A

PROJECT REPORT

ON

"PLANT DISEASE DETECTION CLASSIFICATION"

SUBMITTED TO

SHIVAJI UNIVERSITY, KOLHAPUR

IN THE PARTIAL FULFILLMENT OF THE REQUIREMENT

FOR THE AWARD OF DEGREE

BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING

SUBMITTED BY

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UNDER THE GUIDANCE OF

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AN AUTONOMOUS INSTITUTE

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE ENGINEERING

DKTE SOCIETY'S TEXTILE AND ENGINEERING INSTITUTE, ICHALKARANJI

(AN EMPOWERED AUTONOUMOUS INSTITUTE)

2024-2025

D.K.T.E. SOCIETY'S

TEXTILE AND ENGINEERING INSTITUTE, ICHALKARANJI
(AN EMPOWERED AUTONOUMOUS INSTITUTE)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE ENGINEERING

CERTIFICATE

This is to certify that, project work entitled

"PLANT DISEASE DETECTION CLASSIFICATION"

is a bonafide record of project work carried out in this college by

MISS. PRERANA UTTAM WALVEKAR 23UAD309

is in the partial fulfillment of award of degree Bachelor of Technology in Artificial Intelligence and Data Science Engineering prescribed by Shivaji University, Kolhapur for the academic year 2024-2025.

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EXAMINER: ________________

DECLARATION

We hereby declare that, the project work report entitled “Plant Disease Detection Classification” which is being submitted to D.K.T.E. Society’s Textile and Engineering Institute Ichalkaranji, affiliated to Shivaji University, Kolhapur is in partial fulfillment of degree B.Tech.(AI & DS). It is a bonafide report of the work carried out by us. The material contained in this report has not been submitted to any university or institution for the award of any degree. Further, we declare that we have not violated any of the provisions under Copyright and Piracy / Cyber / IPR Act amended from time to time.

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Thank you,

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ABSTRACT

Plant diseases pose a significant threat to agricultural productivity and food security across the globe. Early and accurate detection of plant diseases can help farmers take timely actions to minimize crop damage and improve yield. This project presents a machine learning and computer vision-based approach for automated plant disease detection using leaf images. The system leverages a convolutional neural network (CNN) trained on a publicly available dataset containing images of healthy and diseased plant leaves across various species. Image preprocessing techniques such as resizing, normalization, and augmentation are applied to improve model performance. The trained model classifies diseases with high accuracy and provides visual feedback to users, making it a practical tool for farmers and agricultural researchers. The project aims to contribute to smart agriculture by providing an accessible and cost-effective solution for plant health monitoring.

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1. Introduction

a. Problem definition

Plant diseases significantly reduce agricultural productivity, leading to economic losses and food insecurity. Traditional methods of disease identification rely on manual inspection by experts, which can be time-consuming, subjective, and inaccessible to many farmers, especially in remote areas. There is a need for an automated, accurate, and user-friendly system that can detect plant diseases early using easily obtainable data like leaf images. This project aims to develop a machine learning-based solution that can identify and classify plant diseases from images of leaves, enabling timely intervention and effective crop management.

b. Aim and objective of the project

To develop an automated system for accurate detection and classification of plant diseases using leaf images.

Objectives:

- To collect and preprocess a dataset of healthy and diseased plant leaf images.
- To build and train a machine learning or deep learning model for disease classification.
- To evaluate model performance using accuracy and other relevant metrics.
- To provide a user-friendly interface for real-time disease detection.

c. Scope and limitation of the project

This project is designed to detect and classify three specific plant diseases: Potato, Tomato, and Corn. It uses leaf images and deep learning techniques to identify disease presence, helping in early diagnosis and improved crop management. The system is intended to support farmers and agricultural workers through an easy-to-use interface.

Limitations:

- Detection is limited to only Potato Early Blight, Tomato Bacterial Spot, and Corn Rust.
- Performance may decrease with poor-quality or unclear images.
- The system cannot detect multiple or mixed infections in a single leaf.
- Environmental factors like lighting, angle, or background may affect accuracy.

