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Agriculture Leaf Disease Detection and Classification Using Deep Learning

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Abstract: ***In this modern world, agriculture is the backbone of our economy. As we all know that the crop diseases lead to great loss of yield in the crops. Therefore, early and exact diagnosis of leaf diseases plays an important role in the management of diseases and for the sake of agriculture production. In this paper, an Agriculture Leaf Disease Scanner system is proposed. It utilizes the technique of deep learning with the help of Convolutional Neural Networks (CNN) to identify and classify the leaf diseases of plants by using the images of leaves. The proposed system has given an accuracy of 97.4% on Plant Village dataset that contains 38 different disease classes of 14 different crops. The proposed system includes Image preprocessing, feature extraction and a mobile application interface that provides real time detection of diseases using the smartphone cameras. The results of the proposed system are compared with other machine learning algorithms which shows that the proposed method gives better results and helps in taking the necessary actions in time for the sake of farmers.***

I. ACKNOWLEDGEMENT

On the successful completion of our project titled **"**Agriculture Leaf Disease Scanner**"**, we would like to express our sincere gratitude to all those who have guided and supported us throughout the development of this project. Their encouragement and cooperation made this work possible. Firstly, we would like to thank our project guide Mr. Hiremath A.G **(**Assistant Professor, Computer Science & Engineering) for their valuable guidance, constant support, and motivation. Their suggestions helped us in understanding the concepts of deep learning, web development, and database integration, which were essential for completing this project successfully. We are also thankful to our Head of the Department, MS. Adat S.M**,** for their continuous encouragement and support during the entire project work. We would like to express our deep gratitude to our respected Principal, Mr. Dhainje P.B, for providing us with a positive learning environment and the necessary facilities to complete our project.

II. INTRODUCTION

Agriculture is vital for feeding the arena and supporting the worldwide financial system. however, plant diseases pose a severe assignment, regularly causing sizeable losses in crop yield each 12 months. Detecting those sicknesses early is very vital, but conventional strategies usually depend on professional agronomists who study plant life visually. This technique may be sluggish, luxurious, and now not effortlessly handy in lots of rural regions .With the boom of artificial intelligence and computer imaginative and prescient, new possibilities have emerged for figuring out plant sicknesses automatically. specifically, deep mastering models like Convolutional Neural Networks (CNNs) have validated to be particularly effective in studying photographs and classifying them correctly. these fashions can be carried out to become aware of diseases in vegetation by means of inspecting leaf photos. This paintings affords an Agriculture Leaf ailment Scanner that uses a CNN-based method to apprehend and classify sicknesses from pics of plant leaves in actual time. The device is designed as a cell utility, making it easy and convenient for farmers and agricultural employees to apply. by means of taking a photograph of an affected leaf, users can fast receive a diagnosis along with advised remedy options. The intention is to make professional-degree agricultural aid greater broadly on hand and help lessen crop losses.

III. OBJECTIVES

the primary goal of the Agriculture Leaf disease Scanner mission is to develop an smart system that could automatically stumble on plant leaf illnesses the use of synthetic Intelligence. The gadget uses a Convolutional Neural community (CNN) model to examine leaf images and offer accurate sickness prediction. The task ambitions to design a consumer-pleasant net software wherein users can without problems add leaf pictures and obtain instant outcomes. The device now not only identifies the disease but also presents the confidence score along side specified descriptions and treatment guidelines to help users take right motion. some other crucial objective is to implement right picture preprocessing strategies such as resizing and normalization to improve the accuracy of the model.

The gadget also specializes in storing test effects in an SQLite database, permitting customers to maintain a history of preceding scans and track plant fitness through the years. similarly, the undertaking consists of person authentication functions to make sure at ease get entry to and personalised utilization. usual, the goal is to create an green, accurate, and easy-to-use answer that supports smart farming and facilitates in early detection of plant sicknesses.

IV. LITERATURE SURVEY

Several researchers have investigated automated plant disease detection using image processing and machine learning techniques. Mohanty et al. [1] demonstrated that CNN models trained on the PlantVillage dataset could achieve over 99% accuracy in controlled laboratory conditions. However, performance dropped significantly in real-world field conditions, highlighting the need for robust preprocessing and data augmentation strategies.

Ferentinos [2] applied deep learning architectures including AlexNet, GoogLeNet, and VGG to the PlantVillage dataset, reporting accuracy above 99.53%. Ramcharan et al. [3] employed transfer learning using Inception V3 to identify cassava diseases from smartphone images, achieving 93% accuracy. These studies underline the potential of deep learning for large-scale deployment.

Traditional image processing approaches using color features, texture analysis, and Support Vector Machines (SVM) have also been applied [4]. While effective for limited disease categories, they struggle with generalization across diverse leaf conditions. Our proposed system addresses these limitations by combining advanced data augmentation, transfer learning, and mobile-friendly optimization.

V. SYSTEM MODELING

The system architecture of the Agriculture Leaf sickness Scanner includes an internet interface, backend server, gadget learning version, and database operating collectively. The method starts while the user uploads a leaf photo thru the internet interface evolved the usage of HTML, CSS, and JavaScript. The uploaded image is dispatched to the Flask backend server, which handles the request and performs image preprocessing inclusive of resizing the image to 224×224 pixels and normalizing it. The processed photograph is then surpassed to the Convolutional Neural community (CNN) model for disease prediction. The model analyses the photograph and generates the predicted disorder along with a self belief rating. primarily based on the prediction, the machine retrieves sickness-related records such as description and treatment hints. The results are then exhibited to the user at the internet interface. at the equal time, the system shops the prediction info in an SQLite database for preserving test history. additionally, the machine consists of consumer authentication capabilities to make certain at ease and customized get right of entry to. standard, the machine architecture affords an green, accurate, and user-friendly answer for plant disease detection.

