DEPARTMENT OF INFORMATION TECHNOLOGY

Major Project Synopsis

Title of the project: - Potato Disease Classification using Deep Learning

Student Details:

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Broad area of technology: Machine Learning

Software/ hardware proposed to be use: - TensorFlow, FastAPI

Mentor/Guide Name: - Ms. Kajal Kaul

Mentor/Guide **Major Project Coordinator**

POTATO DISEASE CLASSIFICATION USING DEEP LEARNING

MAJOR PROJECT SYNOPSIS

Submitted in partial fulfillment of the requirements for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

INFORMATION TECHNOLOGY

by

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DEPARTMENT OF INFORMATION TECHNOLOGY
BHARATI VIDYAPEETH'S COLLEGE OF ENGINEERING
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NEW DELHI – 110063
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CANDIDATE’S DECLARATION

It is hereby certified that the work which is being presented in the B.Tech Major project Synopsis entitled **"Potato Disease Classification using Deep Learning"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** and submitted in the **Department of Information Technology** of **BHARATI VIDYAPEETH’S COLLEGE OF ENGINEERING, New Delhi (Affiliated to Guru Gobind Singh Indraprastha University, Delhi)** is an authentic record of our own work carried out during a period from **February 2024 to June 2024** under the guidance of **Ms. Kajal Kaul, Assistant Professor.**

The matter presented in the B. Tech Major Project Report has not been submitted by me for the award of any other degree of this or any other Institute.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge. He/She/They are permitted to appear in the External Major Project Examination

Ms. Kajal Kaul
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INTRODUCTION

The "Potato Disease Classification using Deep Learning" project addresses the critical challenge in agriculture by introducing an innovative solution for the early detection and classification of diseases affecting potato crops. The significance of this project lies in its potential to revolutionize disease management practices, mitigate economic losses for farmers, and contribute to global food security. The project employs advanced deep learning techniques, specifically convolutional neural networks (CNN), to classify potato leaves into three categories: healthy, early blight, and late blight. This involves extensive data collection of diverse potato leaf images, preprocessing to enhance model robustness, and training a CNN using TensorFlow and Keras. To ensure real-time accessibility, a back-end server is deployed using TensorFlow Serving and FastAPI, and a user-friendly front-end interface is developed using ReactJS for the website and React Native for the mobile application. The integration of front-end and back-end components enables farmers to capture and upload images directly from the field for instant disease identification.Optimization techniques, including quantization and conversion to TensorFlow Lite, are applied to enhance the model's efficiency for deployment on various platforms, particularly mobile devices. Model interpretability features are integrated to provide farmers with insights into the classification process, fostering user trust. The project's expected outcomes include an accurate disease classification model, real-time accessibility, cross-platform deployment, enhanced model interpretability, and improved crop management practices. The comprehensive documentation created during the project facilitates knowledge transfer and future maintenance.The scope encompasses disease classification, real-time accessibility, cross-platform deployment, model optimization, and user interpretability. However, limitations such as model generalization and environmental factors are considered. The methodology involves data collection, preprocessing, model development, back-end server deployment, model optimization, front-end interface design, integration, real-time functionality implementation, cross-platform compatibility, interpretability features, performance evaluation, and documentation. The anticipated timeline spans project setup, data collection, model development, deployment, and user training, with room for testing, debugging, and feedback collection. Required resources include hardware, software, dataset, documentation tools, communication tools, mobile devices for testing, and a deployment environment. References include research papers on potato disease detection using deep learning and machine learning techniques, providing valuable insights into different methodologies and approaches.

In conclusion, the "Potato Disease Classification using Deep Learning" project aims to deliver a practical and impactful solution that empowers farmers with an efficient, accurate, and accessible tool for potato disease identification, contributing to improved crop management and sustainable agriculture practice.

PROBLEM STATEMENT

The agricultural sector, particularly potato cultivation, faces a critical challenge in effectively detecting and managing diseases that adversely impact crop yield. Potato plants are susceptible to diseases such as early blight and late blight, which can rapidly spread and lead to substantial economic losses for farmers. Traditional methods of disease identification rely on visual inspections, often resulting in delayed responses and ineffective management.

The significance of this problem lies in the economic impact on farmers and the global food supply chain. Delayed disease detection can result in reduced yields, increased production costs due to excessive pesticide use, and potential long-term damage to soil health. Inefficient disease management practices contribute to food insecurity, impacting both local and international markets.

