Chapter 1

Introduction

1.1Overview

Due to high rate of road accidents speed control has become the need of hour. Measures such as traffic management , improving quality of roads can pose a way to avoid road accidents.

Drivers always keep on blaming road conditions and equipment failure for the road accidents. As they never blame over speeding and rash driving as the cause . However, the primary cause is implicated behavior of the driver . almost all of the drivers exceed speed limit at any point of their life only few of them agree to committing this offense often . Thus reducing speed of vehicles becomes an important part in providing accidents. And this will reduce number of victims . In the recent years many researchers addressed traffic problems, attempted analyze the several factors that has a influence on driver behavior. Many researchers has worked on other part that involves queuing theory and equations of mathematical physics in traffic management with an attempt to build new algorithms .

Some researchers also worked on using improved sensing technologies in many systems to provide users with information about the traffic thus reducing fraud and theft cases. Some researched had used global positing systems , sensors that works on RADAR, or even digital cameras for calculating vehicle speed and amount of traffic flow on the road to check against over speeding . as a outcome of previous researches huge amount of money , time and effort has been spent on calibrating operations of Large Scale Traffic Control Systems .

To ensure decline in road accidents speed control techniques such as speed using RF transceiver, automatic braking systems, Camera based speed detection, RFID technology based detection are implemented. However the existing techniques still not efficient to reduce the number of accidents. Hence there urgent need to implement **Intelligent Speed Adaptation (ISA)** which provides its user the efficient monitoring , registering and reporting the speed of the vehicle which exceeds the limit.

So, in this research we propose a real time video surveillance system for automated speed detection and law enforcement using automatic number plate recognition system uses image

processing technique and is easily implemented using MATLAB. System measures the speed of vehicle on curved path as well as on linear path . once the vehicle is found over speeding the system captures its image at an instant of time and returns the number of license plate.

The research uses various concept of image processing and tools of matlab to detect a vehicle under the range of high resolution camera to retrieve its number plate . the research work is proven with implementation on hardware set up which makes it a real time solution for commercial traffic control system .

1.2 Objective

In this research work a real time technique for vehicle speed detection and automated number plate recognition using image processing is presented Old methods for speed detection techniques includes radar- or laser based devices to measure speed of vehicles such techniques are comparatively more costlier than a still camera. In this a image is captured of moving vehicle and is used for estimating its speed as well as for automated number plate recognition . When the moving object is running on road because of the relative motion of the camera and moving vehicle / object in the camera exposure time causes motion blur in moving region of image . This system aims at provide visual solution for speed estimation of object in motion. It detects number plate automatically by capturing the frame of an object in motion .

A target region is approximately set under high resolution camera range is first segmented by taking the current frame and parameters that causes blur are estimated from sub image. De-blurring of image is done which is used to derive some other parameters affecting the quality of image . Labels are defined on all connected components which helped in obtaining the centroid of the moving object Finally, the speed of vehicle / moving object is calculated using various matlab functions and is based on the imaging geometry and camera pose of the image. Previous Experiments have predicted estimated speed within accuracy of actual speed or real speed for both highway as well as local traffic .

Apart from conventional “Interceptor”, mobile units or law enforcement units that uses sensor based speed detection system we propose to build a stationary single camera system mounted on traffic light poles or road light poles or at probable suitable locations on

important roads with heavy traffic which enforce traffic speed laws by speed detection and automatic number plate .

Features of the research work are as follows :

- Proposed unit is a stationary unit in form of single camera mounted on poles or traffic light or any other suitable location that detects the speed of moving objects .
- In case of over speeding by vehicles buzzer alarms for intimating interceptor or any other law enforcement unit. LCD display the of moving object.
- This system focuses on finding speed of vehicles on curved path as well as on linear path .
- New algorithm developed can measure speed of more than one vehicle at any point of time .
- System also captures the frame of moving object which provides us with snapshot of moving object at a particular instant.
- Automated Speed detection technique is integrated with law enforcement using automated number plate recognition . while detecting a vehicle crossing speed limit system by using number plate recognition technique displays the number of speed violating vehicle and same can be communicated to the end user of the vehicle.
- This system may reduce manpower involvement in traffic management systems.
- This system brings transparency in traffic management system.
- This system when used on commercial scale proves to be a helping hand to traffic police in managing traffic as well as maintain law and order by controlling fraud cases.

1.3 Speed detection technologies

At present speed detection is achieved by use of speed sensors . The goal of speed detection is to develop varies methods that government agencies can implement.

The most common methods include RADAR and LIDAR devices to detect speed of the vehicles .

1.3.1RADAR (Radio Detection and Ranging)

A RADAR device sends a radio signal to moving object the signal which reflected is then received by a receiver. The traffic radar receiver calculates the difference of frequency of the original and reflected signals and converts it to find the speed of moving vehicle.

1.3.2LIDAR (Light Detection and Ranging)

LIDAR reports the time a light pulse takes to cover a distance from the LIDAR gun to the vehicle and to return back. LIDAR can quickly estimate the distance between the gun and vehicle. After making several adjustments it determines the speed of the vehicle.

1.3.3Ultrasonic detectors

Ultrasonic sensors are available which are used for speed detection . they work by transmitting ultrasonic energy and measure the amount of energy reflected . such type of sensors are common in United States.

1.3.4Microwave detectors

Such detectors operate by measuring the reflected beam of light from target vehicles in the field of view . The advantage of using detectors is that it is a mature technology which has been used in past military applications . these detectors are common in Europe.

1.3.5Passive acoustic data arrays

An array of microphones is used to estimate the vehicle speed. The signals from the microphones are processed to obtain information about vehicle speed.

1.3.6Piezoelectric detectors:

Piezoelectric detectors are very accurate in detecting vehicle’s speed, with a drawback that it does not detect presence of a stationary vehicle. Besides drawback it is commonly used .

The methods listed above use active devices that are comparatively costlier than a passive camera. In addition using RADARS it becomes necessary to integrate fast and high resolution imaging devices to capture images .

1.4Automated number plate recognition

Automated number plate recognition is unique characteristic of optical character recognition . License plate recognition – a technology that allows user to read automatically the registration no. of vehicles. LPR [License Plate Recognition] is an image processing based technique that identify number of vehicles. This technology has its advantage in various in traffic management and security management .

1.4.1Basic Elements of LPR:

LPR systems comprises of following units :

- **Camera** - takes the images of the moving object.
- **Illumination** - a specific amount of light which enhances the number plate both in day and night .
- **Frame grabber** – It is an interface between computer system and camera , allows reading of the information from image .
- **Computer** – basically a PC that runs with a well supported operating system . The LPR application is run which controls the system input image analyze and identifies the number of the plate to interface it with other different applications .
- **Software** – package of application and recognition for plate detection. Commonly used package is DLL
- **Hardware** – Comprises of various ports used to interface the external world
- **Database** - The data is saved on a local database or it may be transmitted on a network sometimes. This type of data includes the recognition results in the numbers from plate of vehicle and (optionally) the image of vehicle and some times the driver image too.

Figure 1.1 License Plate Recognition System

1.5 Research contribution

The research contributions of this dissertation give a video surveillance system for speed detection of vehicles and number plate recognition using image processing The system aims at provide visual solution for speed measurement of moving object from a single mounted camera which replaces old sensor based speed detection method . System detects the moving object with in camera view. Labels are defined on all connected components which helped in obtaining the centroid of the moving object Finally, the vehicle speed is calculated using various matlab functions and is based on the imaging geometry and camera pose of the image. The work focuses on calculation of speed on linear as well as circular / radial path . it can detects speed of many vehicles at any point of time . Number plate recognition uses optical character recognition for displaying registration number of license plate . It detects the image of vehicle along with number plate automatically by capturing the frame of an moving object. This type of work implemented by image processing system using MATLAB.

1.6Thesis Outline

Thesis outlines can be discussed from next chapters and will continue with great and vast approaches to implement:

Chapter-1 The brief overview of video surveillance system for speed detection of vehicles and automatic number plate recognition techniques and their comparison with old speed detection methods . New novel approach for such system and objective of the thesis are laid.

Chapter-2 Describes the Literature survey about thesis topic means i.e explaining what work already had been done apart from previous work the literature survey represents the need of this topic and basic outlines.

Chapter-3 Now moving further to the Experimental setup of the proposed system and hardware details of this system.

Chapter-4 This chapter discuss the Procedures adopted and development techniques of proposed system.

