Introduction:

Diabetic Retinopathy is one of the leading causes of Blindness. An estimated 346 million people worldwide have diabetes mellitus (DM) with more than 80% of those affected living in low and middle-income countries. Diabetic retinopathy (DR) and diabetic maculopathy (DMac) are the most common micro vascular complications of diabetes mellitus and remain the leading cause of legal blindness in the working-age population in western societies. Despite all efforts to diagnose DM early and treat aggressively in order to prevent complications later, over 60% of patients will develop some degree of DR/DMac within 20 years of diagnosis. Unfortunately, around 40% of patients already have established DR at the time of diagnosis. DR is a progressive disease; diagnosing it early provides the best chance to treat effectively and to maintain good vision.

In any Diabetic Retinopathy diagnosis program, the total time taken is 10 minutes for dilation and approximately 10 minutes for diagnosis by a human expert. Thus this is a time consuming and laborious process. With the advent of computers, many of the diagnosis tasks are facilitated using some kind of image processing algorithms or the other. This has resulted in faster, accurate, and reliable diagnosis.

In this work, we are focusing on optimizing the diagnosis period which may be of utmost useful during camp programs on Diabetic Retinopathy screening and also during day to day
routine work. To do so, we are trying to develop software for the automated diagnosis of Diabetic Retinopathy using fundus images. Automatic screening will help the doctors to quickly identify the condition of the patient in a more accurate way. The macular abnormalities caused due to Diabetic Retinopathy can be detected by applying morphological operations, filters, thresholds and other image processing techniques on the fundus images of the patients.

**Objectives:**

The primary aim of this project is to develop software that will be able to identify patients with Diabetic Retinopathy from either color image or grey level image obtained from the retina of the patient. These types of images are called fundus images. The different Diabetic Retinopathy abnormalities that are of interest include micro aneurysm, haemorrhages and exudates. Detection of these abnormalities helps in determining whether the person is infected or normal.

The secondary aim includes developing a MATLAB based Graphic User Interface (GUI) tool to be used by the ophthalmologist in marking fundus images. The marked images are to be used for the development of DR grading and database system for this present and future work.

**Methodology:**

The methodology consists of 5 steps and the flow chart is as shown below.

![Flow Chart]

**Pre-processing**

The retinal image sample of the patient is acquired from database. This RGB or colour image is pre-processed such as extracting ‘G’ plane from RGB background approximation,
resizing etc. The pre-processing processes the given RGB image to the required format in order to carry out different steps easily.

**Optical Disk Segmentation**

Optical Disk Segmentation can be done using thresholding of the G plane of RGB image, this result in the optic disk centre point and exudates. Then using maximum area criteria, we detect the complete optic disk and remove it from the image.

**Fovea detection**

During optic disk segmentation, the diameter of the optic disk is calculated. Using this diameter, we locate the fovea region in the image which is located approximately around 2 times the diameter of the optic disk. The fovea is a dark region and once a small region of it is detected then using the connected components logic, the entire fovea region can be determined.

**Exudates detection**

The exudates are detected by using the operations such as median filtering, clustering etc. Since optic disk is already removed from the image, all remaining high intensity components correspond to exudates.

**Severity classification**

Severity classification is done by analyzing the exudates (detected in step 4) in the fovea region. Thus more the exudates approaching the fovea region, more is the severity of DR otherwise less. To make this system user friendly, a GUI is made so that it’s easy to operate and analyze the outcome of the process without worrying what is happening inside the system.

**Conclusions**

In line with the aim of the project work, we were able to develop a MATLAB GUI based system called ESS (Eye Screening System) which is able to detect Diabetic Retinopathy caused due to hard exudates only with the sensitivity of 80% tested on 10 images. Furthermore, MATLAB based GUI was developed for this work, which can be used by ophthalmologist for the diagnosis of Diabetic Retinopathy.
Scope for Future Work:

To screen Diabetic Retinopathy patient from uninfected ones there is a need to detect MAHM abnormality as well which we are still working on. The idea can be extended to detect other diseases which affect the retina of the person such as Glaucoma, macular degeneration etc. Then these programs must be dumped into a DSP processor which will be integrated with the fundus camera which makes a complete independent system to detect retinal disorders. With the advent of technologies retinal images can be taken by using some smart phones thus if these disease detecting algorithms are dumped into cell phones than people can diagnose themselves at home only.