MAJOR-II PROJECT

Software Requirements Specification

For

Potato disease classification using deep learning

Submitted By

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Project Title - Potato disease classification using deep learning

1. Introduction

1.1 Purpose of the Project

Potatoes are one of the most widely consumed and important crops in the world. However, they are susceptible to various diseases that can cause significant yield losses and affect their quality. Traditional methods of detecting and diagnosing potato diseases can be time-consuming and expensive. Hence, there is a need for an automated and accurate system to identify and classify different types of potato diseases.

1.2 Target Beneficiary

In this project, we aim to use deep learning algorithms to build a model that can classify different types of potato diseases. The model will be trained on a large dataset of potato images that includes both healthy and diseased potatoes. Once trained, the model can be used to classify potato disease images in real-time, enabling quick and accurate diagnosis of potato diseases.

1.3 Project Scope

The successful implementation of this project can have significant implications for potato farming, as it can help farmers identify and manage potato diseases more effectively, leading to higher yields and improved crop quality. Additionally, this project can serve as a template for similar projects in the field of agriculture, where deep learning techniques can be used to address various challenges faced by farmers.

The problem addressed in this project is the accurate and timely detection and classification of potato diseases. Potato is an important crop that is vulnerable to various diseases, which can cause significant losses in yield and quality. Traditional methods of detecting and diagnosing potato diseases can be time-consuming, costly, and often require expert knowledge. Therefore, there is a need for a fast, accurate, and automated system for potato disease detection and classification that can assist farmers in making informed decisions and managing potato diseases effectively.

Deep learning has shown great potential for image classification tasks, including plant disease detection. However, potato disease classification using deep learning is still a challenging task due to the high variability and complexity of potato diseases, as well as the limited availability of labelled datasets. Therefore, the main problem addressed in this project is the development of a deep learning-based approach that can accurately detect and classify different types of potato diseases, while also being able to handle the variability and complexity of potato diseases in real-world settings.

1.4Literature Review:

The classification of potato diseases using deep learning has gained significant attention in recent years. Various studies have proposed different deep-learning architectures and techniques for potato disease classification. In this literature review, we summarize some of the key works in this field.

In a study by Zhang et al. (2016), a deep convolutional neural network (CNN) was proposed for potato disease classification. The authors used transfer learning to adapt the VGG-16 architecture for their dataset of potato images. The results showed that the proposed model achieved high accuracy in classifying different types of potato diseases.

In another study by Sladojevic et al. (2016), a deep neural network was used for potato disease classification. The authors proposed a customized network architecture that includes multiple convolutional and pooling layers. The network was trained on a dataset of potato images that includes various types of diseases. The results showed that the proposed model achieved high accuracy in potato disease classification.

In a more recent study by Shan et al. (2019), a deep-learning model was proposed for potato early blight detection. The authors used a deep CNN with multiple convolutional and pooling layers, and they applied transfer learning to adapt the model for their dataset. The results showed that the proposed model achieved high accuracy in detecting early blight in potato leaves.

Finally, in a study by Liu et al. (2020), a deep learning model was proposed for potato disease classification using a combination of deep CNNs and recurrent neural networks (RNNs). The authors used transfer learning to adapt the VGG-16 architecture for their dataset, and they applied RNNs to capture the temporal dependencies in potato disease progression. The results showed that the proposed model achieved high accuracy in classifying different types of potato diseases.

Overall, the studies reviewed here demonstrate the potential of deep learning for potato disease classification. The use of transfer learning and customized network architectures can help improve the accuracy of the models, while the combination of deep CNNs and RNNs can capture both spatial and temporal dependencies in potato disease progression. These findings can provide useful insights for future research in this field.