A. Block Diagram

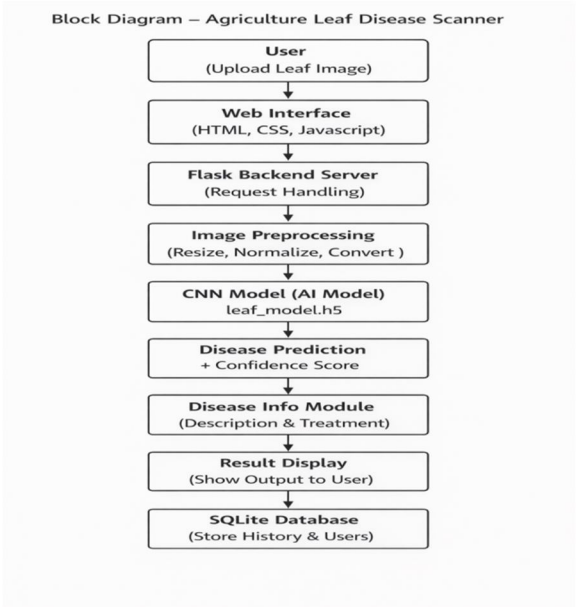


Fig . Block Diagram

B. Description of Programming Languages

1) Python: Python is a high-level, general-purpose programming language widely used for web development, machine learning, and Artificial Intelligence. In this project, Python is used for backend development, image processing, and implementing the deep learning model for disease prediction.

2) Convolutional Neural Network (CNN):- CNN is a type of deep learning model specifically designed for image processing and classification. In this project, a CNN model (leaf_model.h5) is trained using TensorFlow/Keras to identify plant leaf diseases from images with high accuracy.

3) Flask:- Flask is a lightweight Python web framework used to develop the backend of the application. It handles routing, user requests, image uploads, and communication between the frontend and the machine learning model.

4) TensorFlow:- Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design. It follows the "batteries-included" philosophy and includes many built-in features for web development, making it suitable for building complex, database-driven websites and applications.

5) Artificial Intelligence:- Artificial Intelligence refers to the simulation of human intelligence in machines. In this project, AI is used to detect plant leaf diseases automatically. The system uses deep learning techniques to analyse images and provide accurate predictions, helping in smart farming.

C. Description of Libraries use

1) NumPy:- NumPy (Numerical Python) is a powerful library used for numerical computations. It provides support for multidimensional arrays and mathematical operations. In this project, NumPy is used to handle image data, convert images into arrays, and perform operations required before feeding the data into the CNN model.

2) Kera's :-Keras is a high-level API of TensorFlow used for building deep learning models easily. It provides simple functions for creating layers, compiling models, and training. In this project, Keras is used to design and train the CNN model for image classification.

3) Werkzeug:- Werkzeug is a Python library used for web application development. In this project, it is used for secure password handling, including password hashing and verification during user login and registration.

D. Implementation

The Agriculture Leaf Disease Scanner is a web-based application designed to detect plant leaf diseases using Artificial Intelligence and Deep Learning. The system uses a Convolutional Neural Network (CNN) model to analyze leaf images and provide accurate disease predictions along with treatment suggestions.

1) Upload the leaf image through the web interface.

2) The system receives the image and sends it to the Flask backend server.

3) The backend performs image preprocessing such as resizing the image to 224×224 pixels, normalizing pixel values, and converting it into an array format.

4) The processed image is passed to the CNN model (leaf_model.h5) for prediction.

5) The model analyses the image and predicts the disease along with a confidence score.

6) The system retrieves additional information such as disease description and treatment from the predefined dataset.

7) The prediction result, confidence score, and timestamp are stored in the SQLite database for maintaining scan history.

8) The final result is displayed to the user on the web interface.

9) The interaction is completed after displaying the result.

