Chapter 9

CHAPTER 9

CONCLUSION AND FUTURE WORK

9.1 CONCLUSION

Within the scope of this research, a robust DL model was created to correctly categorize leaf diseases and associated pests, and to advise on the most effective insecticides for managing crop yields. The first phase of the research developed the PDATFGAN model to create high-resolution leaf images by learning a coordinate manifold. This model comprised the PGAN, in which the generator was trained to generate high-resolution leaf image patches at each resultant spatial location by constraining each pixel's position and orientation. Those generated image patches were merged to obtain whole leaf images, which were then fed to the ShuffleNetV2, DenseNet121 and MobileNetV2 models for classifying them into healthy and different kinds of leaf diseases.

The second phase of the research work developed the PDATFEGAN model to fine-tune the generator for high-resolution leaf image generation. This model adopted PEGAN to formulate the adversarial learning procedure as an evolutionary problem. First, the PEGAN considered various adversarial objective functions by applying different mutation processes to minimize loss between the generated and actual image distributions. To find the best discriminator, the quality of images produced by the improved progeny was evaluated. Based on the image quality, weakly-performing offspring were excluded and the well-performing offspring were kept for consecutive training of PEGAN. So, high-resolution leaf images were generated by the optimal generator. Those images were classified by the ShuffleNetV2, DenseNet121 and MobileNetV2 models for leaf disease classification.

The third phase of the research work proposed a unified leaf disease and pest classification model to enhance crop yield. Multivariate information was taken into account in this model, including leaf images, soil characteristics, meteorological parameters, and pest information. The MFL-DCNN was trained on these datasets, and then the softmax classifier was utilized to effectively identify leaf diseases and pests.

The fourth phase of the research work proposed a hybrid use of the MFL-DCNN model in a recommendation system for pesticides based on the RSF framework. This model introduced RSF to create the rules by considering the multi-dimensional datasets, showing how leaf diseases, pests, soil, and climate are all interconnected. The developed rules may be used for the prediction and recommendation of suitable pesticides for leaf diseases and associated pests categorised by the MFL-DCNN model. Finally, the proposed models on the multi-dimensional datasets such as PVD, soil, pest, weather and pesticide datasets were implemented using Python 3.7 to measure their performance. Compared to state-of-the-art models and various variations of suggested models for simultaneous classification of leaf diseases and pests together with the pesticide recommendation, the experimental findings demonstrated that the PDATFEGAN with MFL-DCNN-RSF model achieved 98.93% accuracy.

The suggested approach may be utilized by farmers and government agencies to categorize images of leaves. The proposed model may encourage responsible decisions for the control and eradication of leaf diseases and pests by predicting the most effective pesticide for a specific crop in a given geographic region with different soil and climatic conditions. Besides, this model can guarantee that healthy plants have been cultivated by reducing the chances of over or inappropriate usage of pesticides.

9.2 FUTURE WORK

This proposed research can involve the following future enhancements:

- In the future, the proposed models can be extended using leaf images from other multiple species (Some examples are apple, corn, grape, etc.) and diseases (scab, black rot, rust, etc.) to enhance their generalizability
- Future study will investigate the influence of several pre-trained DCNN models on classification accuracy, including GoogLeNet, Xception, InceptionResNet, and EfficientNet.
- The usefulness of the suggested models may be analysed by extending them to categorise illnesses affecting other sections of plants, such as roots, stems, fruits, etc.

- The presented models may be used in the future to perform remote monitoring of leaf diseases utilizing mobile and online apps in conjunction with cloud services.
- Future work can be considered various stages of leaf diseases to provide proper solutions at each stage.