2. Project Description

2.1 Reference Algorithm

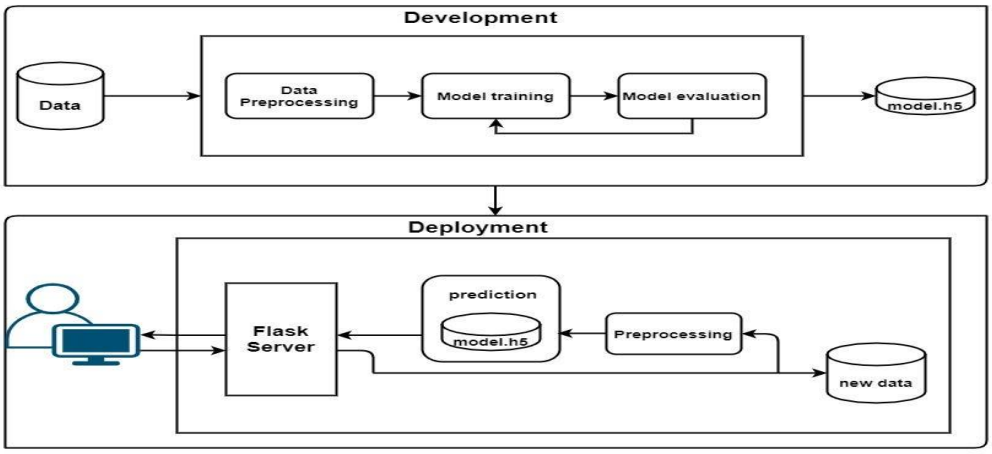
A Convolutional Neural Network (CNN) is a type of deep learning algorithm that is particularly well-suited for image recognition and processing tasks. It is made up of multiple layers, including convolutional layers, pooling layers, and fully connected layers.

The convolutional layers are the key component of a CNN, where filters are applied to the input image to extract features such as edges, textures, and shapes. The output of the convolutional layers is then passed through pooling layers, which are used to down-sample the feature maps, reducing the spatial dimensions while retaining the most important information. The output of the pooling layers is then passed through one or more fully connected layers, which are used to make a prediction or classify the image

2.2 Data/ Data structure

We are taking data from Kaggle
https://www.kaggle.com/datasets/arjuntejaswi/plant-village

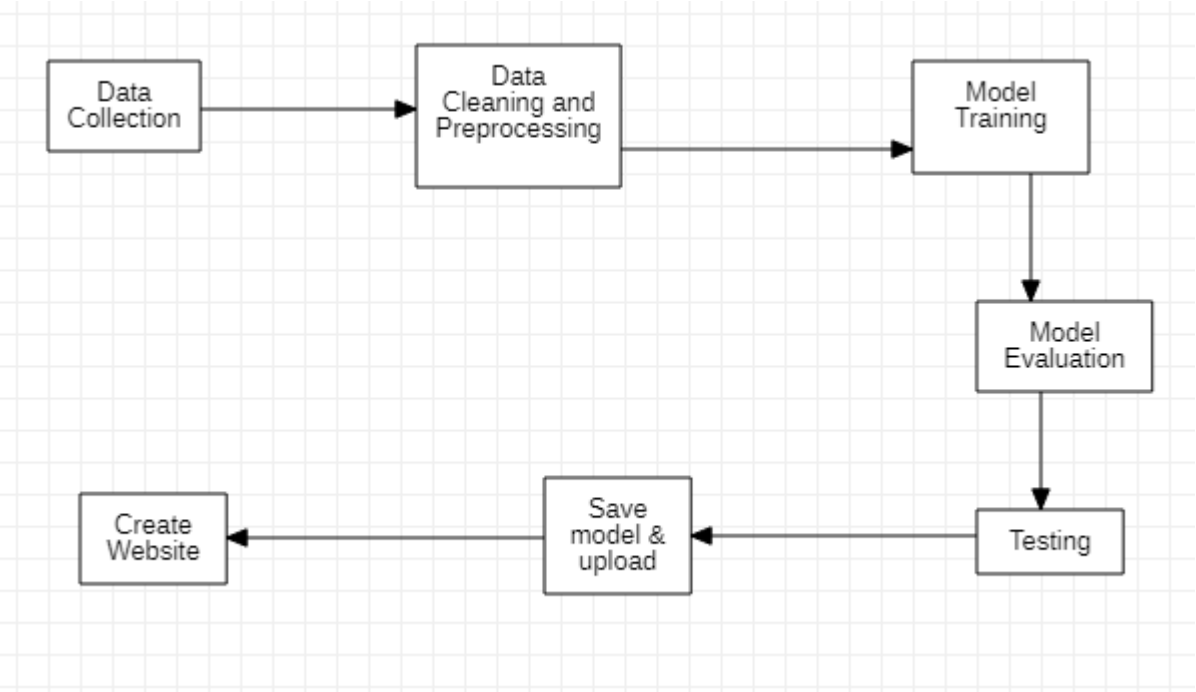
2.3 Design & Implementation:



