Revolutionizing Tomato Production and quality assessment using AI

Project ID: 24-25J-337

Project Proposal Report
Ranawaka .T.D

B.Sc. (Hons) in Information Technology Specialized in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology
July 2024

Disease identification and severity level assessment

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Declaration

I declare that this is my own work and this proposal not incorporate with any material previously submitted for degree in any other university or institute of higher learning and the best of my knowledge and believe it does contain any material previously publish or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
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Signature of the Supervisor Date

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Signature of the Co- Supervisor Date

ABSTRACT

In recent years agricultural field has been evolve with the technology to leverage and make the agricultural process more effective. This has been gone through different phases by now and even artificial intelligence is use largely in agricultural field. Through our research we specifically focus on the tomato cultivation in Sri Lanka. We propose a advanced AI driven system for tomato cultivation to address the different areas in this field. The goal of this research is to integrate advanced image processing and machine learning technology to create an AI-driven system for accurate tomato disease detection and control. The suggested methodology is intended to identify and categorize common tomato diseases in Sri Lanka. The system uses Convolutional Neural Networks (CNNs) to accurately classify leaf images and regression models to measure illness severity, giving useful information about the number of infections.
By recognizing minor visual indicators, the system allows early illness detection and allows for immediate action to reduce yield losses. It also provides specific disease management advice, assisting farmers to apply efficient measures to stop the disease's spread. Smartphone accessibility is guaranteed by a user-friendly interface that offers real-time updates, severity assessments, and detailed instructions for reducing the disease.

By integrating technology for adaptable agricultural decision-making, this creative method closes a big gap in traditional farming practices. The approach reduces financial losses for tomato growers, enhances yield quality, and encourages sustainable farming by improving disease management techniques.

1. INTRODUCTION

1.1 Background & Literature survey

Tomato farming is a significant contributor to global agriculture, and a major source of food and income for farmers. However, tomato plants are extremely vulnerable to a number of diseases that can cause huge output losses and financial difficulties if they aren't detected and addressed quickly. Conventional disease detection techniques usually depend on visual examinations, which are vulnerable to errors because symptoms of several diseases can be the same. When multiple diseases coexist on the same plant, it becomes even more difficult to identify them accurately.
Using advances in machine learning and image processing, the proposed research component seeks to address these problems. The technology can precisely identify patterns of disease by analyzing leaf photos using Convolutional Neural Networks (CNNs). Regression models are also used to measure the severity of diseases, providing farmers with useful data.

To make sure sustainable farming methods and prevent crop losses, early detection of tomato diseases is essential. Disease beginning can be detected with subtle symptoms that can often be ignored by the naked eye. Early detection of these signs is the goal of the suggested method, which will allow for immediate action and effective disease management.

1.2 Research Gap

The accuracy, practicality, and coverage of the current disease detection technologies in tomato growing are very limited. Conventional methods mostly depend on visual inspections and basic tools, which often come up short in differentiating between diseases with similar symptoms. Crop losses and decreased agricultural productivity are caused by these inaccurate interventions, which have become delayed or unsuccessful.

Furthermore, most agricultural applications now focus on basic characteristics like general disease alerts instead of offering precise disease management advice or useful insights into the severity of infections. They don't use advanced statistical or image processing methods to provide in-depth assessments, including classifying disease severity levels.

The failure of current systems to adapt is a further disadvantage. The majority of technologies generate static solutions that are unresponsive to changes in real time because they do not take into account the dynamic environmental factors which impact the progression of disease.A lot of solutions are platform-specific and mostly designed for Android devices, which limits their scalability and usability for a variety of user bases.

By creating an advanced AI-driven system that integrates machine learning and image processing to accurately identify and categorize tomato diseases, the proposed research fills these gaps. In addition, the system will evaluate the severity of infections and offer customized treatment options. It will be available on several platforms, including iOS and Android, and has a simple user interface.

1.3 Research Problem

In tomato farming, crop health, quality of production, and financial success all depend on effective disease management. However, because of the limitations of conventional methods, identifying and treating diseases can be very difficult. When several diseases coexist on a single plant, it can be challenging to accurately detect and differentiate them since diseases often have overlapping symptoms. Delays or wrong diagnoses appear from this, increasing crop losses and causing useless treatments.

Existing methods rarely identify the severity of diseases, so farmers lack useful information to select treatments. Incorrect severity assessments limit early decision-making, which causes the spread of diseases and reduces agricultural output.

By creating an advanced system that properly detects, classifies, and assesses the severity of tomato diseases using image processing and machine learning, this research aims to address these issues. The suggested approach aims to provide farmers with the resources needed for efficient disease management and environmentally friendly farming practices by offering real-time insights and helpful recommendations.