2. Background study and literature overview

a. Literature overview

Recent advancements in machine learning and computer vision have revolutionized plant disease detection using image-based methods. Convolutional neural networks (CNNs) have shown significant promise in accurately classifying plant diseases by extracting complex patterns from leaf images.

A study by Mohanty et al. (2016) demonstrated that deep learning models could achieve accuracy in classifying diseases across various plant species, using the PlantVillage dataset [1].

Furthermore, other research has focused on developing lightweight models for mobile platforms, making disease detection accessible in real-time to farmers in remote areas [2].

While these models show promising results, they often struggle with large-scale deployment due to limitations in dataset variety, environmental conditions, and the complexity of detecting multiple diseases simultaneously. Therefore, a focused approach, like the one proposed in this project, which targets specific diseases such as Potato Early Blight, Tomato Bacterial Spot, and Corn Rust, is crucial for ensuring high accuracy and practical application in agricultural settings.\

Research paper:

https://plantmethods.biomedcentral.com/articles/10.1186/s13007-021-00722-9

The article titled "Plant diseases and pests detection based on deep learning: a review" by Jun Liu and Xuewei Wang, published in Plant Methods in 2021, provides a comprehensive overview of how deep learning techniques are revolutionizing the detection of plant diseases and pests through image analysis.

https://www.researchgate.net/publication/379759100_Detecting_Three_Different_Diseases_of_Plants_by_Using_CNN_Model_and_Image_Processing

The article titled "Detecting Three Different Diseases of Plants by Using CNN Model and Image Processing" presents a Convolutional Neural Network (CNN)-based approach for identifying specific plant diseases. The study focuses on three diseases: corn common rust, tomato bacterial spot, and potato early blight. Utilizing the PlantVillage dataset, the model achieved high accuracy rates: 95.55% for tomato bacterial spot, 96.72% for corn common rust, and 97.63% for potato early blight. This method offers a promising tool for early disease detection, potentially aiding farmers in timely intervention and reducing crop losses.

b. Investigation of current project and related work

The current project focuses on detecting three specific plant diseases—Potato Early Blight, Tomato Bacterial Spot, and Corn Rust—using deep learning techniques applied to leaf images. The aim is to provide a lightweight, accurate, and easy-to-use model that can be deployed for real-time agricultural use, particularly in rural areas with limited access to expert diagnosis.

Several existing studies have explored general-purpose plant disease detection using large datasets such as PlantVillage. Mohanty et al. [1] used deep convolutional neural networks and achieved high accuracy on a wide range of crops and diseases. However, their work was more generic and lacked specialization in specific crops or regional needs.

Other researchers have explored mobile-based disease detection apps, like the work by Ferentinos [2], who used CNN architectures such as AlexNet and GoogLeNet, achieving high performance but requiring more computational resources. Some models have attempted to incorporate disease severity detection and localization using segmentation models, but such approaches are often complex and data-hungry.

In contrast, this project narrows its focus to a limited number of diseases and crops, allowing for better model training, reduced complexity, and practical real-world applicability. By targeting high-impact crops like potato, tomato, and corn, the system ensures relevance to major agricultural economies.

3. Requirement analysis

a. Requirement Gathering

1. Functional Requirements

These are the core features the system must provide:

- Image Input:
  The system should allow users to upload or capture an image of a leaf from potato, tomato, or corn plants.
- Disease Classification:
  The system must be capable of detecting and classifying the following plant diseases:
  - Potato
  - Tomato
  - Corn
- Output Display:
  After processing the image, the system should display:
  - The name of the detected disease (or "Healthy" if no disease is found)
- User Interface:
  The application should have an intuitive user interface for:
  - Uploading leaf images
  - Viewing the results clearly
  - Resetting or submitting another image for analysis

2. Non-Functional Requirements

- Accuracy and Performance:
  The model should provide at least 90% accuracy on validation data and deliver results within a few seconds.
- Usability:
  The interface should be easy to navigate for non-technical users, such as farmers and agricultural workers.
- Portability:
  The system should be deployable on web platforms or mobile devices for field use.
- Scalability:
  The architecture should support easy addition of more plant types and diseases in the future.
- Reliability:
  The system should perform consistently across varying image conditions (lighting, background, resolution).

