ABSTRACT

Diabetic retinopathy (DR) is one of the leading cause of blindness resulting from long term diabetes. Prolonged diabetes weakens retinal vessels and capillaries causing loss of vision. The subsequent blindness caused due to DR can be considerably reduced if DR is detected in early stages during periodic screenings. In recent years to reduce workload on medical professionals and to extend screening and diagnosis facilities to remote and rural areas, the potential ability of computerized algorithms for analysis of retinal images is being extensively investigated. In this thesis, we have identified and explored following issues related to retinal image analysis.

1. Retinal image analysis is a fundamental step in diagnosis and monitoring of diabetic retinopathy in order to follow the evidence/progress of DR. In this work feature based algorithms for registration of retinal images are proposed. Vessel bifurcation points are used as intrinsic control points for registration. In the first algorithm the vessel bifurcation points are represented using moment invariants features. The dimension of the feature set is minimal and the algorithm exhibits better registration accuracy. Further in the second technique for retinal image registration vessel bifurcation points are represented using directional gradient features.

2. Automatic segmentation of retinal blood vessels is essential in development of the computer assisted diagnostic systems for DR. A retinal vessel segmentation technique based on pixel gradient is presented. Prominent grayscale intensity variations are present at the retinal blood vessels. These local changes in grayscale at the vessel pixels with respect to background pixels is the gradient representing retinal vessels. In the second technique for segmentation of retinal vessels gradient co-occurrence features of matched filter enhanced retinal image are used. Along with primary and secondary blood vessels, gradient co-occurrence features enhance the retinal capillaries (tertiary vessels) as well.

3. Hard exudates are a visible sign of DR and also are a major cause of vision loss in the non-proliferative forms of DR. A feature based method for classification of hard exudates has been developed.

The experimentation for the proposed algorithm for retinal image registration using moment invariants features has been carried out on DRIVE database, STARE database, VARIA database and database provided by local government hospital, Pune, India. The registration algorithm using directional gradient features is evaluated on DRIVE and STARE database. The performance of the blood vessel segmentation algorithms are evaluated on DRIVE database, STARE database and database provided by local government hospital, Pune, India. The experimentation for the technique for classification of hard exudates is performed on DIARET DB1 database and MESSIDOR database.