The "Potato Disease Classification using Deep Learning" project addresses this problem by introducing an innovative solution that harnesses the capabilities of deep learning. By leveraging advanced image recognition techniques, the project aims to provide farmers with a rapid and accurate means of identifying diseases in their potato crops. This timely detection enables farmers to implement targeted interventions, optimizing resource use, reducing environmental impact, and ultimately ensuring a more sustainable and resilient potato farming industry.

OBJECTIVES

1. Disease Identification Accuracy:

- Develop a deep learning model with a primary objective of achieving high accuracy in the identification and classification of diseases affecting potato crops, specifically targeting categories such as early blight and late blight.

2. Real-Time Accessibility:

- Implement a user-friendly interface that enables farmers to capture and upload images directly from the field, facilitating real-time disease identification. The goal is to empower farmers with an efficient tool for immediate decision-making in crop management.

3. Cross-Platform Deployment:

- Ensure the cross-platform compatibility of the application by developing optimized front-end interfaces for both web (ReactJS) and mobile (React Native) platforms. This objective aims to provide accessibility across various devices and enhance the reach of the solution.

4. Model Optimization and Efficiency:

- Apply optimization techniques, including quantization and conversion to TensorFlow Lite, to enhance the efficiency of the deep learning model. The focus is on creating a lightweight model suitable for deployment on mobile devices, contributing to broader accessibility in agricultural settings.

METHODOLOGY

1. Data Collection:

Collect a diverse dataset of potato leaf images, including examples of healthy leaves, leaves with early blight, and leaves with late blight. Utilize reputable agricultural databases and sources to ensure dataset quality and diversity.

2. Data Preprocessing:

Employ TensorFlow and the Keras API for data preprocessing, including resizing images to a consistent size, data augmentation for increased model robustness, and normalization to standardize pixel values.

3. Model Building:

Construct a convolutional neural network (CNN) using TensorFlow and Keras. Design the architecture to effectively capture features from potato leaf images, incorporating convolutional layers, max-pooling, and dense layers.

4. Back-End Server Development:

Utilize TensorFlow Serving and FastAPI to create a back-end server capable of serving the trained model. Configure endpoints for receiving image data and returning classification results.

5. Model Optimization:

Apply quantization techniques to reduce the model's size and memory footprint. Convert the model to TensorFlow Lite for efficient deployment on mobile devices, ensuring compatibility and accessibility for farmers.

6. Front-End Interface Design:

Develop a user-friendly front-end interface using ReactJS for the website and React Native for the mobile application. Implement intuitive design principles, enabling farmers to easily interact with the application.

7. Integration of Front-End and Back-End:

Establish communication protocols between the front-end interface and the back-end server. Ensure a seamless flow of data for real-time disease classification.

8. Real-Time Classification Feature:

Implement functionality for real-time classification, allowing farmers to capture and upload images directly from the field for instant disease identification.

9. Cross-Platform Compatibility:

Optimize the front-end application for cross-platform compatibility, ensuring a consistent and responsive user experience on both web and mobile interfaces.

10. Model Interpretability:

Integrate visualization tools to interpret and display model predictions. Provide farmers with insights into the classification process, enhancing transparency and user trust.

11. Performance Evaluation:

Evaluate the model's performance using a separate test dataset. Measure accuracy, precision, recall, and other relevant metrics to assess the model's effectiveness in disease classification.

12. Documentation and Knowledge Transfer:

Create comprehensive documentation detailing the project's architecture, implementation details, and usage instructions. Facilitate knowledge transfer to stakeholders, enabling future maintenance and potential enhancements.

SCOPE

The "Potato Disease Classification using Deep Learning" project has a defined scope with a focus on delivering a robust and accessible solution for potato disease identification. The project encompasses the following aspects:

1. Disease Classification:

- The primary scope of the project is to accurately classify potato leaves into three categories: healthy, early blight, and late blight. The deep learning model will be trained to perform this classification based on input images.

2. Real-Time Accessibility:

- The project aims to provide farmers with a user-friendly interface for real-time disease classification. This includes the ability to capture and upload images directly from the field, enabling instant identification of potential diseases.