We will solve a machine learning problem from agriculture domain using Convolutional Neural Networks and Tensorflow2.

We will build a web application to predict the diseases of Potato plants.

The proposed methodology of potato disease classification using deep learning involves the



following detailed steps:

1. Data collection: The first step in the methodology is to collect a large dataset of potato images that includes both healthy and diseased potatoes. The dataset can be obtained from various sources such as research institutes, agricultural organizations, or online repositories. The dataset is divided into training, validation, and test sets in a ratio of 80:10:10.
2. Data pre-processing: The collected dataset is pre-processed to remove noise, resize the images, and augment the data to increase its diversity. Noise removal techniques such as denoising autoencoders or image filters are used to remove any unwanted artifacts in the images. The images are resized to a standard size to facilitate processing. Data augmentation techniques such as random cropping, rotation, and flipping are applied to generate more images, which helps in preventing overfitting and increasing the model's generalization capability.
3. Model architecture: A deep convolutional neural network (CNN) architecture is implemented using transfer learning techniques. Transfer learning involves using a pre-trained CNN model such as ResNet or VGG as the base architecture and fine-tuning its weights on the potato disease dataset. The last few layers of the pre-trained model are replaced with a few new layers that can adapt to the specific task of potato disease classification.
4. Model training: The model is trained on the training dataset using an appropriate optimization algorithm such as stochastic gradient descent (SGD) or Adam. The model is trained with a suitable learning rate, batch size, and number of epochs. The learning rate determines the step size for updating the weights, while the batch size
5. determines the number of images processed in each iteration. The number of epochs determines the number of times the entire dataset is processed during training.

6. Model evaluation: The trained model is evaluated on the validation dataset to check for overfitting and select the best model. The model's performance is measured in terms of accuracy, loss.
7. Testing: The final model is evaluated on the test dataset to measure its performance on unseen data. The performance metrics obtained during testing are used to determine the model's real-world performance.

Overall, the proposed methodology involves collecting and pre-processing the dataset, implementing a suitable CNN architecture, training and evaluating the model, and visualizing the results. The methodology also involves investigating the impact of hyper parameters and comparing the proposed approach with other methods.

3. System Requirements

OS: Windows 10
Software: Any python software(python 3.10)
Backend Server and ML Ops: tf serving, FastAPI

Frontend: React JS, React Native

3.1 System Architecture- The potato disease classification system will be based on a convolutional neural network (CNN) architecture. The system will consist of several modules, including a data pre-processing module, a feature extraction module, a classification module, and a user interface module.

3.2 Functional Requirements -The functional requirements of the potato disease classification system are:

To allow users to upload images of potato plants for disease classification

To pre-process and normalize the image data to ensure consistent quality

To extract relevant features from the image data using a CNN

To classify the image data into different types of potato diseases

To provide users with the classification results in a user-friendly interface

3.3 Non-Functional Requirements -The non-functional requirements of the potato disease classification system are:

To achieve an accuracy rate of at least 90%

To process images in real-time with minimal latency

To ensure the system is scalable and can handle large datasets

To ensure the system is secure and user data is protected

Requirements 3.4- Use Cases

User uploads an image for classification

System pre-processes the image data

System extracts features from the image data

System classifies the image data into different types of potato diseases

System provides the classification result to the user

3.5 System Interfaces

User interface for uploading images and viewing results

Database interface for storing and retrieving image and classification data

External APIs for accessing additional data sources

3.6 Data Requirements

The data requirements for the potato disease classification system are:

