Identification of Late Blight and Early Blight Diseases in Potato Using Image Processing Techniques: A Case Study

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Introduction

Potato is one of the highly demanded commercial crops that is cultivated majorly in the upcountry region in Sri Lanka. However, the average yield of potato is far below the potential yield as the crop is heavily affected by pest and disease attacks (Eeswaran et al., 2016). Based on several surveys under "Ruhuna Govi-Nena" project and the recent state-of-art findings, it is clearly revealed that lack of context-specific, complete and actionable information to make timely-quality decisions (Ginige et al., 2016) to prevent, detect and control pest and disease are major factors which reduces the potato yield. To check the feasibility of addressing this critical issue, this case study was conducted in selected potato fields in "Boragas" area in "Nuwaraeliya" district Sri Lanka.

Materials and Methods

The novel model is based on Bag of Visual Words (BOVW) and image clustering and classification. Inside the model first it extracts the features of more than 2000 verified and labeled images which was adopted from Plant Village Dataset of Kaggle (Emmanual, 2018) which covers two major diseases of potato which are Potato Late Blight (PLB) and Potato Early Blight (PEB) using SURF detector. Then extracted features are clustered using K-Means algorithm and the center points of the clusters are used to create the visual dictionaries (vocabularies) using frequency histograms. Finally, the symptom prediction of infected image was done through classification using Support Vector Machine (SVM) and nearest neighbor algorithms. As shown in the model architecture in Fig.1, two One Class SVMs are used to identify outliers: to identify non potato leaves and to identify symptoms other than PLB and PEB.

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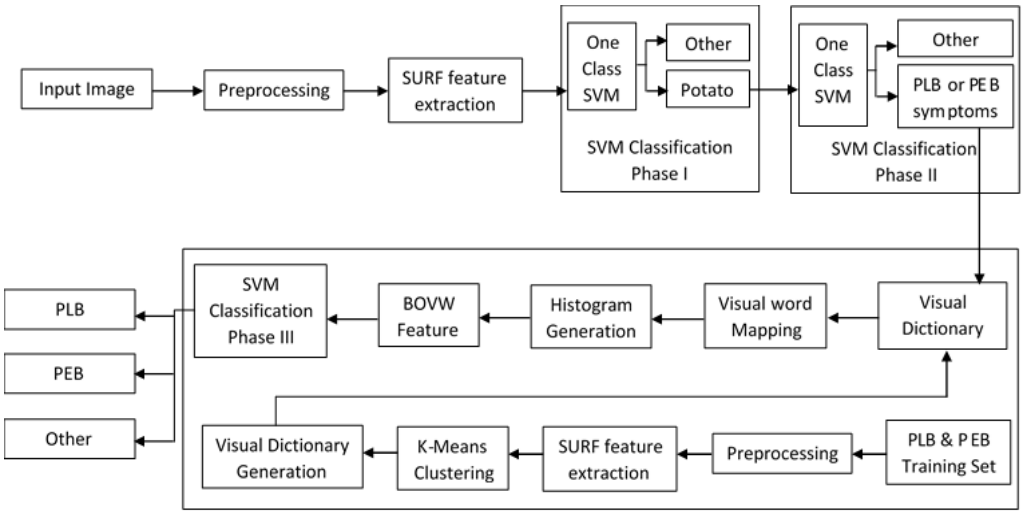

Figure 1: The model architecture

Findings

From the selected dataset 85% were used to train and 15% were used to test the model. The model is then iteratively trained and validated using cross validation where the 80% used for training and 20% used for validating from the original train set. Prediction model achieved over 95% accuracy with the test set. When model was tested with field images under controlled conditions where the infected potato leaves are extracted from the plant and capture one leaf at a time in a white color background the model achieved near similar accuracy level as the test set. When field images are with multiple infections and symptoms, multiple plants with infected leaves and other noisy conditions the model accuracy was reduced drastically and achieved accuracy between 60% to 90% in most cases.

Conclusion

The model was showing promising results in controlled conditions; therefore, we can embed this model into Govi-Nena mobile application for real time identification of PLB and PEB disease symptoms with improvements. The core areas to be focused and developed in the enhanced model are how to tackle multiple co-occurring pest and diseases in the same plant, differentiate the malnutrition and other problems with the pest and disease attacks and improve the disease identification ability in an uncontrolled environment by using a hybrid mechanism.

Keywords: *Early Blight and Potato, Image processing techniques, Late Blight*

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