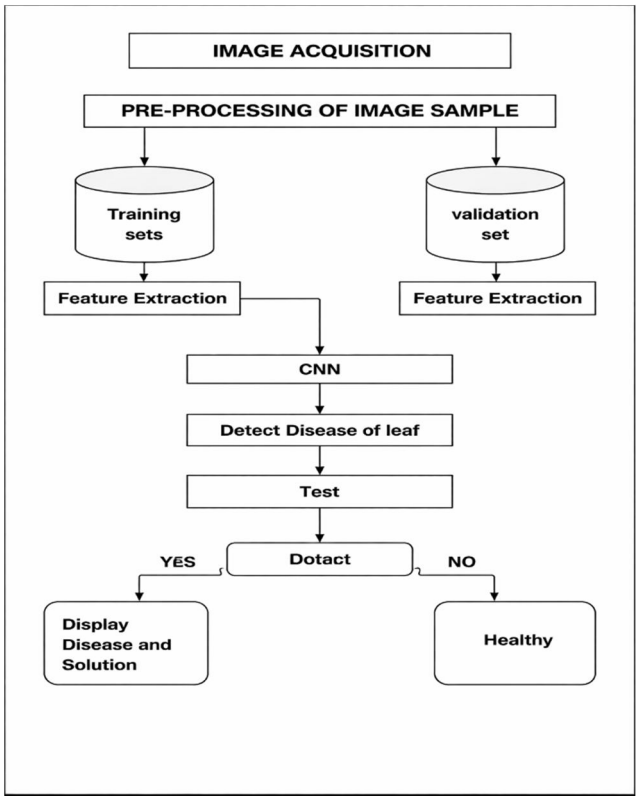


Fig. Architecture of Agriculture leaf disease scanner

E. Project Outcome Images