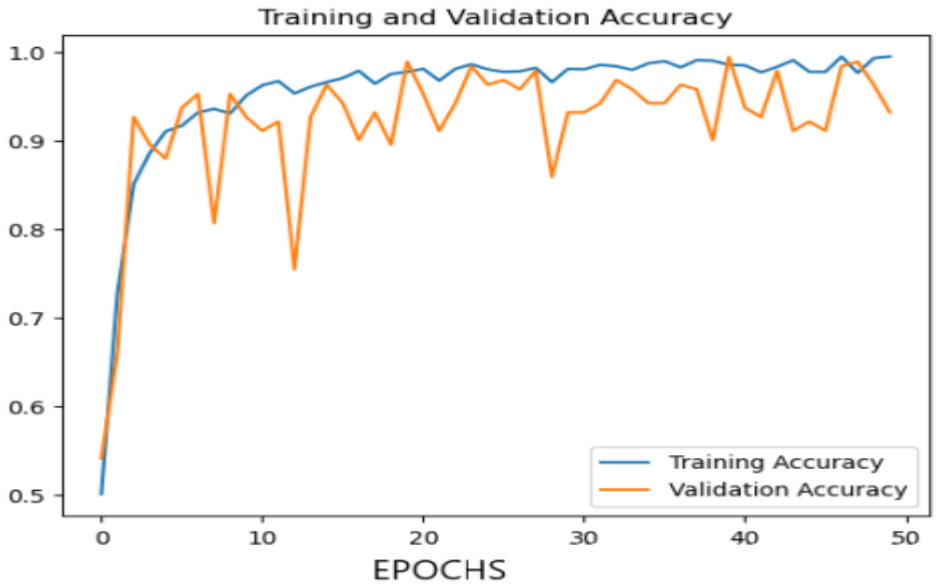
A dataset of high-quality images of potato plants with different types of diseases

Labels indicating the disease type for each image in the dataset

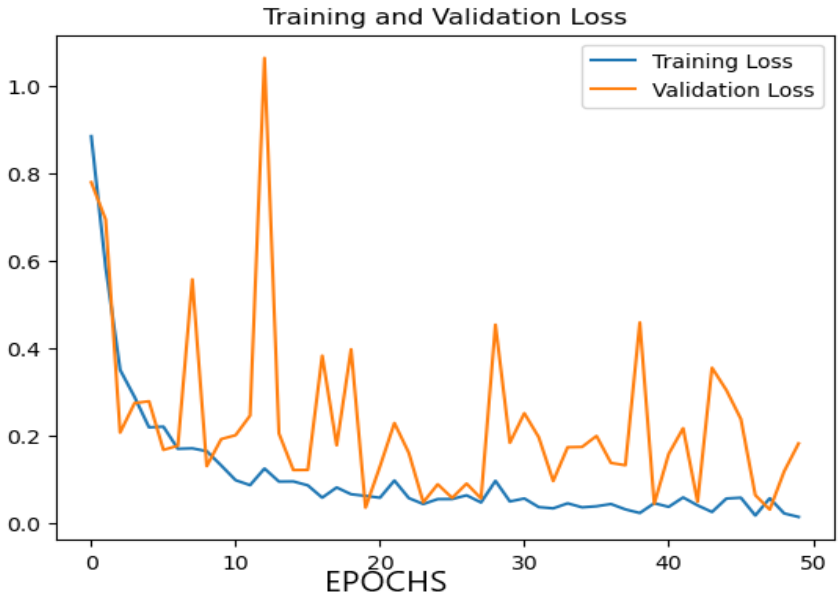
An image pre-processing pipeline for normalizing and augmenting the dataset

4. Result

Training & Validation Accuracy v/s number of EPOCHS



Training & Validation Loss v/s number of EPOCHS



Test dataset result

Actual: Potato___Early_blight,
Predicted: Potato___Early_blight.
Confidence: 100.0%

Actual: Potato___Late_blight,
Predicted: Potato___Early_blight.
Confidence: 94.83%

Test Cases:

Actual: Potato___Late_blight,
Predicted: Potato___Early_blight.
Confidence: 99.67%