1.3.1 Proposed Project

The goal of our project is to develop an AI-powered system for accurate tomato disease management and diagnosis. This component addresses important issues such delayed interventions, inaccurate disease identification, and being unable to assess the severity of the condition. Enhancing output, reducing crop losses, and offering farmers with reliable resources for effective disease management are the objectives.

Disease Detection: Using a large number of annotated leaf photos, create a Convolutional Neural Network (CNN) model that can accurately detect and classify common tomato diseases. In order to address the limitations of conventional methods, the system will also use multi-label classification techniques to identify existing diseases on a single plant.

Disease Severity Assessment: To assess the severity of diseases that have been identified, use machine learning models. This tool will give farmers accurate data about the severity of diseases, enabling them to effectively allocate resources and prioritize interventions.

Targeted Disease Management Suggestions: Provide practical suggestions and guidance for managing diseases that have been recognized, in addition to specific steps to reduce their impact and spread. This will help farmers in making quick and effective treatments.

2. OBJECTIVES

2. 1 Main Objective

The development of a mobile application that helps tomato farmers accurately identify and control crop diseases is the main objective of this research. The system will recognize and categorize common tomato diseases and assess their severity by applying advanced machine learning as well as image processing techniques. This makes it possible for farmers to execute quick and specific actions to stop further crop damage.

In order to reduce crop losses and reduce the spread of diseases, the application will provide helpful suggestions for managing diseases. The system will offer real-time information, including disease detection, severity levels, and treatment methods, and will be provided with a simple to use mobile interface. This approach gives farmers a chance to make educated decisions, reduce financial losses, and use environmentally friendly farming techniques.

Even the most beginner farmer will be able to get to and use the application with ease thanks to its easy-to-use layout. This contains interactive elements that increase usability, clear directions, and clear images. Farmers in a variety of regions will be able to take advantage of and profit from the software.

Devices with low hardware capabilities will be able to use the mobile application. Farmers living in remote or limited in resources areas can find it useful as it ensures low battery consumption, decreased data usage, and effective performance on low-end devices.

3. METHODOLOGY

By combining machine learning, image processing, and predictive decision-making technologies, this project aims to create a modern AI-driven system that will transform tomato disease detection and management. A large collection of tomato leaf photos that marked for a number of common diseases and their symptoms is gathered and preprocessed as part of the technique. A Convolutional Neural Network (CNN) will be trained using these images in order to accurately identify tomato plant diseases.

Multiple co-existing illnesses in a single plant will be detected using multi-label classification techniques to increase the system's efficiency. Regression models will also be used by the system

to evaluate the diseases' severity, giving farmers useful information to help them prioritize interventions.

3. 1 Conceptual Design

Conceptual Design:

The conceptual design of an AI-driven system for accurate tomato disease detection and treatment is the first stage of the method. Determining the main features of the disease detection tool, describing the user experience, and describing how the system will help farmers manage crop health are all part of this step. The following are the main goals for this phase

Identify Learning Objectives:

Put the focus on improving farmers' knowledge of tomato diseases by providing interactive elements that offer current details on disease detection, severity, and management techniques. User app Design: Create a simple, simple to use mobile application that enables farmers to quickly take images of diseased plants. Regardless of their level of technological knowledge, all farmers will be able to use the platform.

User Interface Design:

Create a simple, simple to use mobile application that enables farmers to quickly take images of diseased plants. Regardless of their level of technological knowledge, all farmers will be able to use the platform.

3. 2 Model Development

A number of important steps take place in the development and training of the AI-driven tomato disease detection system in order to build, improve, and optimize the machine learning models required for accurate identification of diseases and severity evaluation. The following are components of the model development and training methodology:

Data Preparation and Collection: The first step in the process is to collect a large set of images of tomato leaves that have been labeled with a variety of common diseases and a level of severity. Before being categorized according to disease types and severity levels, these images will go through preprocessing to normalize them and then be enhanced to show different real-world scenarios. The models will be effectively trained using this dataset.

3. 3 Disease Detection and Severity Assessment

CNN-based classification is provided by tomato disease detection system for accurate detection and severity assessment. Farmers will be able to understand all types of infections . To provide recommendations for the best disease control techniques, a predictive model will take into consideration dynamic environmental factors like temperature and humidity.

The approach will be easy to use and accessible because to the real-time mobile interface, which will provide quick feedback and useful data. This approach transforms traditional farming techniques into more effective, data-driven practices by ensuring better disease management, higher crop health, and increased yield. The system's early and accurate disease detection will encourage environmentally friendly farming practices, reduce crop losses, and increase tomato farming's profitability.