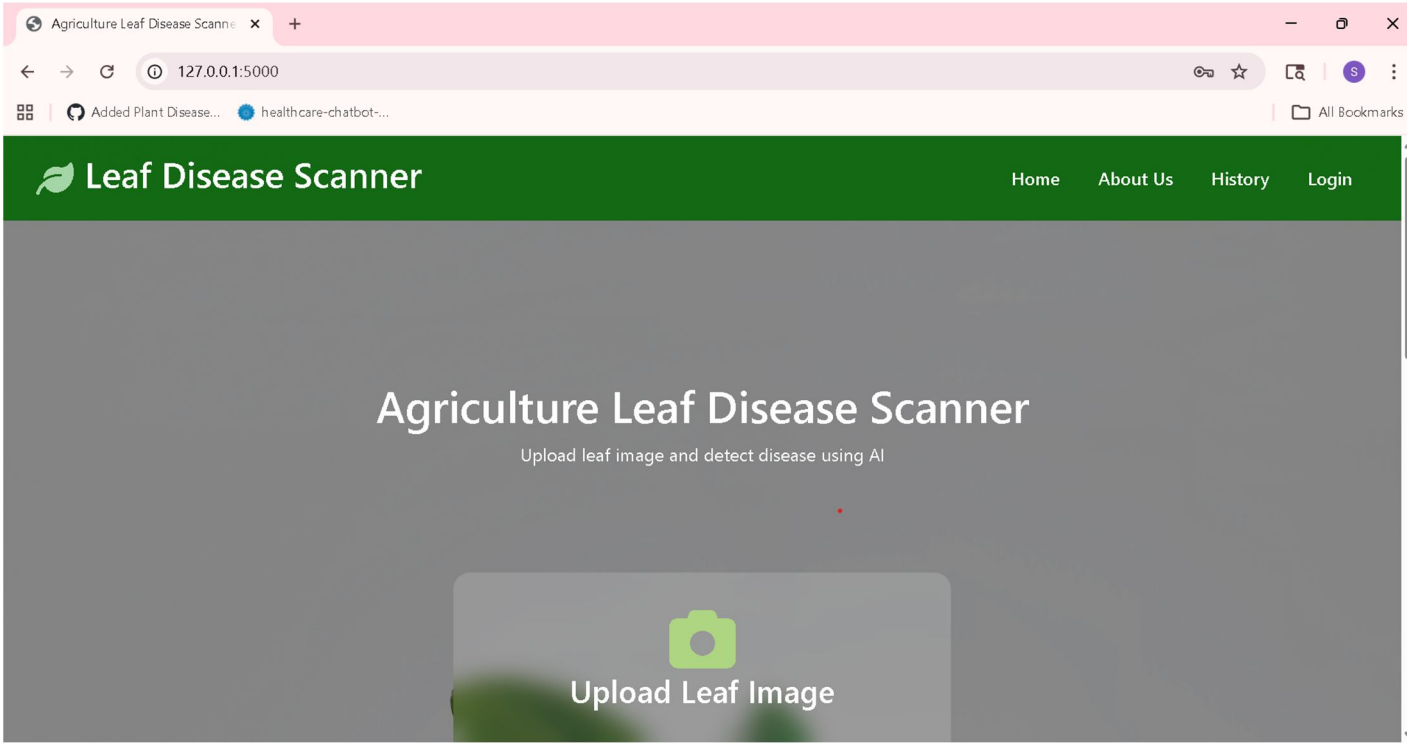


Fig a . Home Page

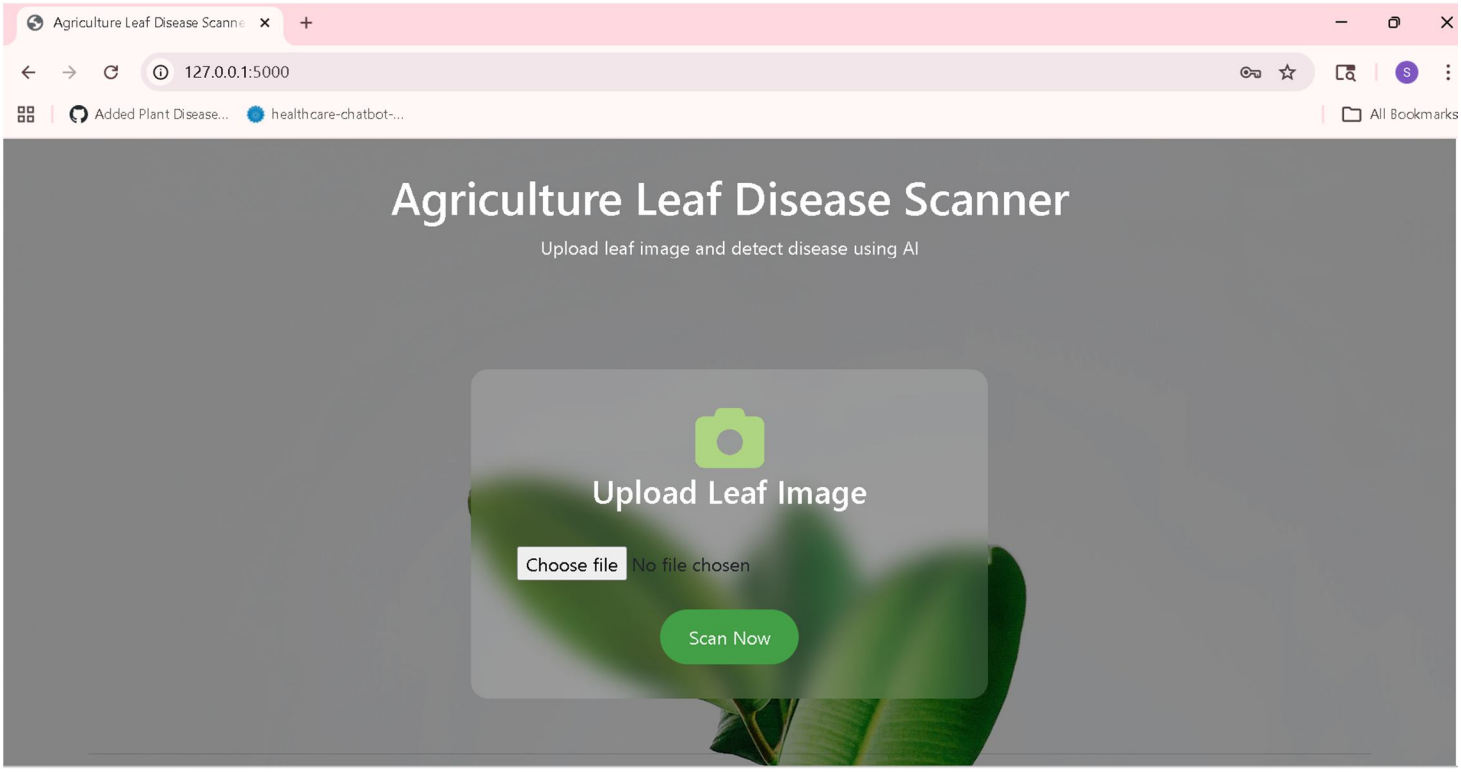