Chapter-5 In this chapter have discussed the methodology for implementation of experimental network. This chapter gives real time system for speed detection and automatic number plate recognition by using MATLAB. And last **chapter 6, 7** discuss the Results, Conclusions and future scope of the system.

Chapter 2

Literature Survey

2.1 Introduction

Here we present some background information necessary for the subsequent chapters. This Chapter have presented the six base papers for this system. A great amount of literature exists on the subjects of speed detection and automatic number plate recognition this system is discussed regularly in publications and conferences on computer science , software engineering and electronic engineering such as International Conference. In addition to this a growing number of special issues and conferences are dedicated to distribute to reduce risk and improve recognition techniques of software. The articles are selected for this issue present new approaches and ideas for speed detection of vehicles .

2.2 Existing System

Existing system used a sensor based approach to measure the speed of moving vehicles. Technologies such as RADAR and LIDAR are most commonly implemented by interceptors . In different countries different sensor based approaches are being used for speed detection . Along with this speed was only detected over a linear path . Automated number plate recognition was treated as separate module .

2.3 Literature Study

2.3.1 Vehicle speed detection from single motion blur image [1]

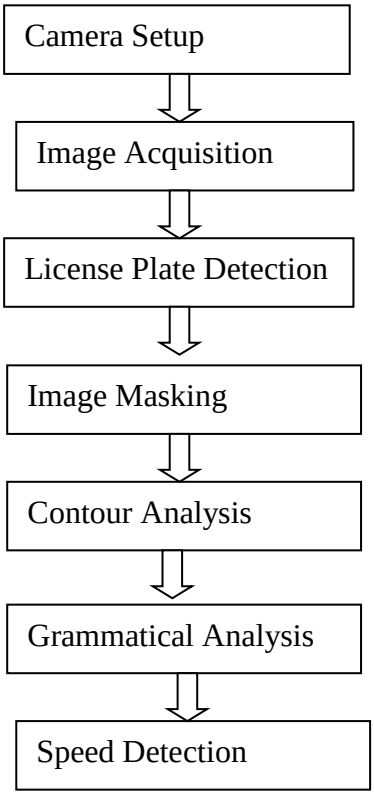
According to **Maceleo Calesteno[1]**The research work is based on image-based real time method for vehicle speed detection and automated number plate recognition is presented Old methods for speed detection techniques includes radar- or laser based devices to measure speed of vehicles such techniques that are comparatively more costlier than camera based system. Here a single image is taken of vehicle in motion and is used for estimating speed as well as for automated number plate recognition When the moving object is running on road because of the relative motion of the camera and moving vehicle / object in the camera exposure time causes motion blur in moving region of image. A target region (approximate

region) is segmented to estimate blur parameters from the moving sub image. There after image is de blurred and used to find several other parameters. At last, of vehicle speed is calculated by considering imaging geometry.

2.3.2 Vision based speed detection methods

According to **Witold czajewski[2]** a unique approach for speed detection is proposed based on visual information. The system here consists of only a digital camera and a software that can estimate the speed and registered number plate numbers of moving vehicle which makes it different from all other various existing and high cost photo radar systems. The functional principal is that vehicles are identified with help of their licence plate then speed is estimated which is based on vehicle position on vertical difference in consecutive images. evaluation showed the higher accuracy of moving vehicle speed measurement as compared to the existing radar based systems.

Proposed Algorithm:



2.3.3 Video Image Processing to Create a Speed Sensor

According to **D.J Dailey and Li li[3]** The approach presented by them for extracting vehicular speed by real time traffic images. After extraction of moving edges the edge information processed to get geometric measurements of moving objects or vehicles . This is different from existing approaches because we use geometric relations obtained directly from the image inspite of using reference objects to conduct camera calibrations. This method allow the recovery of the physical explanations of traffic area without any demand of explicit camera adjustment.

2.3.4 Vehicle speed Determination in video image sequence by CVS method

According to **Arsh Gholami Rad [4]** Video processing is used in surveillance of traffic and analysis as well as managing traffic conditions in many cities , towns , highly crowded urban cities. His research aims to giving a unique concept to determine the vehicle's velocity. For this research work the recorded traffic movies are assembled with passive camera that is fitted on a path or highway . Calibration of camera was done on geometrical equation using references directly . The Camera calibration measurement was done correctly while accuracy in speed estimation is still a difficult task . detected vehicle speed average error was come out to be 7 km/h and experiment was performed by taking different resolutions of various different video stream.

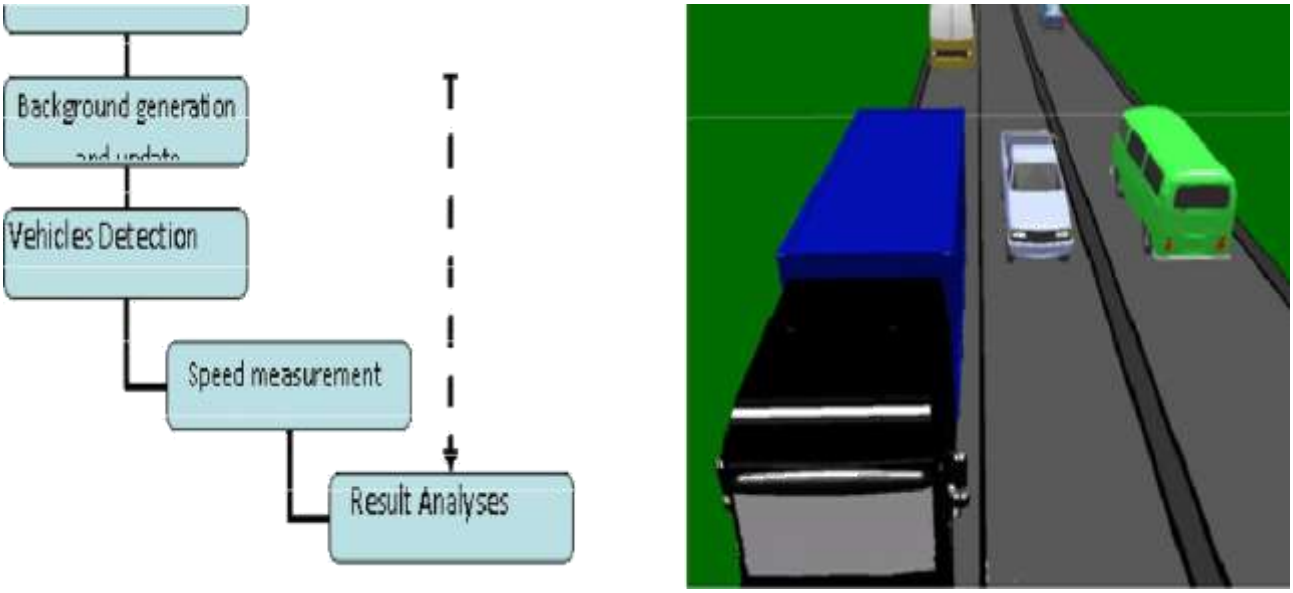


Figure 2.1 speed detection based on image sequencing

2.3.5 License Plate Recognition on an Embedded Platform

According to Clemens arth [5] the approach presented here is a license plate recognition system. Implementation of work was done on embedded platform system that evaluates a video stream in real-time . This system focuses on character reading and detection module. It operates on the Ada Boost approach . Once plates are detected they are divided into stand alone characters with the help of region-based approach. Vector classification has been used to perform character classification . To provide momentum to detection technique on the device integration of Kalman tracker was done in the system . detector searching area is confined to the locations where next registered number plate is there . Hence the results of all frames are collected to improve the accuracy. One of the advantage of system is realtime operatability and also no requirement of any extra sensor input device for example infrared sensors keeping video stream an exception . the system was evaluated on large scale using bad and low quality video . It was derived that compensation of low resolution can be done to a extent by combing results of various frames .

