## CGSM Term Project

## An Elementary Study on Image Processing and Pattern Recognition

Manipulation of Images using various Filters and Transformations is known as Image processing. Image, as it is represented in computers, is nothing but a matrix of intensities values for the three layers, namely red, green and blue. Hence when it comes to definition of Image processing, it is nothing more than mathematical operations done on these matrices.

Pattern recognition in images aim at imparting abilities of recognizing patterns to machines. This is realized with the help of image processing tools and other algorithms.

## **Image Processing**

Image processing itself has got vast applications in various fields of Science and Technology. Apart from the problem of pattern recognition, it finds its application in other important issues like removal of noise from signals & data, pre-processing of signals, analysis of data obtained from various studies in fields of astronomy, geology, spectral analysis, and many other branches of science.

In the present project we have tried to demonstrate the functions of some very elementary tools in Image Processing. The functions that we have incorporated in our project include Sharpening, Diffusing, Smoothening, Emboss, Solarizing, Grey-scaling and finding gradients in images. Though very simple, these tools may often turn out to be very useful for various applications. For example, Smoothening tool is often used in display devices to convert the sharp images produced by computers into ones comfortable for viewing. On the other hand Sharpening is used to increase contrasts in blurred images.

Another important tool that we have implemented in our project is Hough's Transformation. This tool can turn out to be extremely useful when it comes to Pattern Recognition. With the help of this tool we can actually make a machine 'recognize' straight lines or collinear points in an image. Hough's transformation transforms points in a binary image to what we call a 'Hough Space'. The intensities of points in the Hough's Space in turn give an idea about the collinear points in the Image.

## Pattern recognition

Pattern recognition has got vast applications in many modern fields of Technology. In fact, it may be said that Pattern Recognition forms the basis of Artificial Intelligence. Robotics and Autonomous systems extensively use the process of pattern recognition for deciphering the data and signals obtained by them from sensors, and hence make decisions accordingly. Among other common uses of Pattern Recognition are OCR

(Optical Character Recognition), Voice recognition, etc. Pattern recognition is also used vastly in fields of medical science, information technology, etc.

Though standard Image Processing tools might have come very handy for the purpose of our Project's Pattern Recognition section, we preferred to develop our own algorithms because of the time constraint. Moreover, the standard algorithms which we came across were difficult to be implemented in this short period of time.

While developing our algorithms, we had to consider the efficiency, time complexity and ease of implementation and debugging of the algorithms.

Our algorithms have been inspired by the analysis of the way in which human brain attempts to recognize a new pattern to find the closest match with the database of patterns previously stored in it. Whenever a new pattern is encountered, the algorithm tries to mark some characteristic points in the pattern, remembers the pattern local to those points, and the relative positioning of those characteristic points. The algorithm estimates an error between the input pattern and the database patterns and makes decisions accordingly.

However, there are possibilities for further development of the algorithm. A good method for enhancing the efficiency and time complexity of the algorithm is the implementation of Neural Networks along with the present algorithm.