Fig b. Upload Session

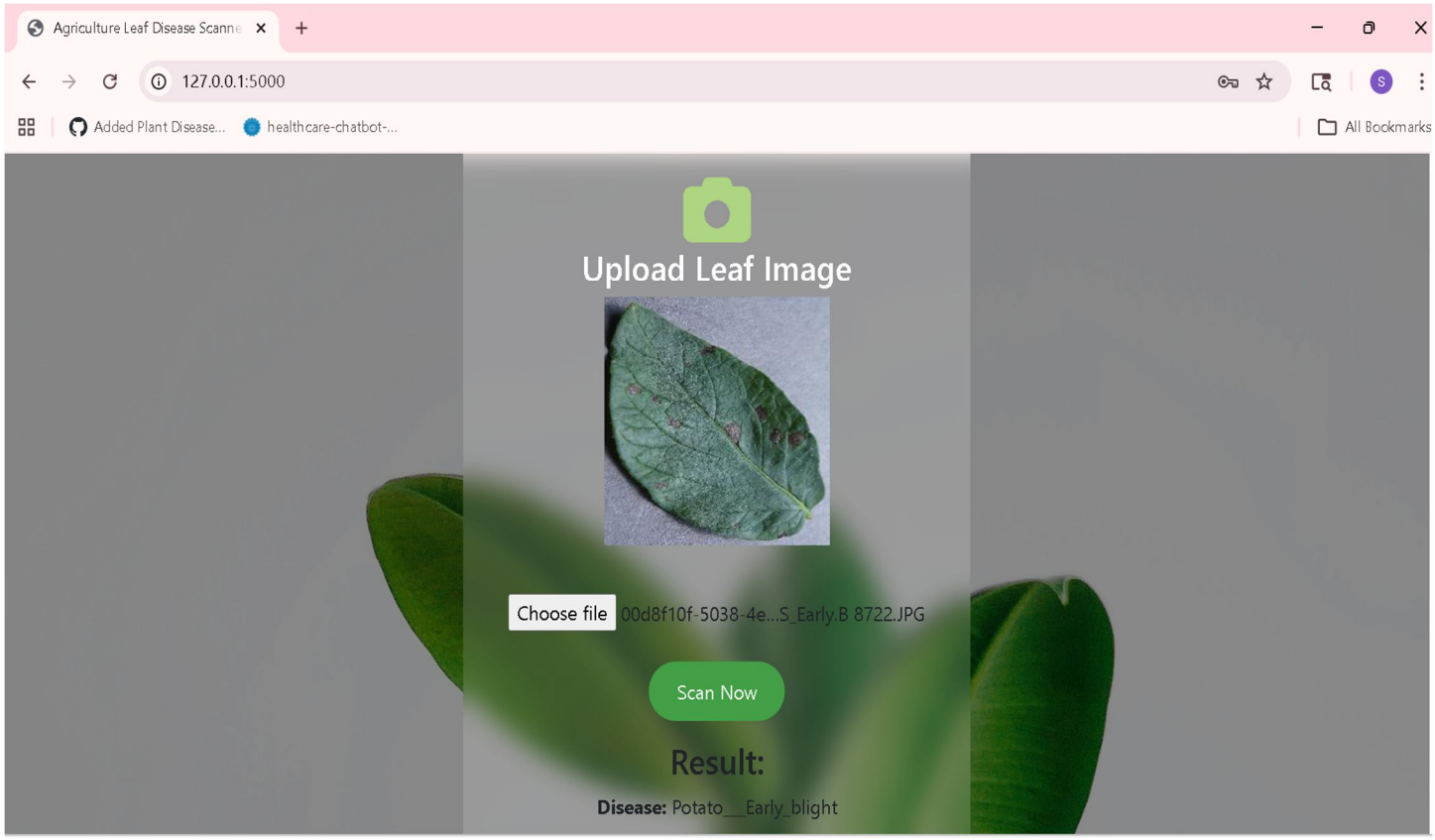


Fig c. disease detection

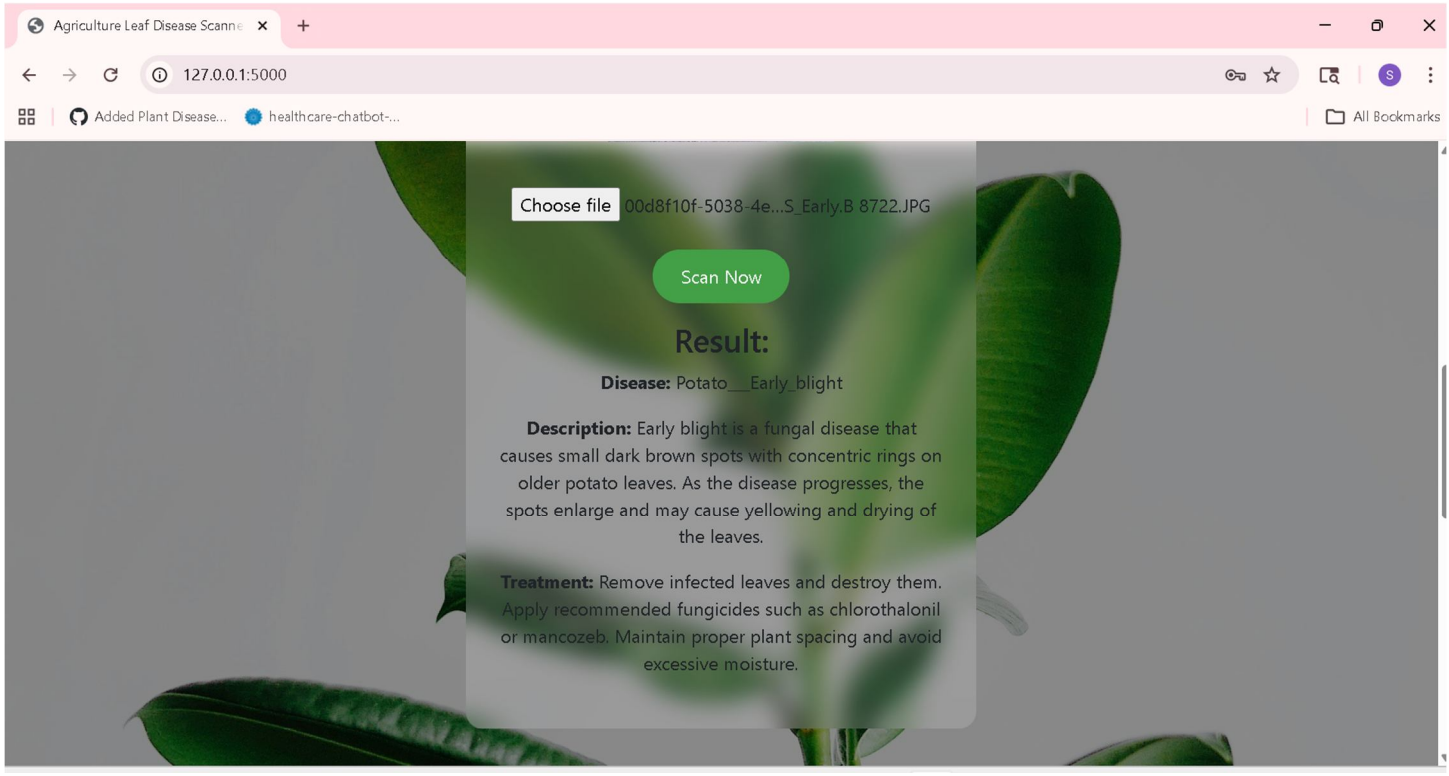