Actual: Potato___Late_blight,
Predicted: Potato___Late_blight.
Confidence: 100.0%

```
loss: 0.3809 - accuracy: 0.9258
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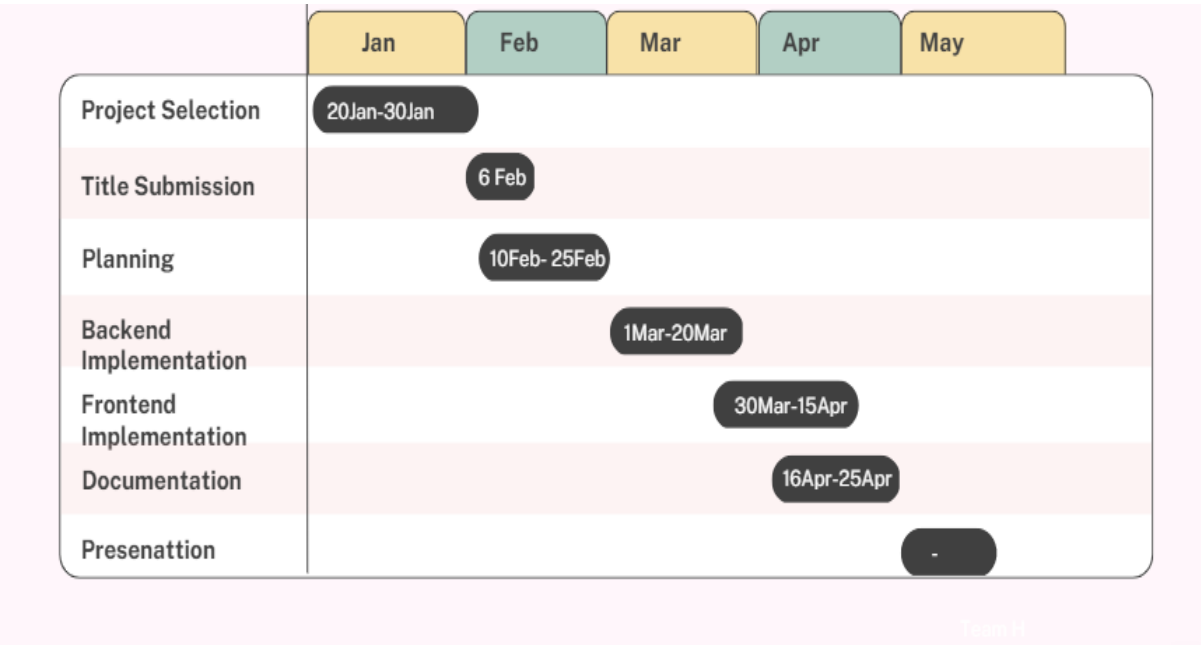
5. PERT Chart



Project Time Line

References

1. Das, S., Saha, S., & Biswas, S. (2020). Deep Learning-Based Potato Disease Classification System Using Convolutional Neural Network. Journal of Computational Science, 47, 101176. https://www.sciencedirect.com/science/article/pii/S1877750320305243
2. Ghosal, S., Nandi, M., & Mandal, J. K. (2020). A comprehensive study on potato disease classification using deep learning. International Journal of Advanced Intelligence Paradigms, 15(4), 318-335. https://www.inderscienceonline.com/doi/abs/10.1504/IJAIP.2020.107767
3. Kadam, S., & Bhosale, R. (2020). Potato disease detection and classification using deep learning. In 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE) (pp. 1-6). IEEE. https://ieeexplore.ieee.org/abstract/document/9235762
4. Singh, R., Kumar, M., & Kumar, N. (2021). An effective and efficient approach for potato disease classification using deep learning. Journal of Ambient Intelligence and Humanized Computing, 12(4), 3641-3651. https://link.springer.com/article/10.1007/s12652-020-02877-2
5. Vargas-Rodriguez, Y., Herrera-Morales, P., & Munoz-Rodriguez, F. (2020). Potato diseases identification using deep learning: A comprehensive review. Computers and Electronics in Agriculture, 175, 105573. https://www.sciencedirect.com/science/article/pii/S016816991931042X