Chapter 7

Conclusion and Future Scope

7.1 Conclusion

Apple is a very important produce for the economy of India which have played a very important part in our economy in past ages but not as abundant in the present times due to various diseases effecting the crops [166]. Thankfully, recent awareness concerning apple agriculture is emerging and what other enriched way there is than presenting an amenity that can be used by any farmer through their mobiles [167]. As it is an era of digital technology, therefore one should make the maximum use of it in all the sectors. Therefore, machine learning came into play [168], [169]. In the proposed work, the prime focus is on apple diseases apple scab and marsonina coronaria and produce different results on disease prediction using artificial intelligence approach. This proposed research will allow farmers to get effective help out of it. Combination of feature extraction like texture with different classifiers has added accuracy to the research. This investigation is carried out to study efficiency of image processing for disease detection in apple crops.

The digitally captured image having live background is initially filtered using gaussian filtering method. After the image has been filtered, image enhancement is done using a novel enhancement algorithm known as binary preserved dynamic fuzzy histogram equalization. Then performance evaluation of the novel algorithm is matched with the already existing enhancement systems. Different performances metrics like contrast improvement index, peak signal to noise ratio, clarity index and normalized absolute error are considered for the comparison. BPDFHE enhancement technique outperforms in all the performance evaluation metrics. The enhanced image is then segmented to get the desired ROI. Removing the background from the leaf plays an important role in extracting features [170]. A novel algorithm for the background removal of live images is proposed.
After removal of background, k means clustering process is implemented on the background removed images further to classify it into different clusters. The proposed algorithm gives better results which were unable to compute using k means algorithm alone. It is observed that performance metrics for segmentation like jaccard index, dice co-efficient and accuracy of proposed segmentation algorithm comes out to be better than using k means clustering procedure alone for the segmentation of ROI. The textural features of the segmented ROI are then extracted. For extraction of textural features, 1st order textural features and 2nd order GLCM features are calculated which included mean, variance, skewness and kurtosis as first order textural features and contrast, correlation, energy and entropy, smoothness and homogeneity as second order textural features. The features are then used for the classification of two disease apple scab and marsonina coronaria.

Four different classifiers that are used to classify the diseased leaves are naive bayes, decision tree, support vector machine and k nearest neighbour. From the observation of the four classifiers, it is found that k nearest neighbour outperforms as compared to other three classifiers. For this all the performance metrics like accuracy, sensitivity and specificity, precision, f-measure, goodness mean and area under the curve for k nearest neighbour comes out to be better than the other classifiers giving an accuracy of 96.41 which is 4.3% better than SVM, 4.3% better than decision tree and 43.8% better than naive bayes classification algorithm.

### 7.2 Future Scope

As various factors like illumination, background is the governing aspects in case of apple disease, consideration of these factors will lead to accurate results. Apple diseases like alternaria, fire blight, cork spot, powdery mildew, black rot and phytophthora rot may be considered for future disease detection. In this research, specifically the two apple leaf diseases i.e. apple scab and marsonina coronaria are chosen, as these two are found to be the main diseases effecting the crops in Himachal Pradesh and Uttarakhand states of
India after discussing the same with the help of agriculture department of Himachal Pradesh. For real time solutions, there is a need to develop the mobile based applications which will guide the farmers to detect the disease in apple leaves on their own.