Fig d . Treatment Guide

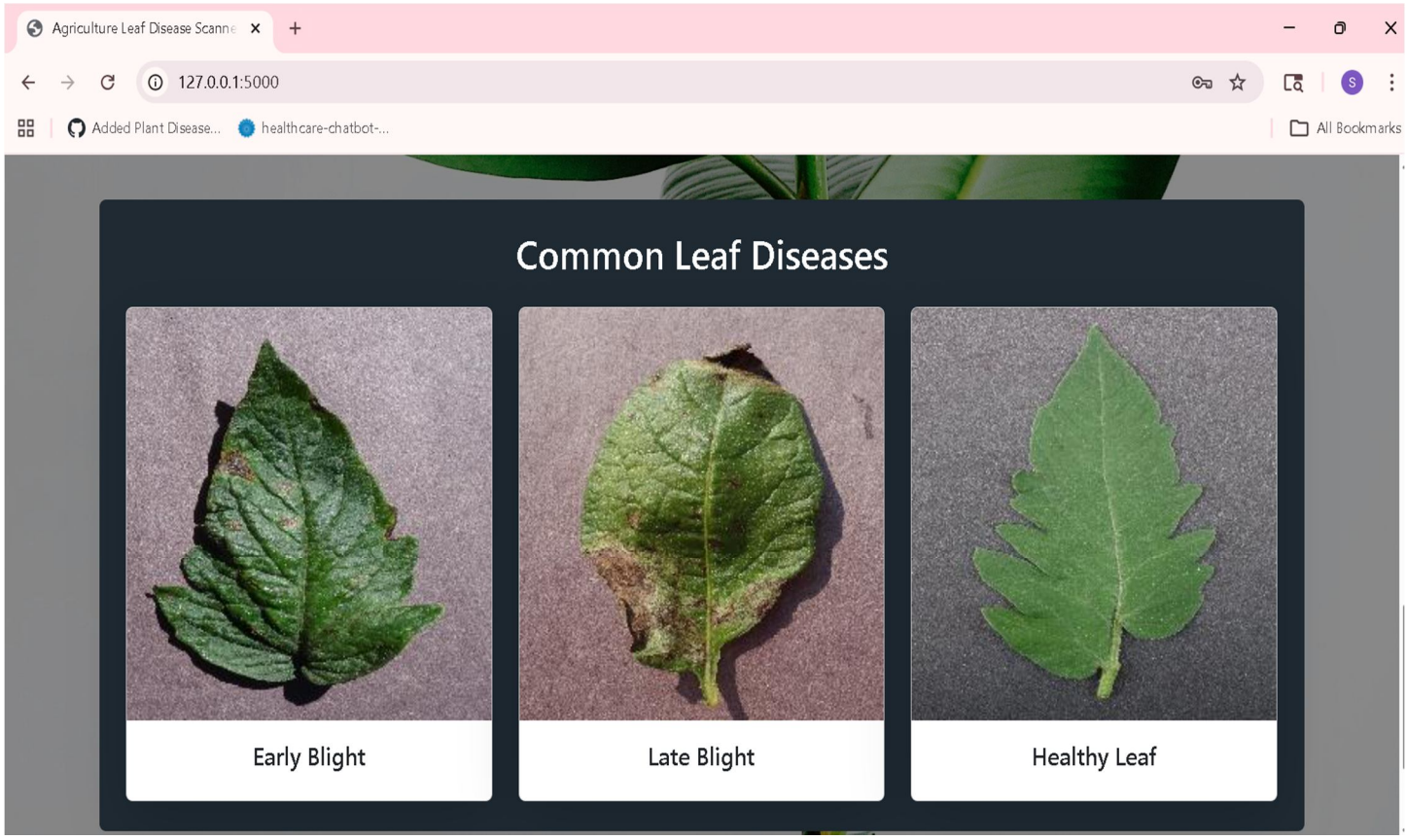
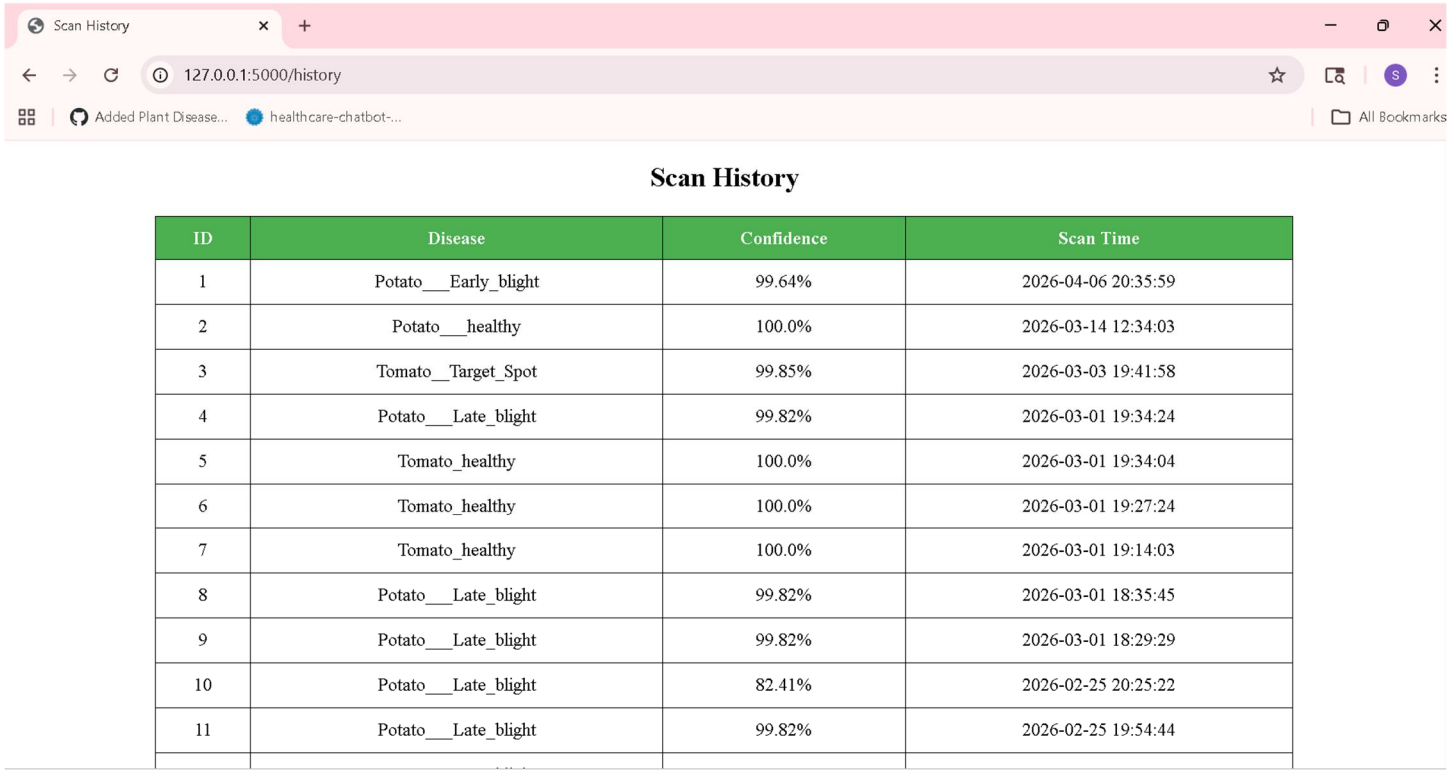


