INTRODUCTION:

1.1 Rear view Mirrors are used in the vehicles (both two wheeler as well as four wheeler) for the safety of the rider in case of two wheeler and driver in case of four wheeler. In the case of four wheeler, there are two types of rear view mirrors i.e. inside rear view mirrors (flat type) and side view mirrors (Convex type). In the case of two wheeler, there is only one type which is side view mirror (Convex type). These mirrors provide the rear view to the Rider/driver and thereby he can take precautions and drive safely. Since safety of the driver is at stake, the quality of these rear view mirrors is of utmost important. So the authorities have laid down some guidelines in terms of some key parameters of the rear view mirrors such as Distortion factor, Radius of curvature, Reflectance etc. These guidelines specify that the rear view mirrors manufactured by various manufacturers should be within certain limit and then only such rear view mirrors which satisfy these limits can be fitted on the vehicle. Some of the limits are given as below.

For side view mirrors (Convex type), the distortion factor should be less than 5% where as for inside rear view mirrors (Flat type), the distortion factor should be less than 2%.

The reflectance of inside rear view mirrors (Flat type) should be more than 90% and that of side view mirror (Convex type) should be more than 85%.

The radius of curvature parameter is applicable to only side rear view mirrors (Convex type) and depending on the type of vehicle (i.e. the view angle required) such as two wheeler, Car, Tempo, Light Commercial vehicle, Bus, Truck etc. the ranges of radius of curvature of these different vehicles are different. Typically, for two wheeler, the rear view mirrors are required to have a radius of curvature of 1400 with a tolerance of -15% and +5%.

For LCV, the radius of curvature required is 400 with the same tolerance of -15% & +5%. 
1.2 As seen in section 1.1, the quality of these rear view mirrors determine the safety of the driver or rider. So accurate measurement of these parameters becomes a issue of paramount importance. Also the acute margins of tolerances allowed for the mirror manufacturers makes it essential for having a facility to measure these parameters accurately. After talking to various manufacturers of rear view mirrors, it was shocking to find out that no such facility existed in house for measuring these critical parameters and what these manufacturers used to do is, to collect some samples of these rear view mirrors and send them to a nodal agency such as Automotive Research Association of India (ARAI) for testing for these parameters which not only used to charge them heftily but also used to take a lot of time in carrying out the testing and handing over the report. Also the entry of Multi national companies (MNCs) in Automobile industry and the stringent procedures of 100% checking under ISO 9000 make it mandatory for these manufacturers to have in-house facility of measuring these parameters and provide a report to their suppliers. So there existed a need of a low cost facility for accurate measurement of these critical parameters.

In the absence of such a system, the manufacturer used to take a photograph of the image of a screen containing 8 concentric circles separated by a distance of 10 mm from each other and then the operator used to manually measure the distances between the circles by a ruler and note down the readings and then generate a report. This system depends heavily on the human operator’s skills in making accurate measurement and any mistake in the measurement and noting down the readings can be very dangerous as the safety of the user is at stake. Also because of the manual process of measurement and report generation, the whole process was not consistent and was time consuming which was leading to decrease in productivity.
1.3 Since most of these parameters are concerning with the vision of the driver i.e. Distortion factor and reflectance, we thought of using a video camera and image processing based system which will be based on a low cost Black & white CCD Camera, a suitable lens, Frame grabber card, a Desktop PC, Related Software and a mechanical arrangement for mounting CCD camera & inserting the sample mirror, Lighting arrangement. The advantage of such system are as follows:

- It is based on a general purpose PC and Windows operating system. So it will be easily acceptable by the operators as no special training is required to operate it.
- Since it is general purpose and not dedicated and since the software is developed in-house, it is easily upgradable or can be modified in case of any changes in the specifications of the rear view mirrors or any new introduction of new series of rear view mirrors for a new vehicle.
- When not in use, the desktop PC can be used for some other applications or other purposes which makes excellent return on investment for the manufacturer.
- Since it is CCD camera based, it will be more accurate in the measurement of these parameters. Also the system will be consistent in the measurement as the human element in the measurement process is eliminated.
- Since the system is PC based, by attaching a low cost printer and writing a software for report generation, the report can be instantly generated and delay in dispatching the packed goods can be minimized thereby increasing the productivity.
- A common measurement system can be used for different models of different suppliers and report can also have the names of these models. This is possible by programming the
system accordingly.

Thus the problem statement of our thesis has evolved which is nothing but ‘Development of CCD camera based Image processing system for the measurement of some of the parameters of rear view mirrors’.