3. 4 Conclusion

The AI-powered tomato disease detection system is a major development in agriculture that is changing how farmers handle crop health issues and disease detection. Through a combination of adaptive decision-making, image processing, and machine learning technologies, this system offers a holistic solution to maximize disease control attempts. It overcomes conventional limitations by correctly recognizing multiple diseases on a single plant, determining how severe they are, and providing practical suggestions for successful treatments.

Farmers' mobile devices get real-time insights, severity assessments, and recommendations for disease control straight from the system's backend integration, which ensures smooth communication between the machine learning models and the mobile interface. The system is built to change in response to user input, adjusting to the ever-changing farming environment and patterns of disease.

3. 5 Project Requirements

3. 5. 1. Functional Requirements

- Data Collection and Preprocessing
- Disease Detection using CNN
- Disease Severity Assessment
- Real-Time Recommendations

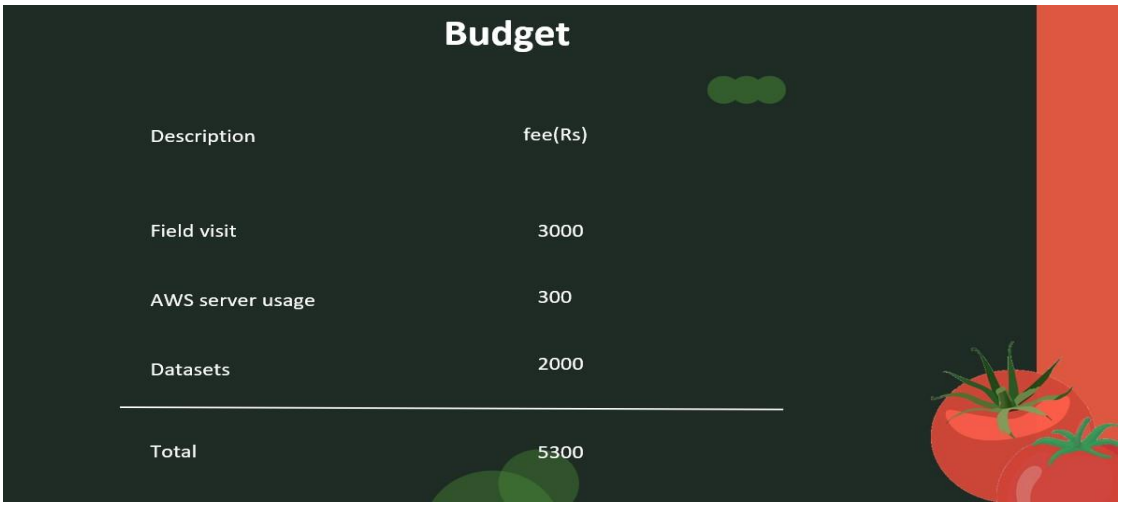
3. 5. 1. Non-Functional Requirements

- Response Performance
- Reliability
- Availability
- Security

3. 6 Commercialization

Individual farmers and major agricultural organizations are the intended customers for this AI-driven tomato growing system, which offers several subscription packages in four tiers: Basic, Standard, Premium, and Enterprise. To promote adoption, a 14-day free trial period will be offered. Expanding reach will be achieved through partnerships with technology companies, internet outlets, and direct sales at agricultural events. User retention will be fueled by consistent, purposeful customer service, updates, and involvement at all levels. While focusing on home markets, the system intends to grow globally while always innovating to meet changing demands. In the agriculture industry, this approach guarantees the system's long-term viability, affordability, and accessibility.