Fig E . Common leaf disease



Scan History

ID	Disease	Confidence	Scan Time
1	Potato___Early_blight	99.64%	2026-04-06 20:35:59
2	Potato___healthy	100.0%	2026-03-14 12:34:03
3	Tomato__Target_Spot	99.85%	2026-03-03 19:41:58
4	Potato___Late_blight	99.82%	2026-03-01 19:34:24
5	Tomato_healthy	100.0%	2026-03-01 19:34:04
6	Tomato_healthy	100.0%	2026-03-01 19:27:24
7	Tomato_healthy	100.0%	2026-03-01 19:14:03
8	Potato___Late_blight	99.82%	2026-03-01 18:35:45
9	Potato___Late_blight	99.82%	2026-03-01 18:29:29
10	Potato___Late_blight	82.41%	2026-02-25 20:25:22
11	Potato___Late_blight	99.82%	2026-02-25 19:54:44

Fig F. Scan History

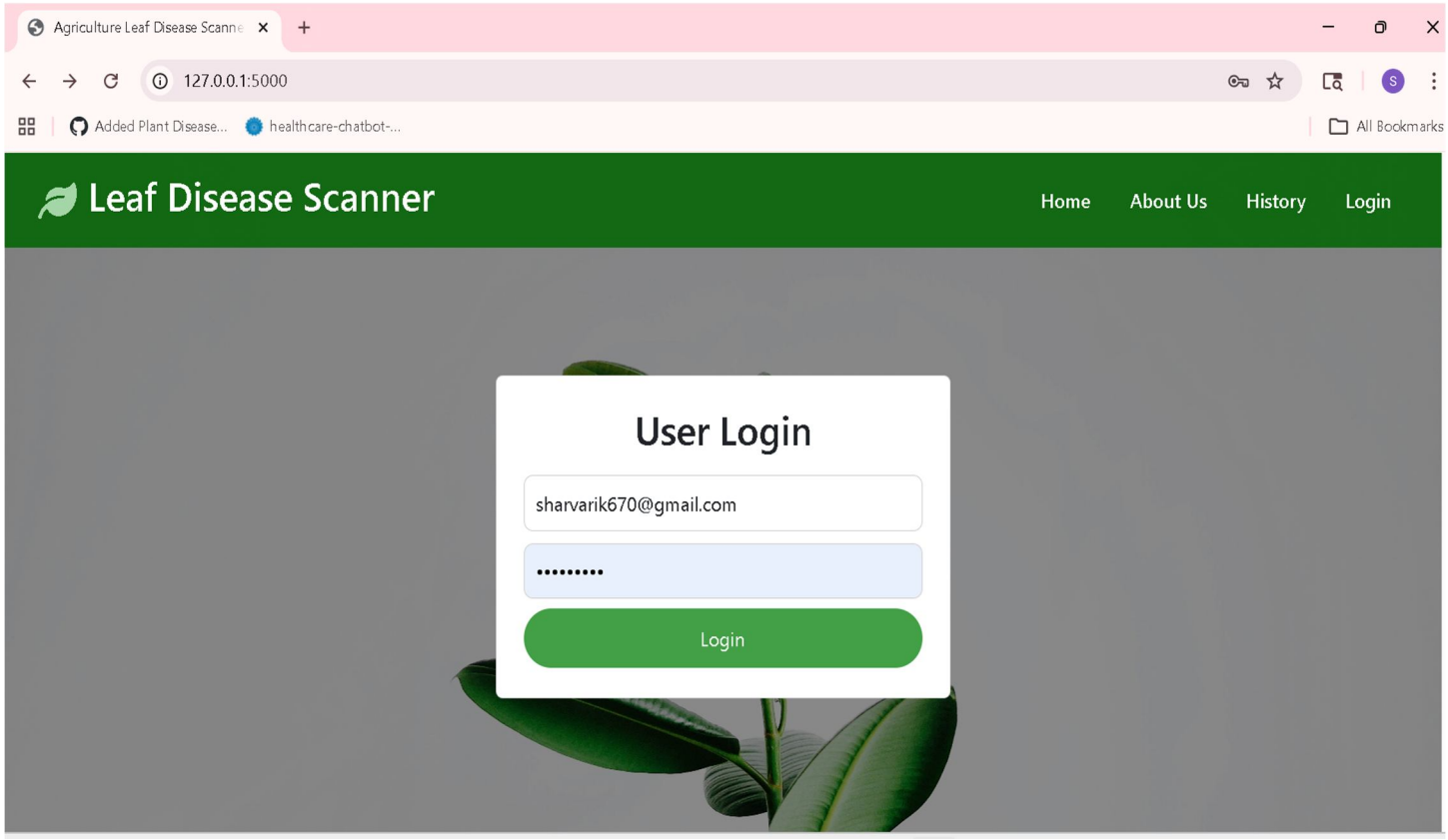


Fig g. Login Page

VI. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The Agriculture Leaf ailment Scanner mission successfully demonstrates using artificial Intelligence in agriculture for early ailment detection. The system uses a Convolutional Neural network (CNN) model to accurately become aware of plant leaf sicknesses from pics. through integrating a user-friendly internet interface with a Flask backend, the gadget permits users to effortlessly add leaf photographs and receive instantaneous predictions.

