Conclusion and Future Scope

The method reported in the thesis can be used to design a soya bean expert system for farmers for the early detection of plant foliar infection, infection grading and getting the appropriate cure remotely. Through the thesis work, we have tried to highlight the problems associated with the cultivation of soybean and causes of low yield loss in the developing countries like India.

It has been taken-up six soya plant foliar diseases, namely; Rust, Bacterial Blight, Sudden Death Syndrome, Brown Spot, Downy Mildew, and Frog Eye, which are mainly responsible for significant yield loss; it has been proposed a fully automatic method for identification and classification by different digital image processing techniques and also to classify the disease severity level using five classes. It has been derived and development various new parameters and indices like DSI, IPR, DLP, which are subsequently used for disease level prediction.

The methodology has been implemented successfully and performance tested on a real set of soya leaf data. The result is quite convincing and wide adaptability in developing countries, where such information plays an important role for improvement in yield. The proposed method uses mobile cams for capturing the diseased images and does not require any kind of special training and sophisticated capturing devices. The proposed method is (i) fully automatic for ROI calculation, background separation and parameter
evaluation (ii) disease independently, (iii) low cost and possibility for the wide usability in field conditions, (iv) simpler segmentation method and more advanced parameters are used. We have developed a fully automatic color image sensing based system for classifying the four most dangerous soya bean foliar infections, namely bacterial blight, frog’s eye, brown spot, and soya bean rust. All four infections have similar color shades and are confusing for a non-plant pathologist. An algorithm was developed to find the refined lesion texture histogram and apply the DCT on statistical features of RLTH, followed by a normalization process. We develop a ST-NDCT based hybrid feature descriptor for lesion areas, and proved the suitability of using the same for classifying the infections under consideration.

The ST, ST-DCT and ST-NDCT based feature descriptors have been used for cataloguing and a performance comparison carried out. The superiority of ST-NDCT hybrid descriptors over the others has been proved. We have introduced two methodologies to solve the soybean plant foliar detection problem. The first method is based the retrieval concept, whereas the second one is based on the classification concept. Both the approaches are supervised in nature. We also presented two feature descriptors HIST and WDH and also explored several other colors and texture based feature descriptors such as BIC, CCV, CDH, LBP, SSLBP, LAP and SEH.

All the feature descriptors are tested using both the methodologies. In retrieval approach, the system retrieves the top matching images from the database for a query image using some similarity measure applied over its feature descriptors and assigned the category of which most images are present in the retrieved images to the query image. We have tested 6 different similarity measures, namely L1, Euclidean, Canberra, Chi-square, Cosine and D1. In the classification based methods, first the system train a classifier with the feature
descriptors of the training images and finally classify the test images to a category using trained classifier and feature descriptor of the test image. In this method, we have tested three classifiers namely SVM, KNN and PNN. From the experimental observation, we conclude that the BIC feature descriptor is having the better performance as compared to the other tested feature descriptors for both recognition methods i.e. retrieval and classification.

The L1 similarity measure are more time efficient as well as producing better results as compared to the other used similarity measures for retrieval based recognition. The KNN classifier is having better classes’ seperability with the BIC descriptor for the classification based recognition method.

In the future, the proposed methodology can be integrated with other yet to be developed, methods for disease identification and classification using color and texture analysis to develop an expert system for early soya plant foliar disease warning and administration, where the disease type can be identified by color and texture analysis and the severity level estimation by our proposed method since it is disease independent. The performance of the system can be improved in the future by using advanced background separation methods to separate the leaf object from a complex background.

More infections like downy mildew (DM) and sudden death syndrome (SDS) can also be classified along with the BB, FE, BS, and SR by using the proposed ST-NDCT based cataloguing algorithm, but due to non-availability of suitable and sufficient training and test data at present it has not been incorporated into the present work. The similar methodology can be applied to other plant foliar infections and early warning systems for
rice, cotton-crops, fruits, vegetables and beans, etc. The use of other cataloguing methods can be exploited to improve the accuracy of the system in future.