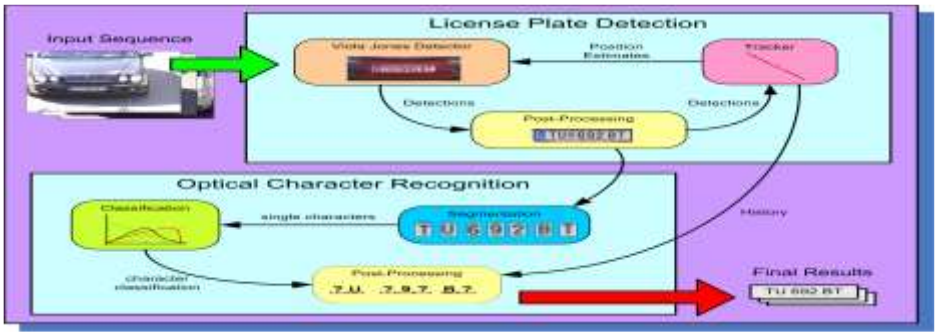


Figure 2.2 License Plate recognition

2.3.6 Speed detection of Moving Vehicles with help of Lucas-Kanade Algorithm

According to Dolly Shukla [6] The approach presented here is velocity estimation method for moving vehicles. The job here is to automatically determine vehicle speed from video sequences acquired with help of fixed mounted camera. The moving object is detected and traced along the frames by using Lucas-Kanade algorithm. The average distance travelled is calculated by using the movement of centroid over the various frames and the speed is estimated. Average speed of vehicle is determined with help of various frames. Such type of system is developed using Matlab and Simulink.

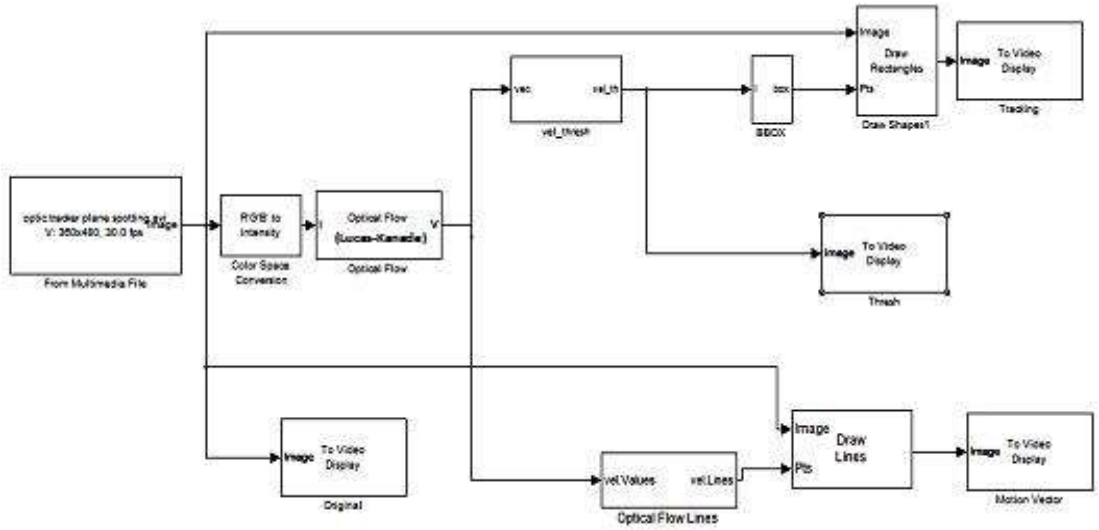


Figure 2.3 block diagram of lucas- kanade approach

CHAPTER 3

Experimental Setup

3.1 Hardware Setup

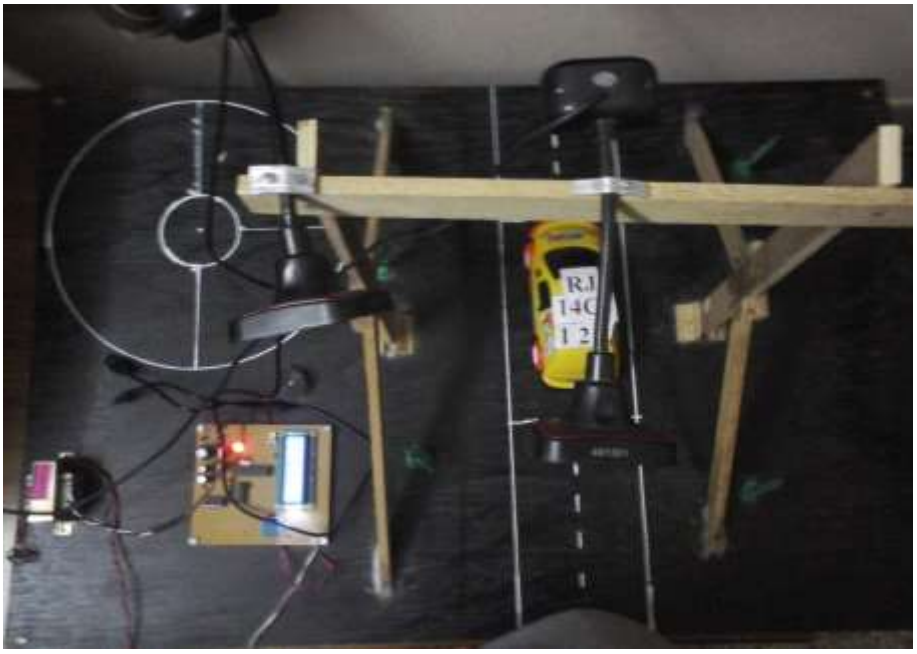
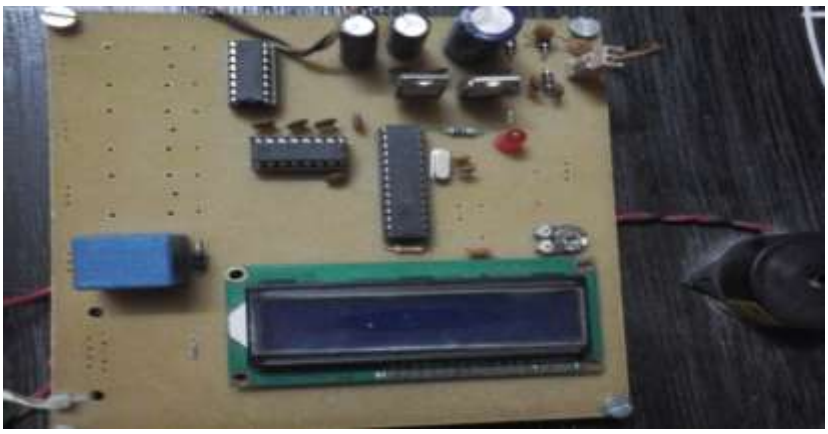
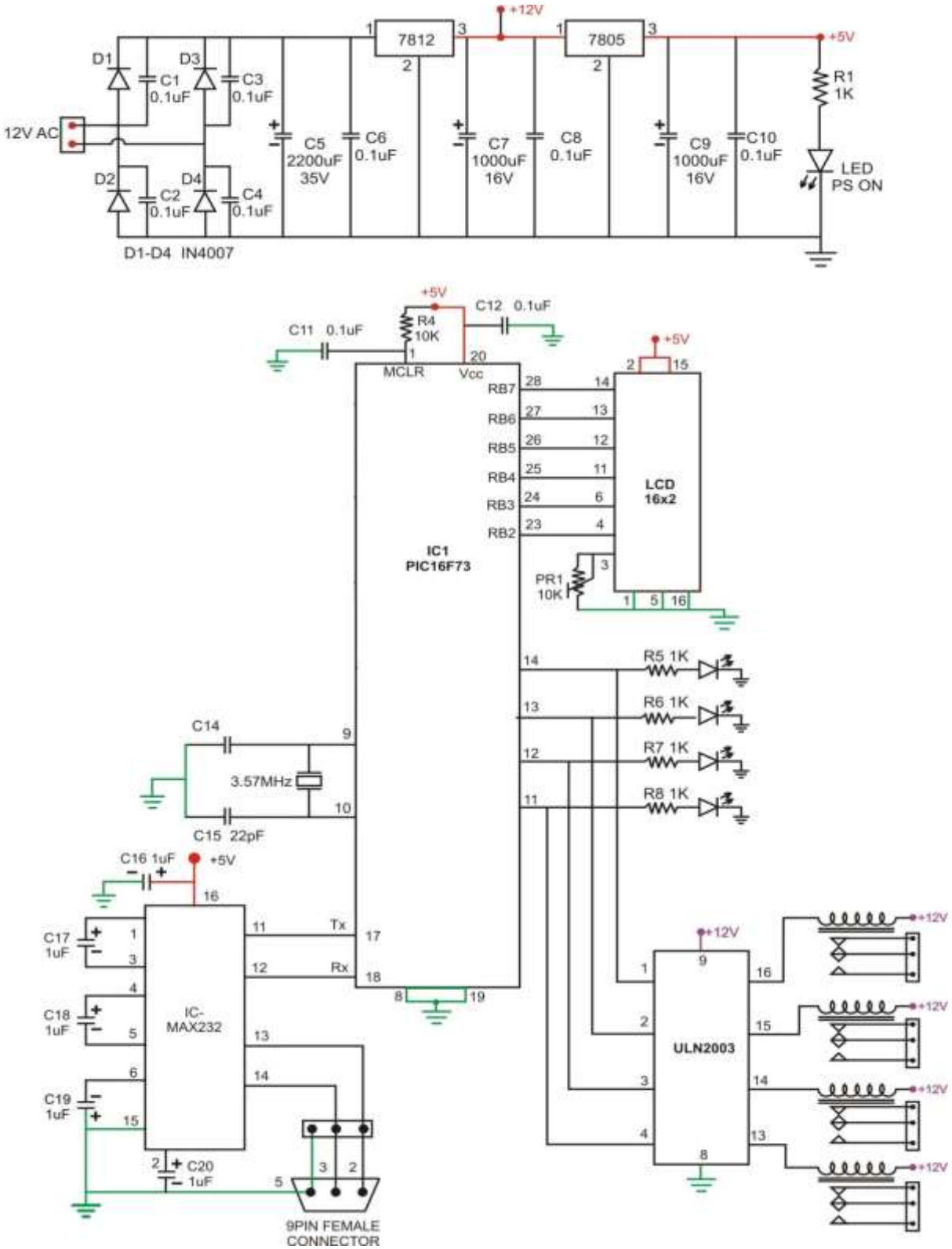


