ABSTRACT

Colour fundus images of the human retina are increasingly used in the diagnosis and treatment of several eye related pathologies and in ailments such as diabetes, hypertension and arteriosclerosis. The effectiveness of treatment for many eye related diseases lies in the early detection through regular screenings. But, screening a large number of patients is a significant problem faced by medical practitioners in populous developing countries like India. Moreover, there are large influences of human errors and subjectivity on the results of inspection by a human expert. This opens up the possibility of applying digital image processing techniques in fundus images to facilitate and improve diagnosis in different ways. Thus, computer aided analysis and automatic detection of pathologies in retinal images play a major role in modern diagnostic procedures and screening systems. Reliable and robust extraction of retinal features like optic disc, macula and vasculature is a prerequisite for subsequent retinal image analysis and processing since these are the predominant and most stable structures appearing in the retina. However, automatic segmentation of retinal images is a complicated affair since retinal images are often noisy, poorly contrasted, and there are a wide variations in orientation. Many researchers are performing investigations to

make diagnosis automatic to reduce the ophthalmologist' labor and to increase the accuracy. To detect the anatomical features such as optic disc, macula, and vasculature in fundus images, there exist many algorithms. However, all the methods currently in use are either less accurate or time consuming. Hence, an attempt is being made to develop suitable algorithms that are automatic, reliable and swift.

The proposed algorithms perform the task of automatic detection and extraction of these landmark anatomical features reliably and accurately. Further, these may be extended to detect abnormalities like exudates, hemorrhages and micro aneurisms, which are key features for the early detection of pathologies like diabetic retinopathy automatically by the computer. These algorithms are based on a novel approach combining contrast limited adaptive histogram equalization (CLAHE), bitplane decomposition and mathematical morphology. Bitplane decomposition and mathematical morphology forms the heart of all the algorithms providing a computationally simple yet reliable feature detection and extraction method in colour fundus images. Moreover, unlike most existing algorithms available today, these algorithms work independently and do not require a prior knowledge of other retinal features. Hence there is little error accumulation. In this research, the image processing is carried out in MATLAB environment. These algorithms have been evaluated by comparing against gold standards on three publicly available retinal image databases namely

MESSIDOR database, STARE database and DRIVE database and robustness with respect to changes in the parameters of the algorithms have been examined.

With the algorithms developed in this research, it becomes easy to conceive diagnostic tools that may play a major role in mass-screening and monitoring of most eye related pathologies such as diabetic retinopathy.