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CNN based deep learning model for tomato crop disease detection

M. M. Gunarathna[1*] and R. M. K. T. Rathnayaka[2]

[1]Department of Computing and Information Systems, Sabaragamuwa University of Sri Lanka, Sri Lanka
[2]Department of Physical Sciences and Technology, Sabaragamuwa University of Sri Lanka, Sri Lanka
mmgunarathna95@gmail.com*

Tomato is one of the most commonly cultivated solanaceous short duration vegetable crops, grown in outdoor and indoor conditions, worldwide. However, unfortunately, many diseases affect these crops which have an impact on quality and the quantity of the produce, agricultural productivity, and causes considerable economic losses to the producers and to the contribution to the growth of the agricultural sector. Therefore, continuous monitoring of the crop is required throughout the growing stage to identify the diseases. The most traditional way of identifying diseases is naked eye observation, which is tedious and time-consuming. Today, advances in computer vision paved by deep learning have led to a situation where disease diagnosis is based on automated recognition. The main objective of this study is to develop an accurate tomato disease classification model which eliminates human error when identifying diseases. Due to a variety of similar disease and pathological problems, even experienced agronomists and plant pathologists often fail to recognize the correct disease. This computer vision system will assist agronomists in detecting a variety of tomato crop diseases. The proposed algorithm consists of four main steps; data collection, data pre-processing, CNN model creation, and evaluation of performance metrics. A leaf is a good indicator of the tomato's health. Therefore, tomato leaf images belonging to 10 different classes with a resolution of 256x256 were collected from the Internet to build, validate, and test the model. Collected images were normalized and image augmentation techniques were applied to increase the size of the training data set in the pre-processing phase. The CNN model of the study was built from scratch using the Keras library, which runs top of the Tensorflow backend. The model comprises four convolutional blocks followed by batch normalization, max pooling, and dropout layers. Two dense and flatten layers were also included at the end. A time-based learning rate scheduler was used with an initial learning rate of 0.001, momentum of 0.5, an epoch of 15 and a batch size of 27. The final model was able to achieve a training accuracy of 94% and a testing accuracy of 92%. This proposed system would encourage tomato cultivators to detect diseases at an early stage and start treatments without relying on experts. In the future, we hope to build an ensemble approach to classify plant diseases with real-time images towards the development of a decision support system.

Keywords: Automated disease recognition, Computer vision system, Tomato disease classification