Figure 3.1 hardware Setup for research work



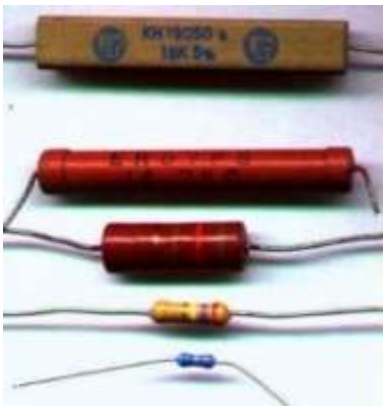
Fugure3.2 PCB design for speed detection

3.2 Circuit diagram



3.3 Primary Components

3.3.1 Resistors



Resistors used in the setup has predetermined resistance . Resistors define the flow of current through any conducting material. wires of resistors are made of metal as metals have low resistance . These metallic wires allow flow of current from one point of wire to another . Wires are usually covered with plastic which avoids them coming in contact with each other and also reduces the chances of short circuit .

3.3.2Variable resistance:

It comprises of dial and knob that allows to change resistance. It is used in circuits to vary current passing through resistors. It changes the value of current across the circuit it is also known as voltage divider. The value input in variable resistor is highest resistance value. It is also known as potentiometer .

3.3.3 Capacitor

It stores charge in electric circuit . It is similar to battery but charges and discharges more rapidly . It is next to electron storage bank , if any circuit is functioning slow it delivers electrons to it to rapid the operation . Some capacitors are polarized means current can flow through them only in one direction .Capacitor has a lead which is longer than other that means it is always connected to positive terminal . Capacitors are used to prevent power spikes that can almost fry any circuit .It also eliminates switch bouncing i.e switch actually bounds several times with in microsecond range.

3.3.4 Diode

Diodes are those hardware components that allows flow of current only in one direction . diode has two legs – positive and negative . When voltage on positive leg is higher then current flows on negative leg of diode . When voltage on negative leg is lower then current do not flow on other side . The negative end is called cathode and positive end is called cathode . When current flows through diode the voltage on positive end is higher then negative end by 0.65.

3.3.5 Switches

Switch is a component that either creates short circuit or an open circuit depending upon the type of electric circuit . it uses two terminology ON –OFF. ON means short circuit and OFF means open circuit. When switch is on it looks like a wire . When it is off then there is no connection .

3.3.6 LED

LED are light emitting diodes. Important feature of diodes is that they can conduct current only in one direction. Besides red they are available in yellow green and blue colors.

3.3.7Additional filter capacitor

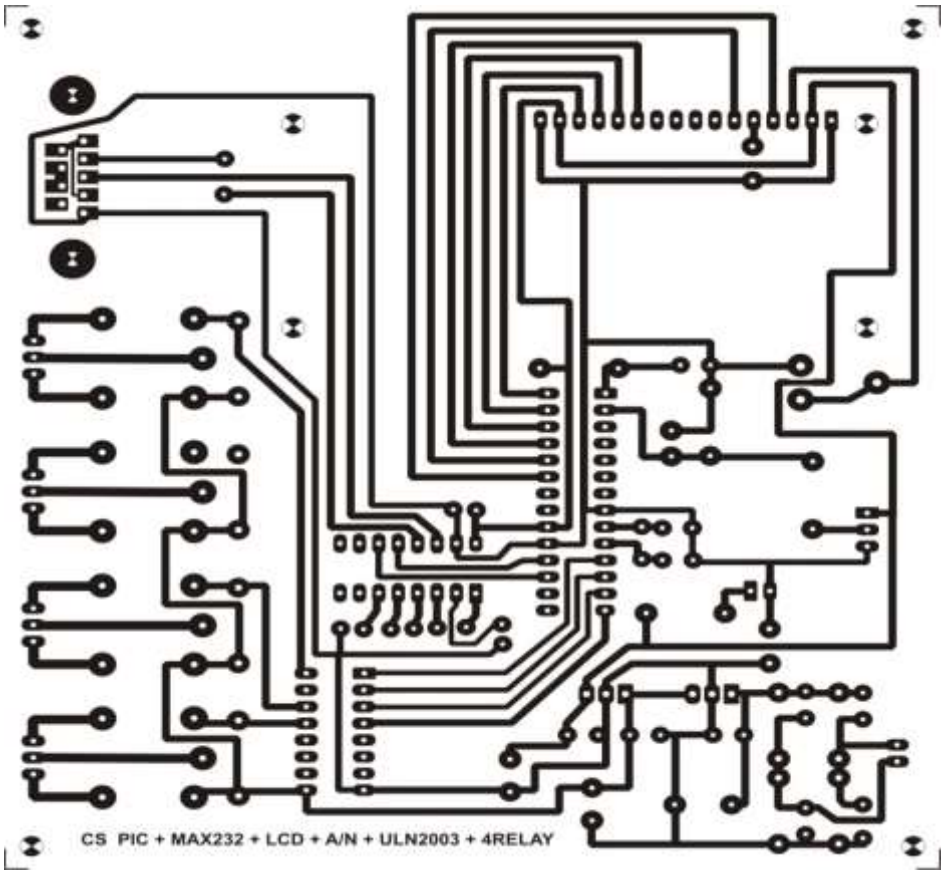
They are electronic component which filters undesirable frequencies. Its main function is to remove noise from power line .

3.3.8Step down transformer

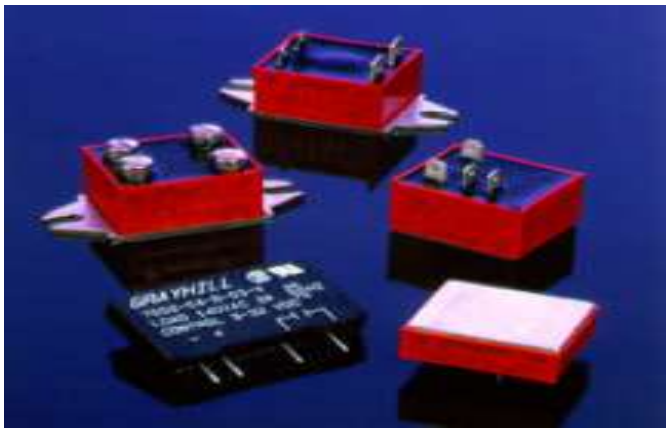
In the setup step down transformer is reducing voltage from 220 v to 12 v .

3.3.9Printed circuit board

Printed circuit boards are electronic circuits consisting of thin sheets of conducting material like copper which have been attached to form a layer fixed to flat insulating sheet called printed circuit boards to which IC and other components remains attached .



