SOFTWARE REQUIREMENTS SPECIFICATION

for

RICE LEAF DISEASE PREDICTION USING DEEP LEARNING

Under The Supervision of

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1. Introduction

- Rice leaf diseases are a big problem, causing major losses in crops worldwide.
- Current methods for spotting these diseases are slow and rely on human judgment, calling for a quicker and more reliable solution.
- The current approach, using textual datasets and SVM/KNN algorithms, faces difficulties with image complexity, potentially leading to suboptimal classification.
- Recent technological advances enable automated disease detection using image processing techniques.
- Our project is centered on enhancing the accuracy and efficiency of rice leaf disease prediction through the integration of deep learning techniques like Convolutional Neural Network(CNN).

1.1 Purpose

The purpose of this project is to develop a deep learning model for predicting rice leaf diseases, specifically targeting bacterial blight, blast, tungro, and brown spot. The model aims to assist farmers in early disease detection, contributing to better crop management and yield preservation.

1.2 Intended Audience and Reading Suggestions

This document is intended for developers, data scientists, and stakeholders involved in agriculture. Readers should have a basic understanding of deep learning concepts and image classification. It is recommended to review the document in its entirety to gain insights into the project's scope, features, and requirements.

1.3 Project Scope

The project focuses on creating a deep learning-based system that can analyze images of rice leaves and accurately predict the presence of specific diseases. The system aims to provide a user-friendly interface for farmers or agricultural practitioners to assess the health of their crops.

1.4 Reference

[1] Trébuil, G., 2011. Rice production systems in Asia: The constant presence of an essential cereal on a continent in mutation.
[2] Papademetriou, M.K., 2000. Rice production in the Asia-Pacific region: issues and perspectives. Bridging the rice yield gap in the Asia-Pacific region, 220.
[3] Mahlein, Anne-Katrin. "Plant disease detection by imaging sensors– parallels and specific demands for precision agriculture and plant phenotyping." Plant disease 100.2 (2016): 241-251.
[4] Ramesh, S. and Vydeki, D., 2019. Application of machine learning in detection of blast disease in South Indian rice crops. Journal of Phytology, pp.31-37.

2. Overall Description

2.1 Project Perspective

The product exists as a standalone deep learning model tailored for rice leaf disease prediction. It interfaces with input data, processes it through the trained model, and outputs predictions. The model operates independently of other systems but may be integrated into agricultural management platforms in the future.

2.2 Project Functions

The primary function is to predict rice leaf diseases based on input images. The system includes preprocessing, model training, prediction, and result visualization functionalities.

2.3 User Classes and Characteristics

Users include farmers and agricultural practitioners. They may have varying levels of technical expertise but should be able to use the system for disease prediction with minimal training.

2.4 Operating Environment

The system will operate on personal laptops with the following hardware requirements:

Multi-core Processor: A processor with multiple cores to support parallel processing.

Sufficient RAM: Adequate RAM to handle large datasets and memory-intensive tasks.

Adequate Storage: Sufficient storage for storing datasets and trained models.

2.5 Design and Implementation Constraints

The deep learning model is constrained by the quality and diversity of the input dataset. Limited computational resources and time for training may affect the model's complexity.

2.6 User Documentation

Comprehensive user documentation will be provided, covering installation, usage, and interpretation of results. This includes guidelines on preparing and uploading images for disease prediction.

2.7 Assumptions and Dependencies

The project assumes the availability of a labeled dataset for training and relies on deep learning frameworks for model development. It depends on stable hardware and software environments for consistent performance. The project requires the following libraries:

Python (version 3.x)

Pandas

NumPy

tensorflow

Scikit-learn

3. External Interface Requirements

3.1 User Interfaces

The user interface will be designed to allow users to upload images, initiate predictions, and visualize the model's results. It should be intuitive and accessible for users with minimal technical expertise.

3.2 Hardware Interfaces

CPU: Jupyter Notebook provides access to CPUs that vary in power, typically from 1 to 4 cores, depending on theruntime. CPU cores are used for tasks that don't require significant parallel processing.

Storage: Jupyter Notebook or Colab provides a limited amount of free storage space (approximately 30GB) for storingdatasets and files. You can also access Google Drive for additional storage.

Internet Connection: A stable internet connection is essential for using Google Colab, as it operates in the cloud and requires constant internet access.

3.3 Software Interfaces

The system interfaces with deep learning frameworks (TensorFlow, Keras) for model development and may integrate with web-based technologies for the user interface.

3.4 Communications Interfaces

Communication interfaces may involve interaction with external databases for data retrieval during training. For deployment, standard communication protocols for user interaction may be utilized.

4. System Features

4.1 System Feature: load datasets

4.2 System Feature: Preprocessing

4.3 System Feature: classify features according to attacks

4.4 System Feature: Apply feature subset selection

4.5 System Feature: Select best feature subset selection

4.6 System Feature: Apply the algorithm

4.7 System Feature: Calculating Accuracy, Precession, Recall, F1-score

5 Nonfunctional Requirements

5.1 Performance Requirements

The model should achieve a high accuracy level in disease prediction, with efficient processing times for both training and inference.

5.2 Safety Requirements

The system should not cause harm to users or their data. Proper error handling should be implemented to ensure user safety. Safety requirements are crucial for maintaining the integrity and availability of the system.

5.3 Security Requirements

Implement security measures to protect the dataset, user data, and prevent unauthorized access to the system.

5.4 Software Quality Attributes

Software quality attributes encompass characteristics that define the overall quality and reliability of the rice leaf disease detection system. These attributes include factors like reliability, maintainability, usability, and performance. Ensuring these attributes are met is essential for creating a robust and user-friendly system.

Reliability: The system should consistently provide accurate predictions of rice leaf diseases, minimizing false positives and false negatives. The reliability of the model is crucial for farmers and agricultural practitioners to make informed decisions about crop management.

Maintainability: The code and system architecture should be well-documented and organized, facilitating ease of maintenance and updates.

Usability: The user interface of the system should be intuitive and user-friendly, allowing farmers and agricultural practitioners to easily interact with the model. The design should prioritize simplicity and clarity, ensuring that users can upload images, initiate predictions, and interpret results without the need for extensive training. User documentation should also be provided for guidance.

5.5 Business Rules

In the context of the rice leaf disease prediction system, business rules encompass specific guidelines governing the system's functionality within the agricultural domain. These rules may include operational procedures for data collection, compliance requirements related to the use of agricultural datasets, and adherence to ethical considerations in disease prediction.