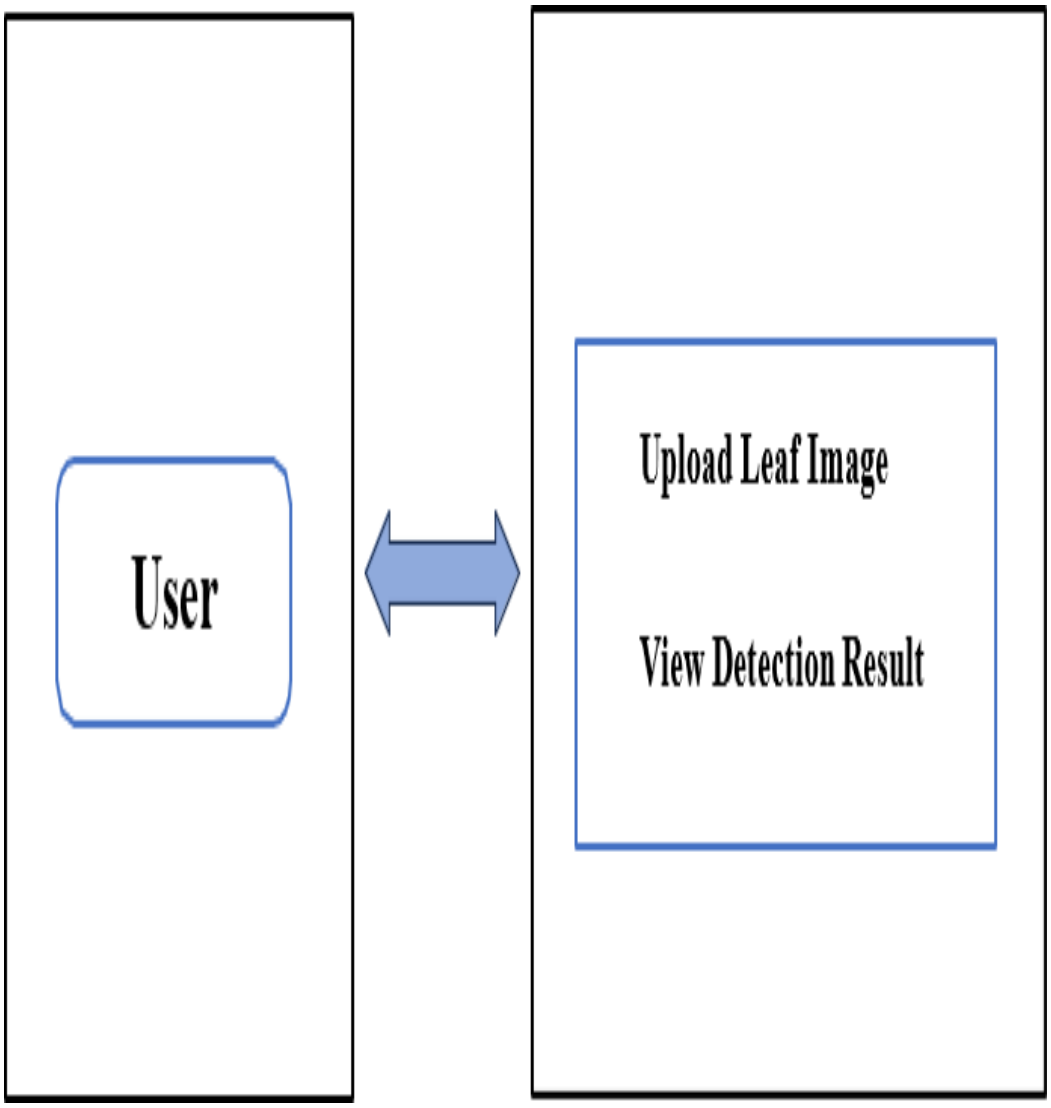


Fig. 3.1.1 Software Architecture

Technical Architecture

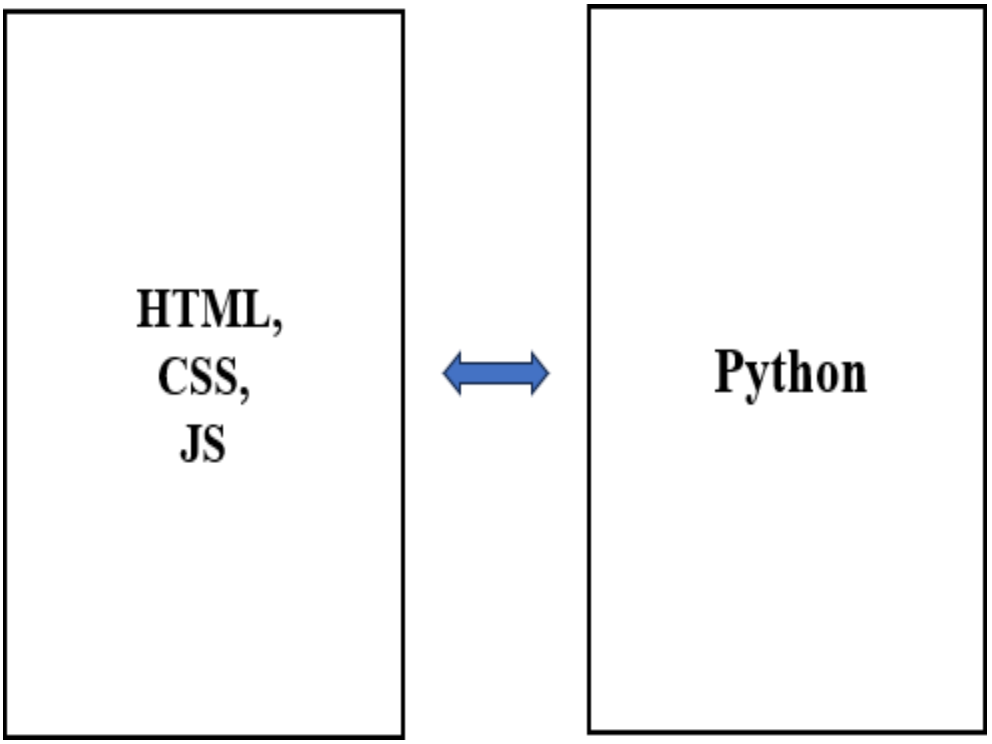


Fig.3.1.2 Technical Architecture

4-IMPLEMENTATION

Python

Python is one of the most popular programming languages now existing. The main reason for the creation of a programming language like python was to enhance the features to a large extent that were available in the present existing languages. The other reason was to invent a language which can be used easily for the developers who work a lot on media other than texts like speech, images and videos. The other important reason was to increase the built-in functions so as to reduce the number of lines in the codes and implement simplicity. Python is basically created in such a way that the garbage is involuntarily and