7. Conclusion and Future Scope

7.1 Conclusion:

Non proliferative diabetic retinopathy (NPDR) is an early stage of diabetic retinopathy. In NPDR swelling in the blood vessels are occurs due to high sugar level. After swelling blood is leak in to the retina. NPDR is categorized in to three stages that are mild, moderate and severe NPDR. NPDR causes sudden blindness. From this research we can prevent the people from the vision loss. For detection of NPDR we are using fundus images. These fundus images are captured by the fundus camera. This technique is totally non-invasive technique. We have used standard database like HRF, DIARETDB0, DIARETDB1, and STARE. Firstly we have localized the optic disc and macula. To detect abnormality in the retina we have extracted retinal blood vessels, microaneurysms and exudates. For localization of OD and Macula we have used HRF, DIARETDB0, DIARETDB1 database which are publically available. For localization of OD we have done preprocessing. In that we have done channel separation, image enhancement. Then we have applied morphological operation. Then Image intensity adjustment is done. Then we have applied wavelet decomposition, and localization of OD is done. We got 92.24% accuracy using HAAR wavelet and 96.02 % using DR wavelet. For Macula localization we have done the preprocessing then applied thresholding and decomposition using HAAR wavelet and DR wavelet. We got 86.85 % accuracy using HAAR wavelet and 92.24 % accuracy using DR wavelet.

For Extraction of NPDR lesions and Blood vessels we have used publically available databases STARE, DIARETDB0, DIARETDB1 databases. For Extraction of NPDR lesion firstly we have done preprocessing. In that we have done channel separation, image enhancement and optic disc removal. Optic disc removal is important step because we have to extract exudates from retina and structure of optic disc and exudates are same there may be confusion in between optic disc extraction and exudates extraction. After preprocessing step we have extracted microaneurysms, exudates and retinal blood vessels using HAAR wavelet and new designed
(DR) wavelet. After extraction of lesions and retinal blood vessels we have done the classification using SVM and KNN classifier. Accuracy is calculated using confusion matrix. We found that new designed wavelet (DR) gives the result as good as HAAR wavelet. And we got more accuracy using KNN classifier. We got 91.39 % accuracy for HAAR wavelet and 90.18% accuracy for DR wavelet using SVM. And using KNN classifier we got 97.40 % accuracy for HAAR wavelet and 97.73% accuracy for DR wavelet.

7.2 Limitation:

This developed algorithm is limited for the particular lesions that are microaneurysms, exudates and abnormal blood vessels. The diabetic retinopathy is having more number of lesions that are hemorrhages, cotton wool spot, drusen, macular edema etc. These lesions are not considered by this algorithm.

7.3 Contribution of the research:

Major contribution of this research work is summarized as

1) We have designed new wavelet filter named DR.
2) Localization of Optic disc using HAAR wavelet and new designed (DR) wavelet is done.
3) Localization of Macula using HAAR wavelet and new designed (DR) wavelet is done.
4) Extraction of Microaneurysms and Exudates using HAAR wavelet is done.
5) Extraction of Microaneurysms and Exudates using new designed (DR) wavelet is done.
6) Extraction of retinal blood vessels using HAAR wavelet is done.
7) Extraction of retinal blood vessels using new designed (DR) wavelet is done.

7.4 Future Scope:

In future we will extend this algorithm with all diabetic retinopathy lesions that are hemorrhages, cotton wool spot, drusen, macular edema etc. We will also work on the cardiovascular diseases using Fundus images.