3. Model Optimization:

- Model optimization techniques, including quantization and conversion to TensorFlow Lite, will be implemented to enhance the model's efficiency for deployment on mobile devices. This contributes to the project's goal of accessibility.

Limitations:

While the project aims to address the specified aspects, there are certain limitations and considerations:

1. Model Generalization:

- The model's generalization may be influenced by the diversity and representativeness of the training dataset. It may not perform optimally on images that significantly differ from the training data.

2. Environmental Factors:

- The model's performance may be affected by environmental factors such as lighting conditions and image quality. Extreme variations in these factors might impact the accuracy of disease classification.

3. Limited Disease Types:

- The project focuses on the classification of healthy leaves, early blight, and late blight. Other potential diseases affecting potato crops may not be covered within the scope of this project.

EXPECTED OUTCOMES

1. Accurate Disease Classification:

- The primary expected outcome is a trained deep learning model capable of accurately classifying potato leaves into three categories: healthy, early blight, and late blight. The model should demonstrate high accuracy and reliability in disease identification.

2. Model Optimization:

- The application of optimization techniques, including quantization and conversion to TensorFlow Lite, is anticipated to enhance the model's efficiency for deployment on mobile devices. This contributes to accessibility and wider adoption.

3. Improved Crop Management:

- Overall, the successful implementation of the project is expected to contribute to improved crop management practices. Farmers equipped with a reliable tool for disease identification can make informed decisions, leading to optimized resource use and increased crop yield.

4. Enhanced User Trust:

- The transparency provided through model interpretability features is anticipated to enhance user trust in the system. Farmers should feel confident in relying on the application for disease identification and decision-making in their agricultural practices.

TIMELINE

Weeks 1-2: Project setup, planning, and defining project goals, scope, and deliverables.

Weeks 3-4: Data collection, preprocessing, and gathering a diverse dataset of potato leaf images.

Weeks 5-6: Model development, including constructing a CNN using TensorFlow and Keras, training, and initial evaluation.

Weeks 7-8: Back-end server deployment, setting up TensorFlow Serving and FastAPI, and configuring server endpoints.

Weeks 9-10: Model optimization, applying techniques such as quantization and conversion to TensorFlow Lite.

Weeks 11-12: Front-end interface development, creating user-friendly interfaces using ReactJS and React Native.

Weeks 13-14: Integration of front-end and back-end components, focusing on communication and accuracy.

Weeks 15-16: Real-time classification feature implementation, cross-platform compatibility, and final testing and debugging across all components.

RESOURCES REQUIRED

1. Hardware:

   - High-performance computing hardware for model training (GPU recommended for faster processing).
   - Mobile devices for testing and optimizing the mobile application (iOS and Android).

2. Software:

   - TensorFlow and Keras for model development and training.
   - TensorFlow Serving for deploying the model on the back-end server.
   - FastAPI for building the back-end server.
   - ReactJS for web front-end development.
   - React Native for mobile front-end development.
   - Python for scripting and backend development.
   - Image processing libraries (e.g., OpenCV) for preprocessing.
   - Development environments (e.g., Jupyter Notebook, VS Code).

3. Dataset:

   Access to a diverse dataset of potato leaf images, including healthy leaves, early blight, and late blight examples. The dataset should be of sufficient size and quality to ensure effective model training.

4. Documentation Tools:

   - Documentation tools such as Markdown for creating project documentation.
   - Version control system (e.g., Git) for code versioning and collaboration.

5. Communication Tools:

   Collaboration and communication tools (e.g., Slack, email) for team coordination and updates.

6. Internet Connectivity:

   Stable internet connection for accessing online resources, updates, and potential cloud services.

7. Mobile Devices for Testing:

   Actual mobile devices for testing the React Native application on both iOS and Android platforms.

8. Development Environment:

   Adequate development environment with necessary software dependencies and libraries.

9. User Feedback Mechanism:

Mechanism for collecting user feedback, potentially through surveys or interviews.

10. Training Space:

Space for conducting user training sessions, if applicable.

11. Deployment Environment:

Environment for deploying the system, which may include a server for hosting the back end and a web server for the front end.

12. External Support:

Access to external support or expertise in deep learning, TensorFlow, and ReactJS/React Native if additional guidance is needed.

13. Budget:

Allocation of budget for potential cloud services, software licenses, or additional resources as needed.

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