automatically collected. The Python language can be called as a mixture of all the languages with more features added to it. It is a structured language yet it does not support the use of the semicolons at the end of each operation. Python consists of a very large standard library which consists of a huge number of built-in functions which reduce the developer's load of writing hundreds of lines to perform a single and simple task.

Features of Python

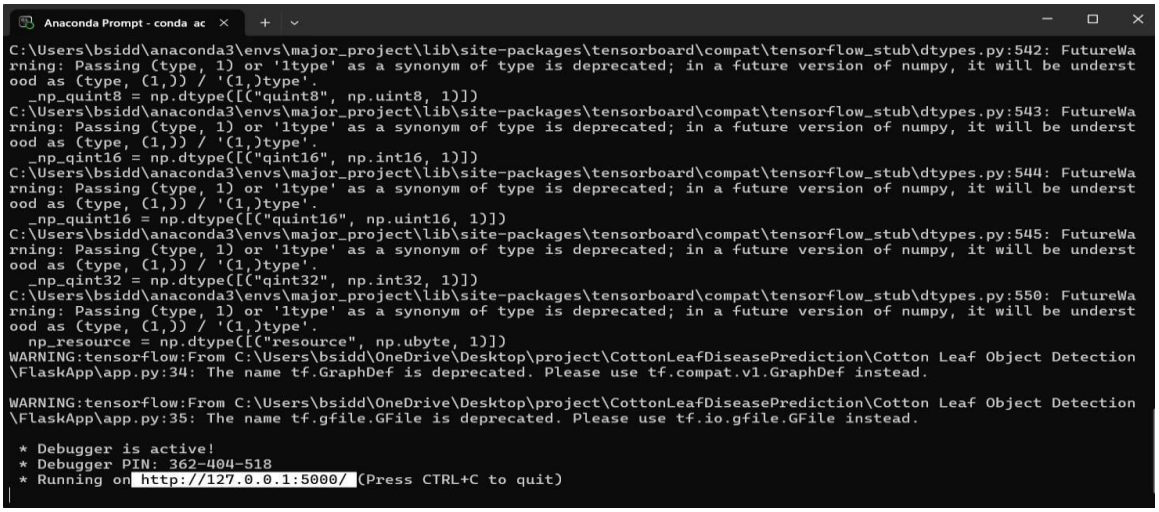
- **Interpreted:** Python is processed at runtime by the interpreter. You do not need to compile your program before executing it.
- **Interactive:** Interaction with the interpreter directly is possible by using the python prompt.
- **Object-Oriented:** Python supports Object-Oriented style or technique of programming that