4. BUDGET AND JUSTIFICATION



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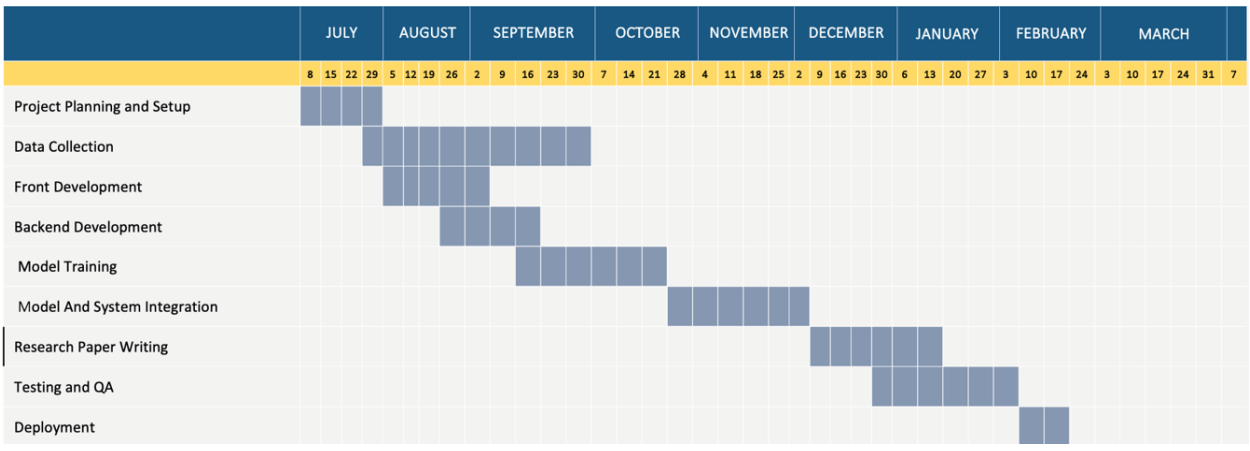
- An efficient deep learning model for tomato disease detection Xuewei Wang1 and Jun Liu

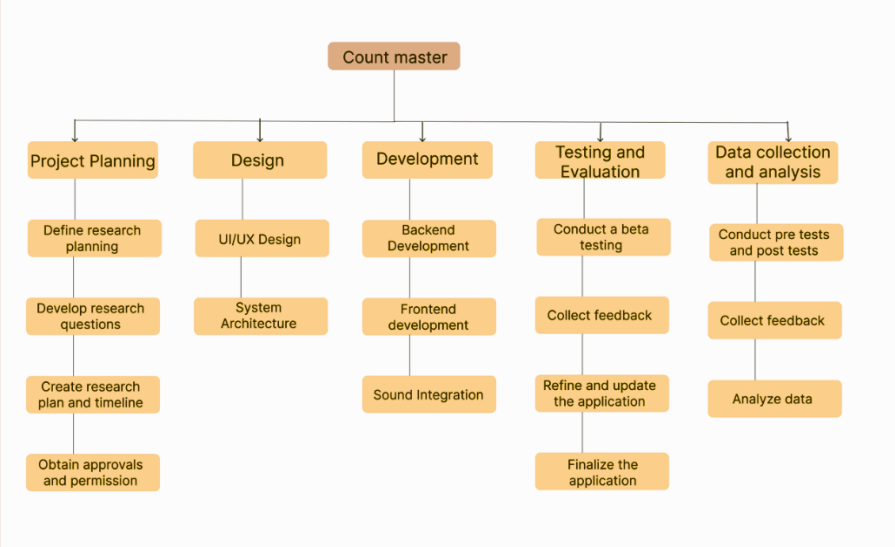
- ToLeD: Tomato Leaf Disease Detection using Convolution Neural Network Mohit Agarwala,∗ , Abhishek Singhb, Siddhartha Arjariac , Amit Sinhad, Suneet Guptaa

6. APPENDICS

Gnatt chart



Work Breakdown chart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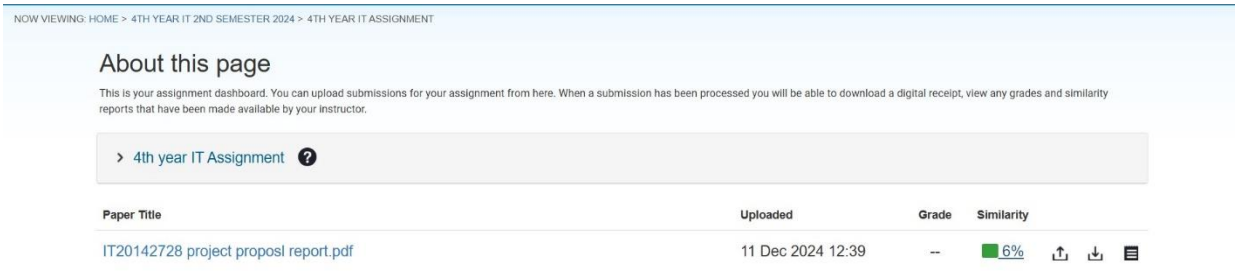
Project Planning
Design
Development
Testing and Evaluation
Data collection and analysis
Define research planning
Develop research questions
Create research plan and timeline
Obtain approvals and permission
UI/UX Design
System Architecture
Backend Development
Frontend development
Sound Integration
Conduct a beta testing
Collect feedback
Refine and update the application
Finalize the application
Conduct pre tests and post tests
Collect feedback
Analyze data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