3. Technical Requirements

- Programming Language:
  - Python
- Libraries/Frameworks:
  - TensorFlow (for deep learning model)

- OpenCV (for image processing)
  - NumPy and Pandas (for data handling)
  - Matplotlib/Seaborn (for visualization and evaluation)
- Model Architecture:
  - Convolutional Neural Network (CNN)
- Dataset:
  - A curated dataset from sources like PlantVillage containing labeled images of the target diseases. Images should be preprocessed (resized, augmented, normalized) before training.
- Development Environment:
  - Jupyter Notebook / Google Colab / VS Code
- Deployment Tools (if applicable):
  - Streamlit / Flask (for web deployment)

b. Use case Diagram

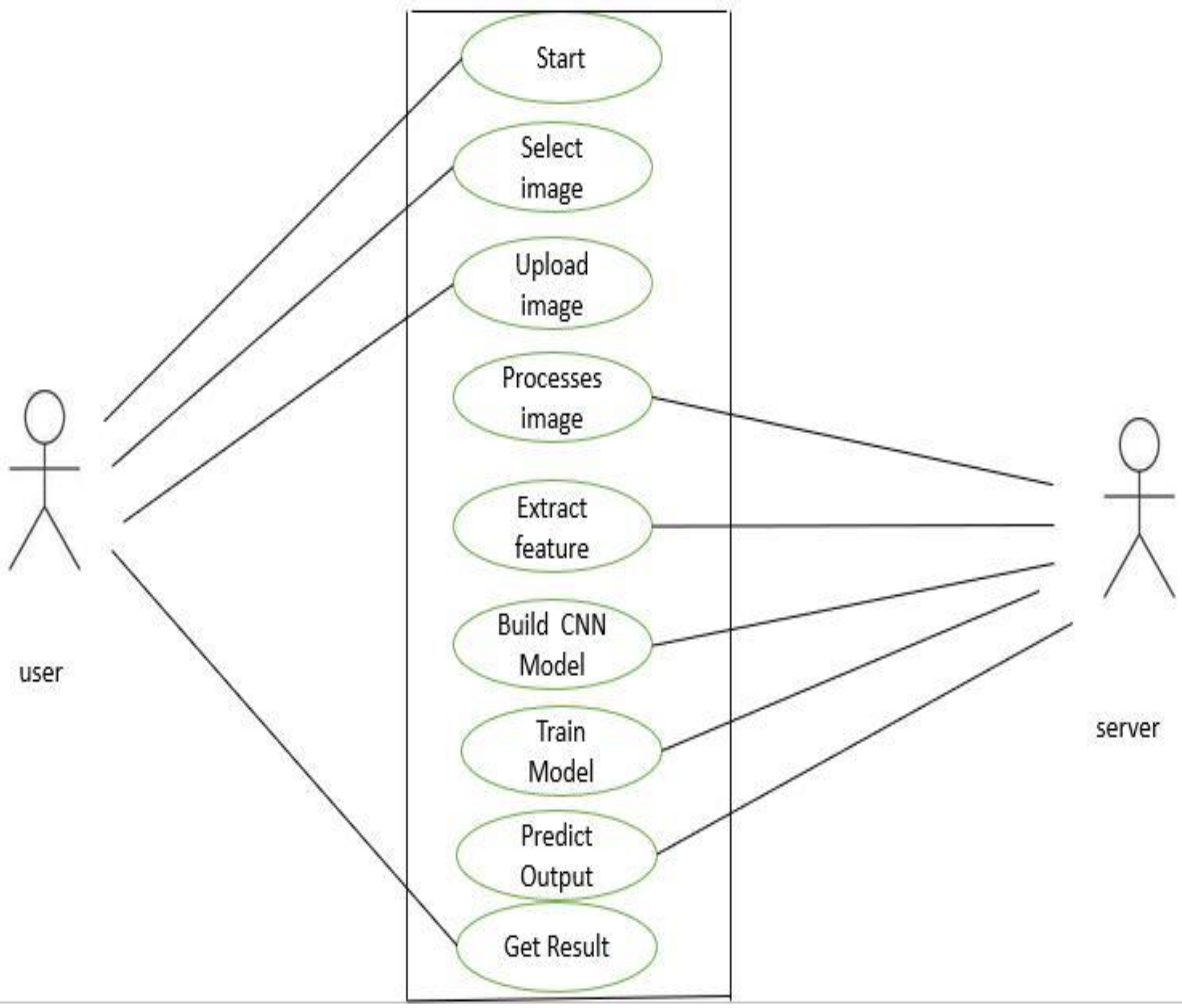

Fig: use case

4. System design

a. Architectural Design

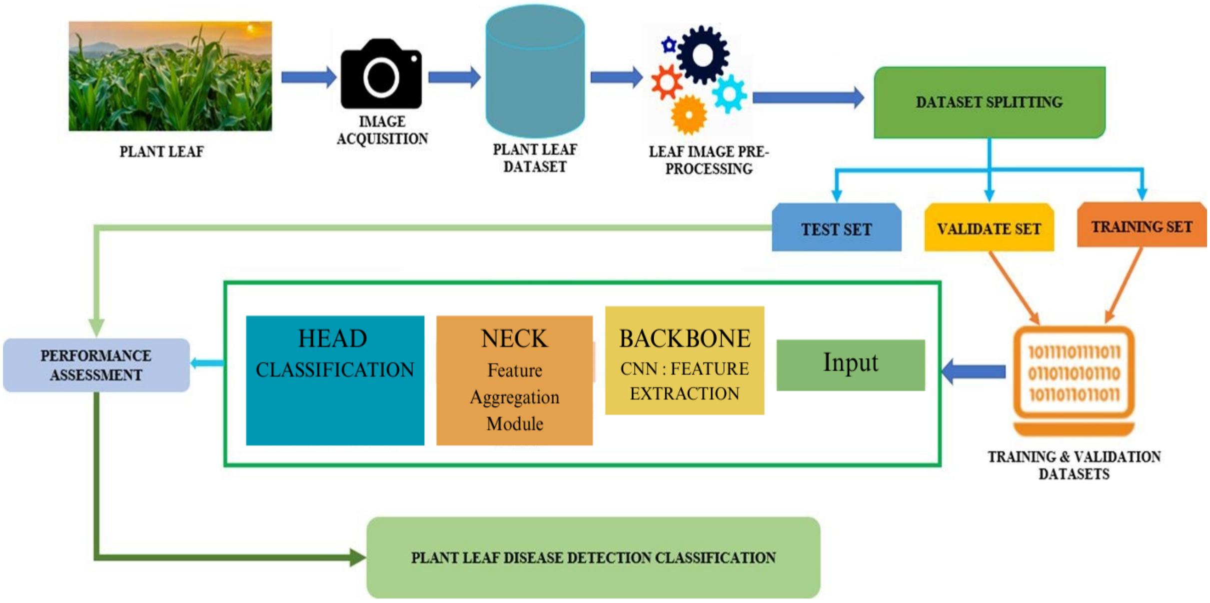

Fig: architecture diagram

b. Flow Chart

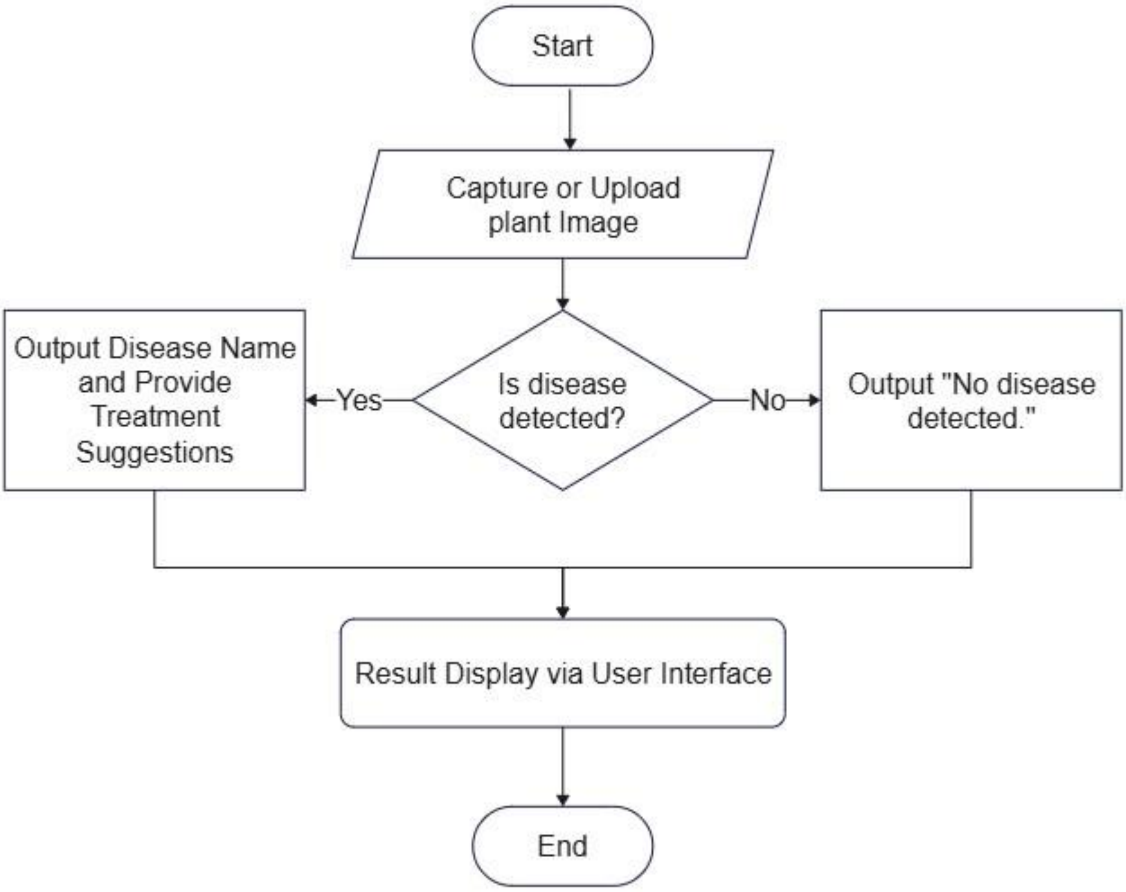

Fig: flow chart