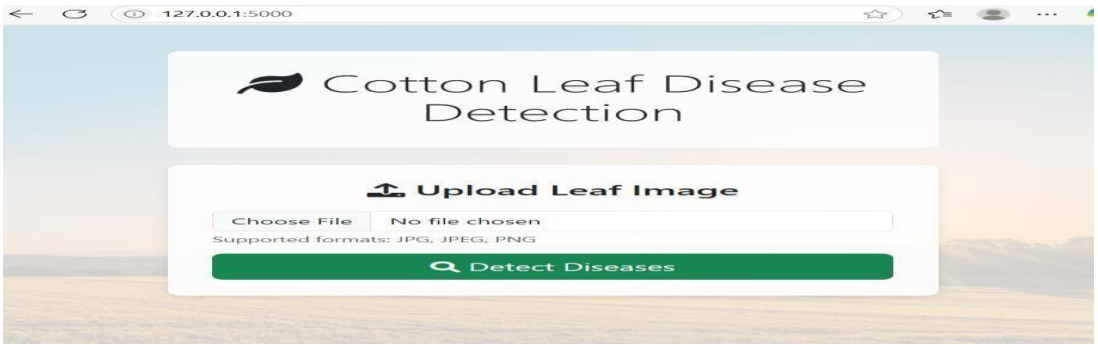
encapsulates code within objects.

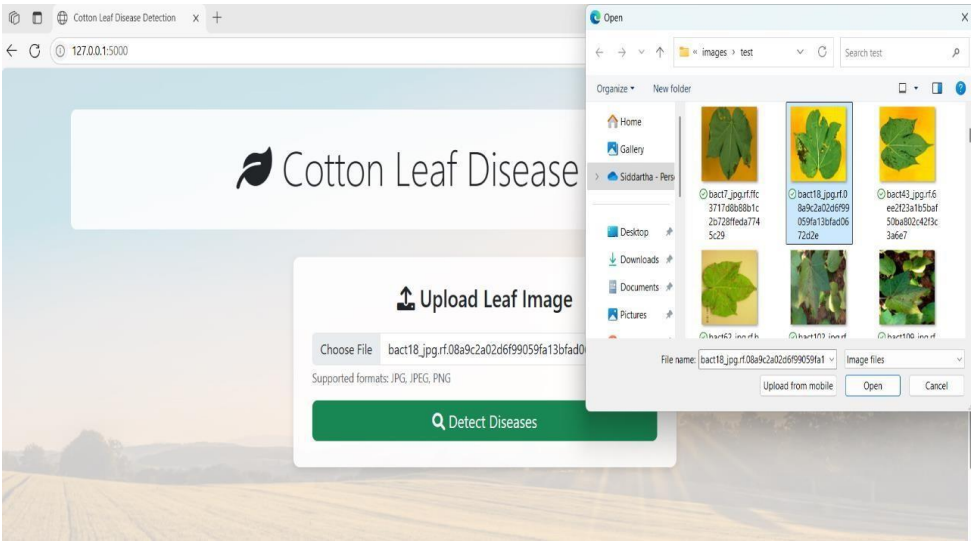
Beginner's Language: Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to browsers to games. Apart from the above-mentioned features, Python has a big list of good features, few are listed below:

- It supports functional and structured programming methods as well as object-oriented programming.
- It can be used as a scripting language or can be compiled to byte-code for building large applications.
- It provides very high-level dynamic data types and supports dynamic type checking.
- It supports automatic garbage collection.