3.3.10 Relay

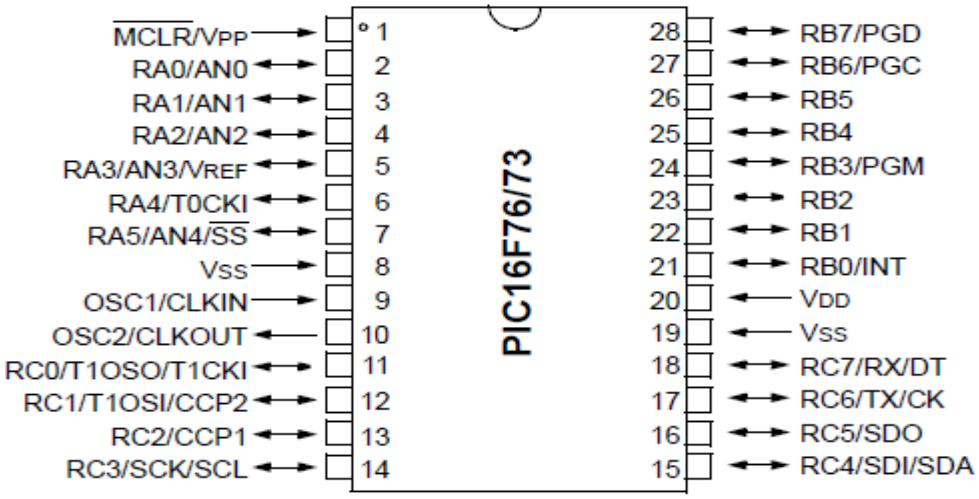


Relay is simple electromechanical switch made up of electromagnet . it is found in almost all the devices . They are used to control circuit by low power signal . First relay was used in telegraph circuits.

3.3.11 ULN 2003 (seven Darlington arrays)

ULN 2003 is high voltage high current array that contains 7 open collector Darlington pairs with common emitters.

3.3.12 PIC16F73



3.3.13 HD44780U LCD(Dot matrix liquid crystal display)

A LCD display is used here to give the output amount. LCD is a flat panel used for displaying information such as text and moving pictures. The LCD display is interfaced with the microcontroller.

3.3.14High resolution camera

High resolution camera is used to detect the vehicle within boundary box , calculates its speed and detects its number plate .

3.3.15Microcontroller

Special Microcontroller Features:

- High Performance RISU CPU
- There are only 35 single word instruction
- 4K byte Flash memory program
- 192 byte RAM
- On-chip RC oscillator
- There I/O port-Port A=6Bit,Port B & C=8 Bit
- The PIC16F73 has 4 Kbyte of program memory.
- 192 Bytes Resister as data memory:

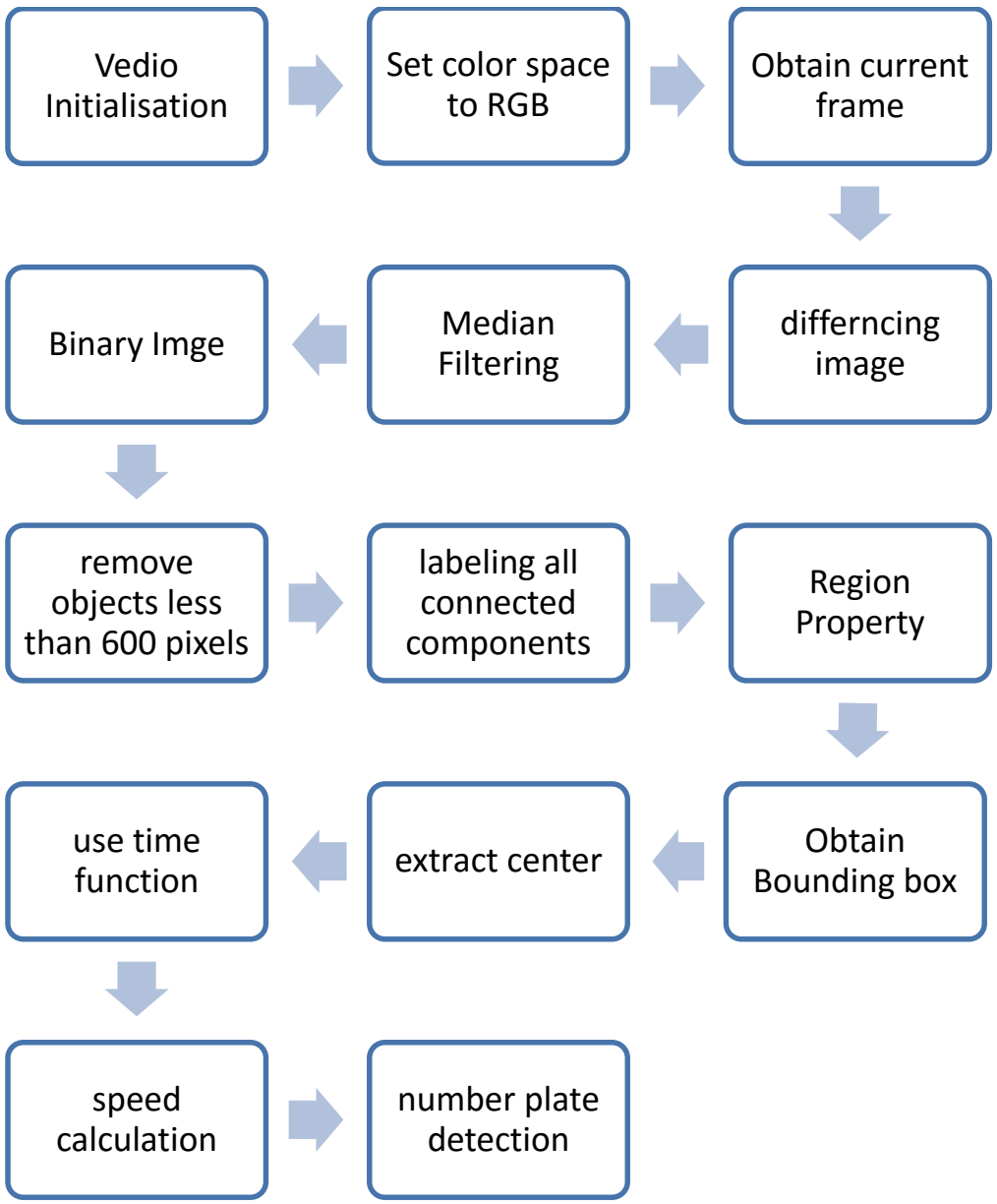
    1. Special function register used to control peripheral and PIC behavior
    2. General purpose register used for temporary storage of data

CHAPTER – 4

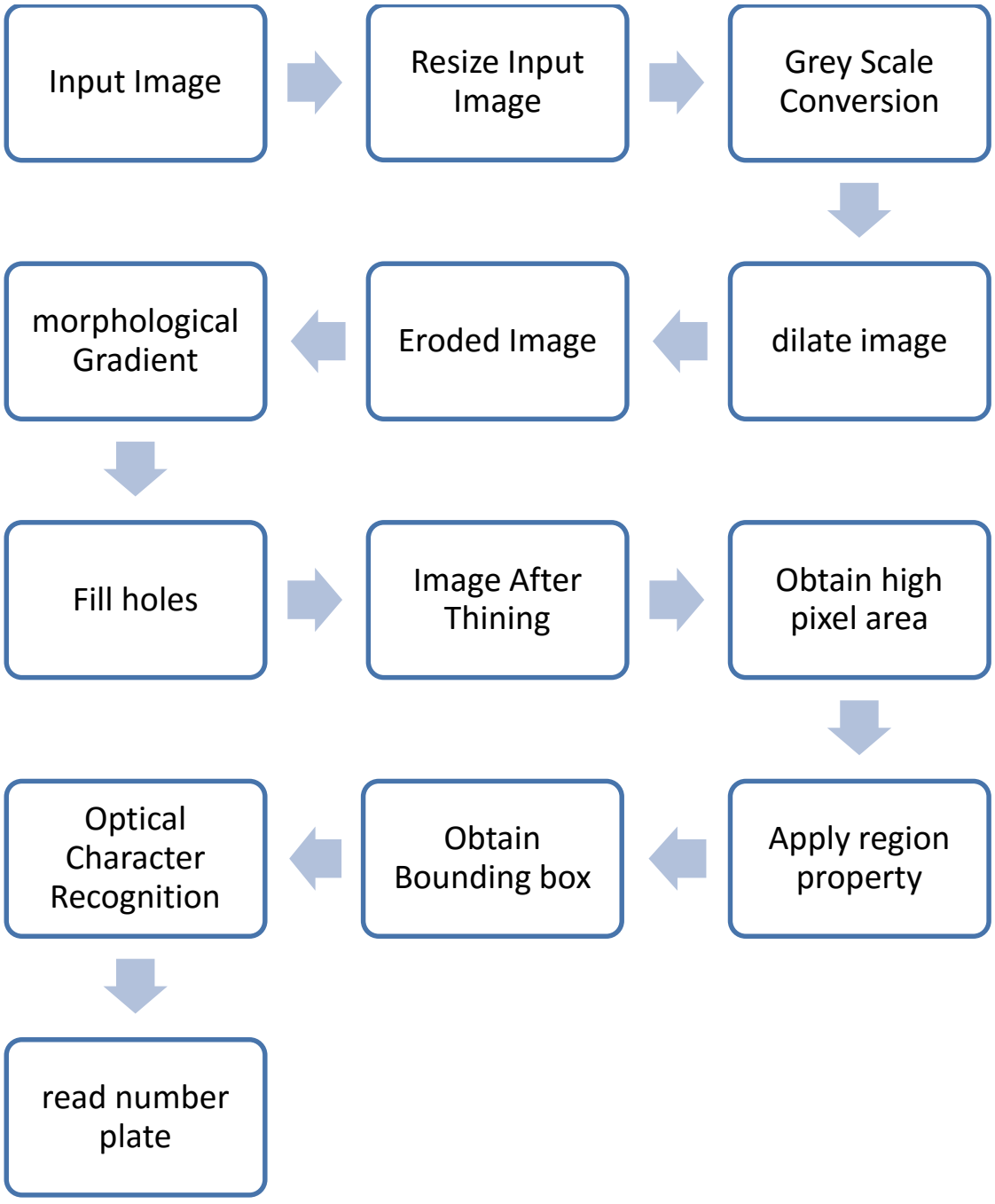
Procedures adopted and Development Techniques