c. System Modeling

1. Dataflow Diagram

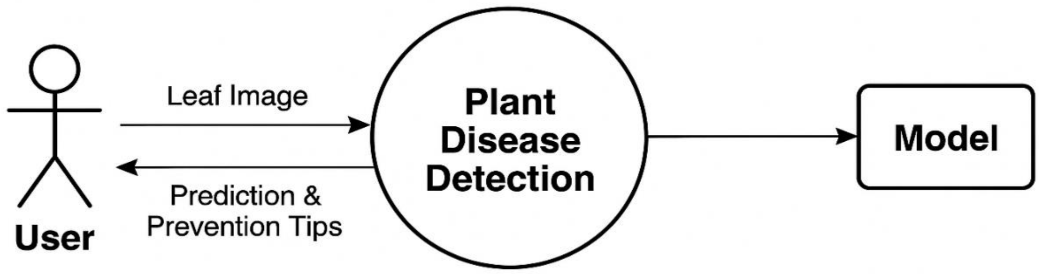

Fig: DFD level 0

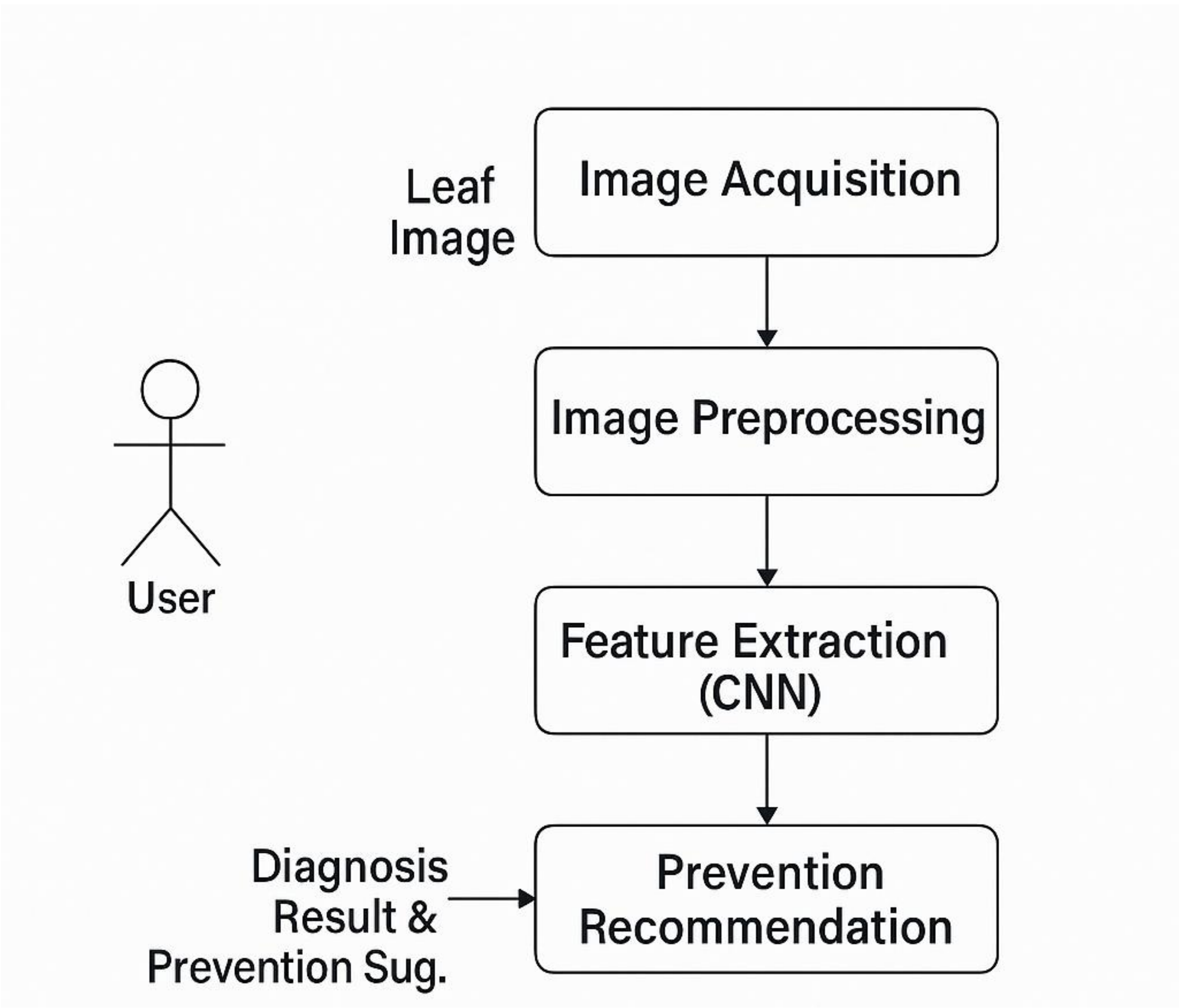

Fig: dataflow diagram level 1

5. Implementation

a. Agile Methodologies

The Agile methodology is used in this project to ensure flexible, iterative development with continuous feedback and improvement. The project is divided into short development cycles called sprints, each focusing on specific features such as image preprocessing, model training, and interface design.

During each sprint:

- Sprint Planning is done to set clear goals.
- Daily Standups help track progress and resolve issues quickly.
- Iterative Development allows building and improving features step-by-step.
- Continuous Testing ensures each new feature works without breaking existing ones.
- Sprint Reviews and Retrospectives are held to gather feedback and make improvements for the next cycle.