The project also provides extra capabilities which includes sickness description, treatment guidelines, and scan records garage the use of an SQLite database. these functions assist users take well timed motion and song plant fitness over the years.

B. Future Scope

The Agriculture Leaf disorder Scanner can be further advanced by growing a mobile software for Android and iOS, making it more available for farmers. The accuracy of the machine can be more desirable by using large and greater diverse datasets and by means of adding aid for greater crops and diseases.inside the future, the system can include real-time digital camera scanning in place of handiest photo add and provide multilingual support for better usability. it may additionally be linked to cloud storage for efficient data control and scalability.

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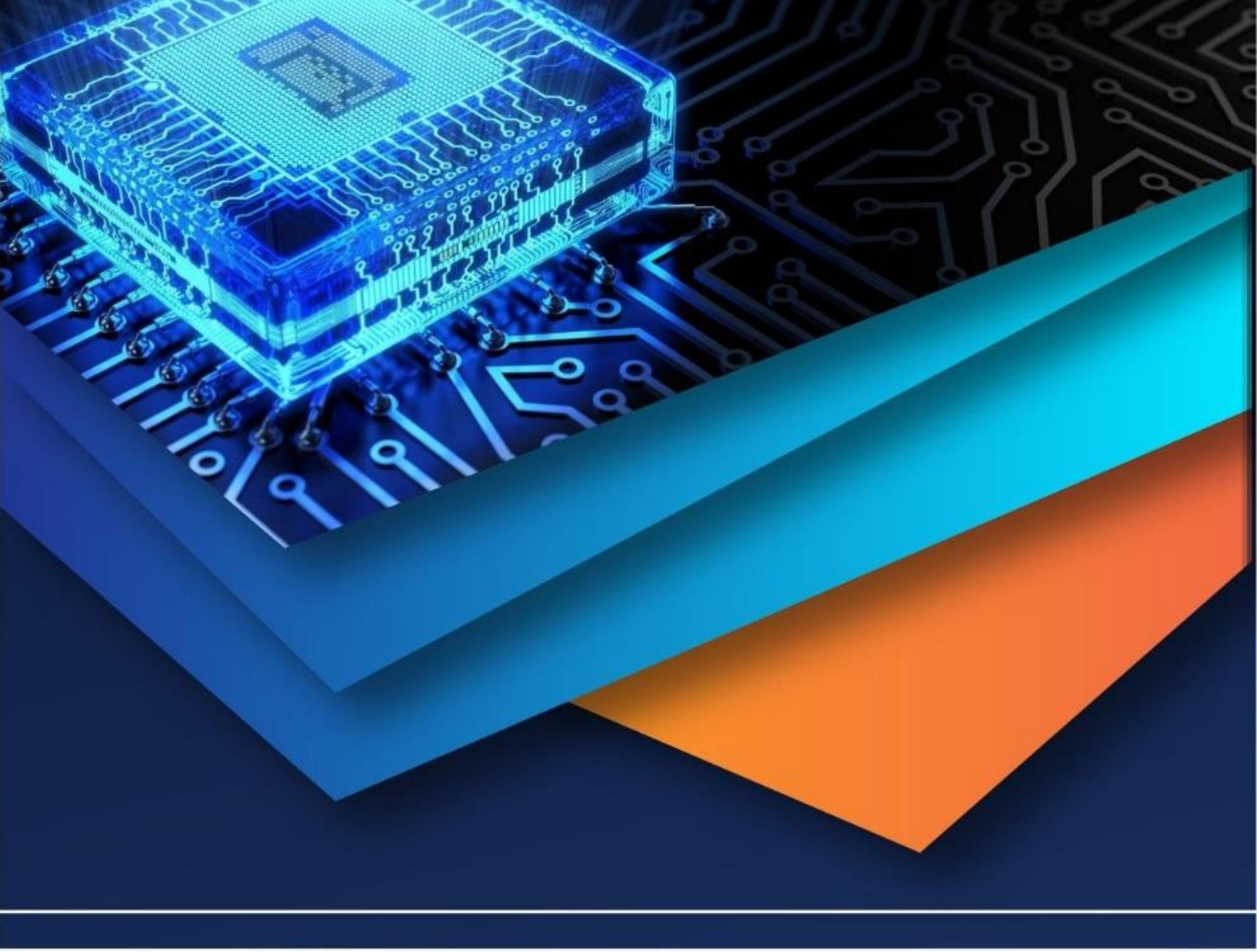

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