Procedures Adopted

4.1 Work flow for Speed Detection Of moving vehicles



4.2 Work flow for Automatic Number Plate Recognition:



4.3 Working Details of System :

4.3.1 Video Initialization :

Performing video initialization in video surveillance system is always the first step in the workflow sequence because without a video no processing is possible. The video that is acquired using high resolution camera is unconditionally unprocessed . A video adapter is to be connected to the computer for this . An object is initialized containing information abiut video adapter. Matlab function used for this is video input.

vid = videoinput('winvideo',1,'YUY2_640x480')

4.3.2 Set color Space

Here we had set color space to RGB . RGB image represents each pixel of the image in set of three values that are of RED , GREEN and BLUE intensities that makes the color . These intensity values are directly stored in the image array not in a colormap.

In MATLAB all the three color component of RGB image reside in a single [mXnX3] array . m and n represents rows and columns each of the pixels of image whereas third one consists of three planes comprising of red, green and blue intensity values and for every pixel the image is containing the red, green, and blue elements mixes to create actual color of pixel . After setting color space to RGB obtain the current frame i.e the object image in a particular video range .

4.3.3 Differencing Image :

The next step is to obtain differencing image by subtracting the RGB component and grey scale component of the image . Let us now understand why is grey scale image .Grayscale is part of digital image .The image of this type carry only intensity offer advice. It is basically a range that comprises of shades of gray with out any other color. Darkest possible shade is black . lightest possible shade of total transmission is white .

At time intervals t and t-1 the difference image between two consecutive frames is calculated by obtaining different values of gray scale representation.

4.3.4 Median Filtering :

Median filtering is non linear technique used to eliminate noise from images. It is very effective at removing noise while and preserving edges at the same time Median Filter is particularly efficient at removing “salt and pepper” type of noise. It works by traversing through the image pixel by pixel and substituting each value with the value of nearest pixels. The pattern of nearest pixel is termed as the window that moves pixel to pixel over the whole image In this process the median is obtained by first sorting all the pixel values from window in a numerical order and then substituting the pixel in consideration with the middle or median pixel value.

4.3.5 Obtaining Binary Image :

The speed is calculated in in domain of binary image that is transforming pixel into either “1” or “0 depending on its information of motion . we use two different techniques first one is interframe difference or differencing image that is already discussed earlier and the second is background subtraction. This Method is the important function for all monitoring system that uses computer vision as its principle . exact and accurate background subtraction is a primary element to achieve object tracking . region of foreground object can be determined by using this technique . Static modeling is mot common method to subtract background . Here Background as well as foreground decision depends on parametric equation. Thus Inter frame difference technique for binary image generates an representation of moving vehicles .

Figure 4.1 Construction of motion matrix

4.3.6 Remove objects less than 600 pixels:

In this system we have assumed area of 600X 480 pixels as the target area . Here target area means the area which is under camera range and will detect moving objects so that they can be traced . So here the objects less than 600 pixels are removed to obtain target area . in the target region we tend to obtain those moving objects which have uniform coloring over their roofs .

4.3.7 Object Labeling :

Object labeling is a phase of object tracking . the aim here is to provide labels to all closely connected components . To track all moving objects, labeling turns to be a important process . This is required as every object must represented by a new label and it must be assumed that while moving object will maintain its label with out any change from the moment object enters the target region (frame F0) till it leaves the target region (frame Fn).

Figure 4.2 Object labeling

4.3.8 Obtain Bounding Box :

By using region property of matlab we tend to define bounding box and find centroid of the moving object. Bounding box is defined as rectangle containing the figure or moving object and whose sides does not touch the object . In our work we have used region props function of MATLAB to which detects a unique bounding box whose sides are not touching the other object . region prop function of matlab defines the properties for each labeled region in

matrix .Properties are list or array of strings . Two such property we have used is centroid and bounding box .T he purpose of finding centroid is to obtain a center o the moving vehicle by which vehicle movement can be traced .

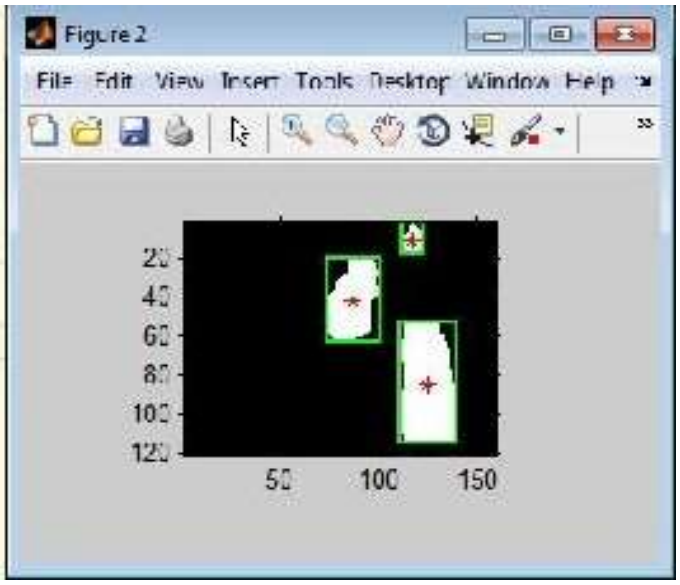


Figure 4.3 Bounding box of image

4.3.9Time calculation:

Calculation of time of object can be done through either using tic –toc or clock function . in this a area of 600x480 is set as target area . the area is marked with two lines indicating starting and ending points between which objet is labeled , object is tracked through centroid , time is calculated for the distance travelled . As soon as the moving object is detected within the region its coordinates of centroid are available Start variable initializes to 0 , when vehicle crosses the end line marked value of start becomes 1 and returns the duration of time in which object has travelled a particular distance . Tic function starts the stop watch timer of MATLAB . Toc timer measures the elapsed time of stop watch timer . Another way to calculate time using MATLAB is to use clock function . Clock function returns current date and time in decimal form . This representation is in six element date vector form.

4.3.10 Speed calculation:

The speed of the vehicle is determined based on time elapsed by moving vehicle in the target region . The speed of object is calculated by obtaining time which when object has entered the scene at (F0) and tacking entire object till it leaves the scene at frame (Fn) in case

of over speeding the buzzer alarms for violating the speed and system call for number plate extraction .

4.3.11 Grey Scale Conversion:

Grayscale image is a part of digital image .This type of image carry only intensity offer advice. Grayscale is part of digital image .The image of this type carry only intensity offer advice. It is basically a range that comprises of shades of gray with out any other color. Darkest possible shade is black . lightest possible shade of total transmission is white .

Wavelength primary colors represent equal brightness levels of shades of gray and equal amount of the cyan , magenta , yellow for reflected light.

4.3.12 Dilated and eroded Image :

Dilation makes objects grow and erosion makes objects to shrink in size . amount by which objects grow or shrink depends on the structuring of element . Dilation and erosion can be carried out through MATLAB . pixels to the boundary of image are added by dilation whereas pixels from the boundary of image are removed by erosion . Maximum value of all pixels in input pixels is output for dilation . Minimum value of all pixels in input pixels is output for erosion . In any binary image value of any pixel is 0 then the value of output is 0 .