Agile allows us to adapt to changing requirements, involve stakeholders regularly, and deliver a working, user-friendly plant disease detection system efficiently.

b. Development Model

Spiral Model

The Spiral Model is chosen for this project due to its iterative approach, strong focus on risk management, and flexibility. This model is particularly suitable for complex systems like plant disease detection, where requirements and challenges evolve over time. The development will occur in multiple spirals, each consisting of four main phases: Planning, Risk Analysis, Engineering, and Evaluation.

<u>1. Planning Phase:</u>

In this phase, the project requirements are defined, and the scope is outlined. This includes identifying the three target diseases (Potato Early Blight, Tomato Bacterial Spot, and Corn Rust), as well as the specific functionalities needed, such as image uploading, disease classification, and output display. The planning phase sets clear objectives for each spiral, such as the development of a basic model or implementation of a user interface.

<u>2. Risk Analysis Phase:</u>

This phase identifies and assesses potential risks that may affect the project's progress. Risks include issues like insufficient or poor-quality image data, challenges in model accuracy, or technical obstacles in deployment. Mitigation strategies will be developed, such as using data augmentation or transfer learning to improve model generalization. Continuous risk monitoring will be conducted throughout the development process to address emerging challenges early.

<u>3. Engineering Phase:</u>

This is the development phase where the core system is built. The first spiral will focus on fundamental tasks such as data collection, preprocessing, and developing an initial deep learning model for disease classification. Subsequent spirals will refine and enhance the system, improving model performance, optimizing accuracy, enhancing the user interface, and ensuring compatibility across platforms. Regular testing (unit, integration, and performance tests) will be conducted to ensure that new features do not negatively affect the system.

4. Evaluation Phase:

At the end of each spiral, the system will be evaluated to ensure it meets the set objectives and user needs. This includes checking the accuracy of disease classification, assessing the user interface, and evaluating the overall performance. Stakeholder feedback (e.g., from farmers or agricultural experts) will be gathered and analyzed, and necessary adjustments will be made. Based on this feedback, new requirements or improvements may be added to the following spiral, ensuring the system is constantly evolving to meet user expectations.

Advantages of the Spiral Model:

- Flexibility and Adaptability: Each spiral allows for adjustments based on feedback and evolving requirements, ensuring that the system remains relevant throughout development.
- Risk Management: Regular risk analysis ensures that potential problems are identified and mitigated early in the process.
- Continuous Improvement: Each cycle delivers incremental improvements, refining the system’s functionality and performance step by step.
- Stakeholder Engagement: Frequent evaluations and feedback loops keep the system aligned with real-world needs, ensuring that the final product meets user requirements.

6. Future Scope

1. **Expand Disease Coverage:**
   The system can include more crop diseases, such as those affecting wheat, rice, or cucumbers, making it applicable to a wider agricultural range.
2. **Disease Severity Assessment:**
   Future versions could estimate the severity of infections, helping farmers decide on treatment measures.
3. **Mobile Application:**
   A mobile app could be developed for real-time, on-field disease detection, with offline capabilities.
4. **Integration with Management Systems:**
   The system can be linked with agricultural management software, offering a comprehensive solution combining disease detection with other crop management tools.
5. **Multilingual Support:**
   Adding language options would make the system accessible to farmers in various regions.
6. **Drone and Satellite Imaging:**
   Incorporating drone or satellite imagery would allow large-scale monitoring of fields for automated disease detection.
7. **Improvement of Deep Learning Models:**
   Advanced models and techniques like transfer learning and ensemble methods could improve accuracy and performance.
8. **IoT Integration:**
   Integrating IoT sensors for environmental data could enhance disease prediction based on real-time conditions.
9. **Collaborative Platform:**
   The system could evolve into a platform where farmers share insights, contributing to a community-based disease database.

7. References (public repository GitHub source code links)

https://github.com/Prerana-walvekar/Plant-Disease-Detection-using-CNN.git