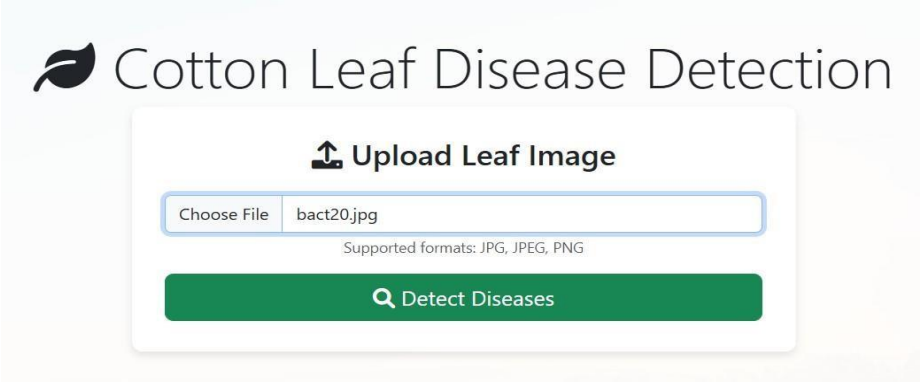
4. SCREENSHOTS





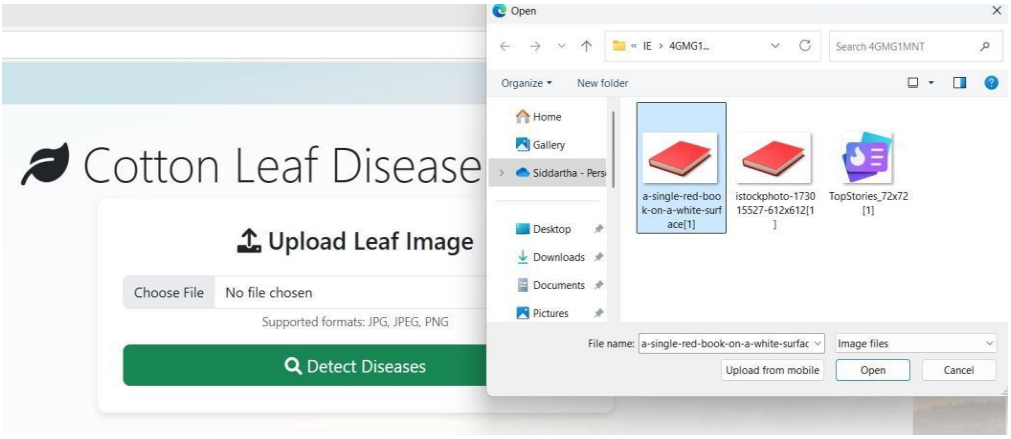


Screenshot 3 Upload the Cotton Leaf Image

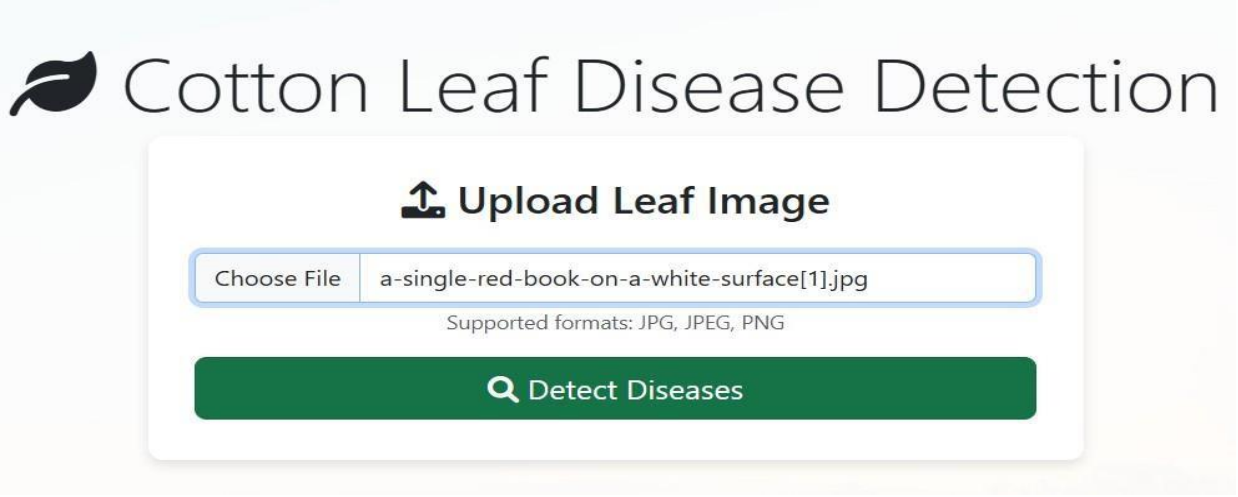


Screenshot 4 Click on Disease Detection Button

Screenshot 5 Detection Result1: Displays a type of disease with confidence score and Recommendations



Screenshot 6 Upload Invalid Image



Screenshot 7 Click on Disease Detection Button

Screenshot 8 Detection Result2: Display Invalid Image Detected

5. CONCLUSION

This project presents a robust and intelligent system for detecting cotton leaf diseases using a CNN-based deep learning model. Achieving approximately 90% accuracy, it significantly reduces the dependence on manual diagnosis by experts. The system is capable of identifying diseases accurately and suggesting appropriate remedies. It enhances agricultural efficiency and promotes timely intervention for disease management. By empowering farmers with technology, it contributes to healthier crops and improved yield. Overall, the project supports smart farming practices and advances modern agricultural solutions.

Future Scope

Future work includes improving accuracy, reducing loss, and comparing performance with transfer learning models. The system can also be extended for multilingual support, mobile access, and real-time monitoring using IoT or drones.

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