4.3.13 Morphological Gradient:

Morphology is image processing technique which works on images that contain shapes. These operations create same size output by applying structuring element to input image . the value of every pixel in output image is result of comparison with next pixel .morphological operation can be constructed by choosing shape and size that are sensitive to specific shapes if input image . After applying various rules to corresponding pixel in image its state can be estimated for dilation and erosion using morphological gradient .

4.3.14 Holes:

Holes may be defined as background pixels which are not that do not become invisible themselves unless they are filled .

Figure 4.4 Shows holes filling through matlab

4.3.15 Optical Character recognition:

OCR is a technique to convert printed images containing text from text format .The source can be scan image , screenshots , photos etc . A typical Optical character recognition system comprises of three logical components – source image , OCR software , hardware and a output interface. The OCR captures the input image to be recognized .It fetches the text images . These Text images are then processed with OCR software & hardware. This process is done in three steps: document analysis , recognizing of images , contextual processing that is either to correct any miss classifications made by the recognizing algorithm or to limit recognizing choices .

Figure 4.5 Character Recognition through OCR

CHAPTER 5

Methodologies developed and adopted

This section briefly discuss about methodologies adopted in system design and implementation. The system design is classifies in five phases that are as follows :

- Objects Detection
- Objects Tracking
- Speed Calculation
- Capturing Object Frame
- Extract Number Plate

Recognizing moving objects / vehicles with help of video stream is viewed as very important and complicated research task . Apart from the high benefit of segmenting video stream to detect foreground -background components makes detection of moving blobs to be a area of interest for recognition and analyzing the concept thus making the later processes to be more accurate and simple by considering only moving pixels .

Object tracking objective is establishing correspondence between various objects in its consecutive frames . Object tracking works by extracting temporal information of the objects like their speed , trajectory and direction . Frame by frame tacking of detected objects is an important task . Due to the reason in absence of object tracking , system is unable to get all temporal information of moving objects . Object tracking becomes an important part of smart surveillance system. In case of wrong foreground object segmentation because of reflectance and occlusion creates difficulty to track objects thus makes research difficult . the object detection phase can handle sudden illumination changes , shadows and result are all most reliable . Thus the foreground image is set for segmentation , tracking and labeling . The speed of object is calculated by tracking object from starting of scene at [F0] till ending of scene at [fn] .

5.1Object Detection

Efficient algorithm that involves object detection in vehicles is used. The algorithm works on combination of background subtraction technique along with three frame differencing algorithm. The mixture of both overcomes the ill effects of using background subtraction alone .Means no references are made for the objects that are stationary in the scene which are about to move . Though when such objects are detected they tend to leave holes behind where newly exposed background image differs from the existing model . Explained with help of figure . when this model adapt to such Holes then false alarm is generated for short interval of time .This phenomenon will not be subjected towards frame differencing. It is not a good method to estimate shape of moving vehicle as illustrated in figure.

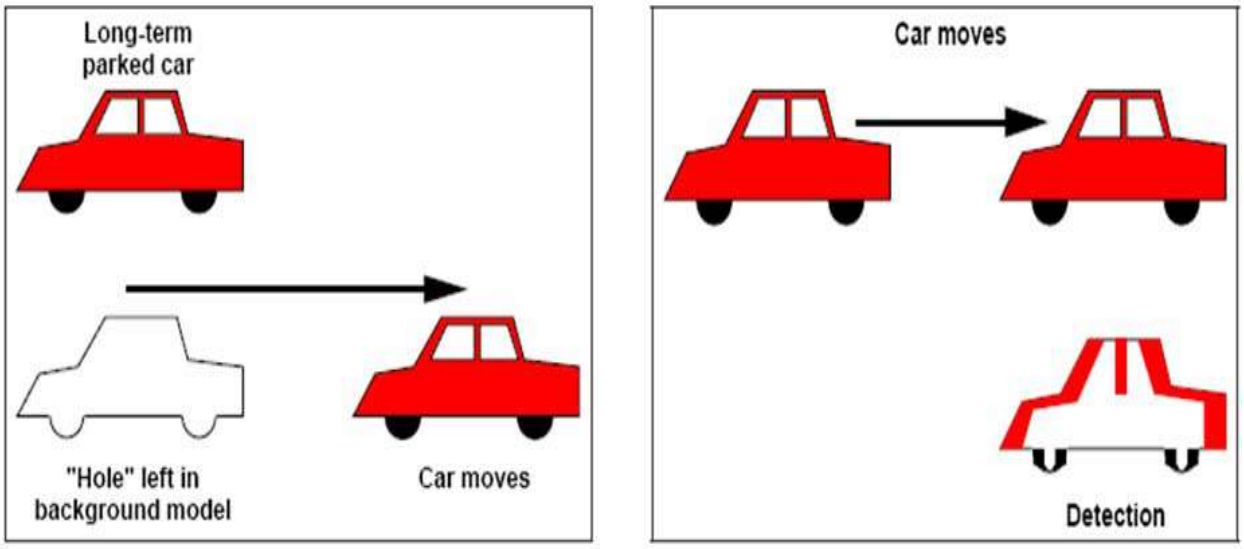


Figure 5. holes with moving car

To overcome the problems of individual methods In this system we suggest using combination of both methods . Object detection contains Two different successive steps :

5.1.1Constructing the motion matrix

The aim here is to construct matrix for current frame. This step is done to observe those pixels of the object that are moving and those that are stationary. Here probability that

moving pixel represents foreground pixel and stationary pixel will represent background pixel is high .

Three frame differencing operation carried out to find region of motion or we say to construct a motion matrix as shown at figure . adaptive background subtraction is used after this to extract the moving region. Let us consider a video available from a passive mounted camera. . Suppose Is*(x,y)* represents the intensity value of pixel at position *(x,y)* at any time n. According to three differencing rule a pixel is in motion if its intensity significantly changes between the current image frame (Is) and the last frame (Is-1) and the current image (Is) and the next to last frame (Is-2) significant intensity change at a pixel position (*x*,*y*) .

Figure 5.2 Motion matrix sample, a; sample scene with two moving objects, b;the constructed motion matrix represents the pixels which are in motion in the current frame ln.

5.1.2The masked subtraction

Let *B (x,y*) be the background intensity value for a pixel position (*x*,*y*) calculated over time for video . The idea here is that object does not lie in moving area that is the pixel is not in motion there is no requirement of applying background subtraction to it . In other words, when pixel is not moving or stationary we will neglect it since the probability of any stationary pixel to be a part of a big object is very low on the other hand the probability of another pixel that is in motion to be a part of object is very high. On contrary ignoring other pixels causes some loss of information and leads to un-connected objects. There when we combine the output of this operation along with the result of two frame temporal differencing shows that it gives impressive result and temporal differencing detect about 50% of the

moving object. So we can obtain foreground image *Fi* (*x*, *y*) by using masked subtraction method in combination with two frame differencing method.

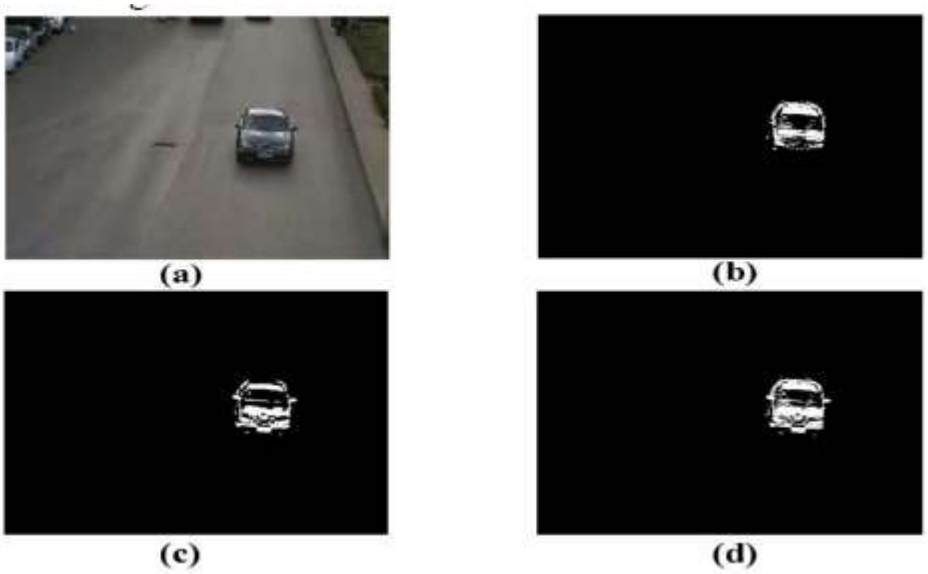


Figure 5.3 Masked subtraction sample, a: sample scene with moving object, b:foreground image constructed by masked subtraction, c: foreground image constructed using two frames differencing, d: final foreground image after combining both images

Most of the algorithms that detect foreground are susceptible to shadows and sudden illumination changes that cause inaccurate foreground object segmentation. But with the help of later processing step - object classification and tracking depends ,on the accuracy of object segmentation thus it becomes important to cope up with shadow and instant illumination changes in video surveillance systems.

5.2 Objects Tracking

Tracking of detected objects frame to frame in video stream is a significant and difficult task. Due to the reason that without object tracking the system is unable to extract cohesive temporal information about moving objects . Object tracking becomes an important part of smart surveillance system. In case of inaccurate foreground object segmentation because of

shadows or reflectance and occlusions creates difficulty in tracking of objects thus makes research difficult .

Object tracking comprises of three successive phases;

• Object segmentation

• Object labeling

• Object center extraction

5.2.1Object segmentation

Object segmentation works on the connectivity of the objects. To segment any foreground image in a group it should be confirmed that objects are connected as a whole . Else segmentation can not be done correctly and their may be objects count excess because the single object will be seemed as several objects.

Since there are non connected objects our goal is to detect an area around the objects. In simple words the operation maps the object in a rectangular box . This comprises of iterations one after other and each iteration is completed as a part of horizontal scanning & vertical scanning. Horizontal scanning start at leftmost top pixel in the foreground image . The foreground image is scanned horizontally. while scanning if any pixel found to be foreground pixel , the scanner will skip this line and moves to the next line to scan . This is illustrated with the figure below which shows the result of horizontally scanning of the image in foreground . vertical scanning begins at the left top most pixel In the image foreground Fg (0,0). The purpose here is to scan image vertically and if white pixel is not found then whole line is marked as scan . If a pixel seems appear foreground pixel that is white in color scanner will skip the line and moves to the another line to scan.

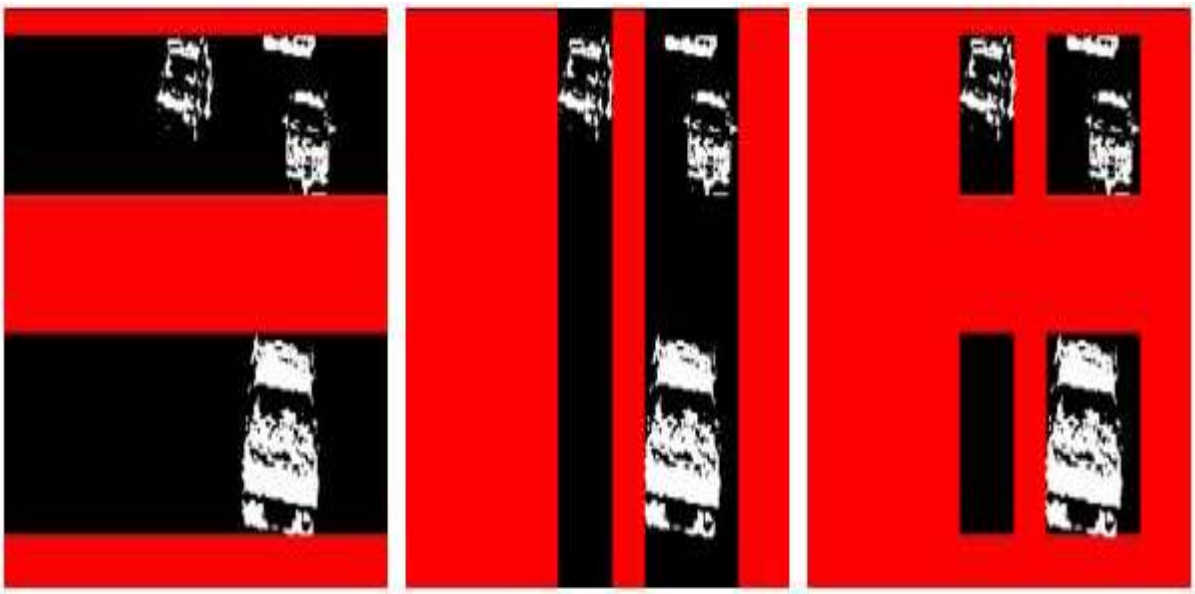


Figure 5.4 Object segmentation 1st iteration

After the first iteration we came to know that still there is a requirement of one more iteration to provide with an exact and precise result and also there are some false detected regions in existence that will hopefully be removed after one more iteration . see in figure below.

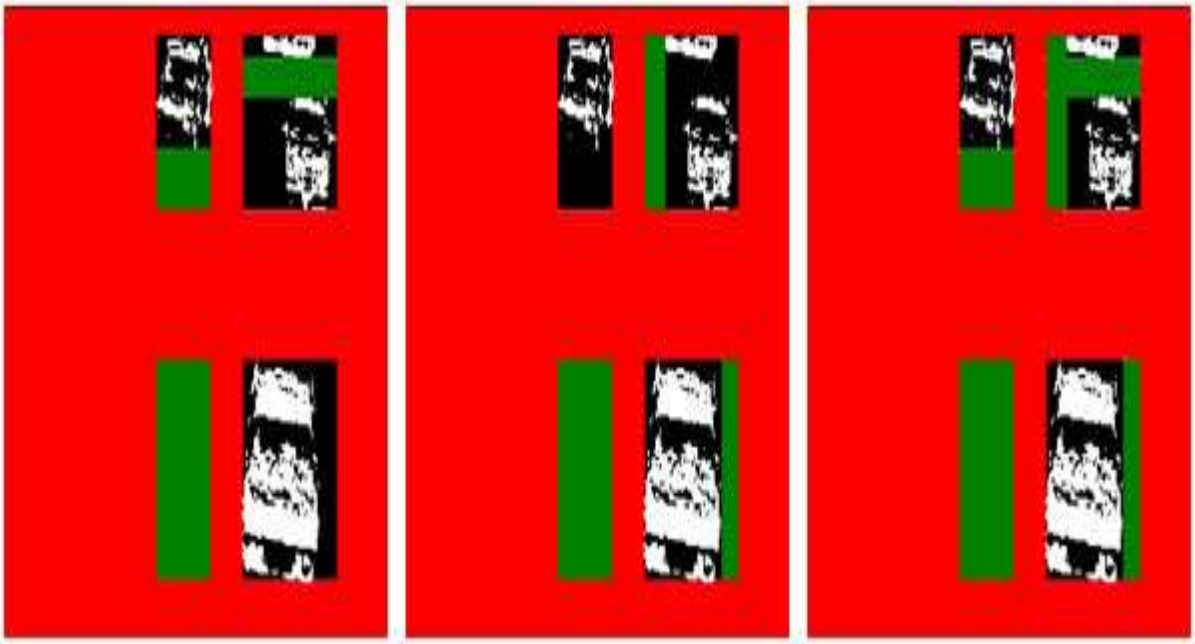


Figure 5.5 Object segmentation 2nd iteration

The second separates the two objects of the same region shown and also discarded untrue regions that are detected . requirement of third iteration is not there as no more segmentation could be perform now here comes different problem that is how many iterations are necessary to give accurate segmentation the answer is simple as system performing segmentation until further segmentation is done hence the method is self proven , flexible and adaptive to all the cases .

5.2.2Object Labeling

To track moving objects labeling becomes as essential process. Object labeling becomes important because each object is represented by a separate label with a condition that object must safeguard its label without change From the time object enter into the scene at frame F0 that is the starting frame until it exit the scene at the end of frame .

segmentation process in the last stage gone guarantee us an array of separated regions to represents moving object and the separated region represented by the object is assigned a label that is unique and preserves it until object leave the frame .

Figure 5.6 depicts the clear segmented region with unique labels.

5.2.3Centre extraction

Now we have an object that is ready to track . Considering optimization issue it is inferred that there is no need to perform tracking on entire object pixel to pixel there is only requirement of descriptive point that represents the object. The point is called object center also refers to as centroid it represents the object as a whole and mapping and tracking of object can be done easily .

previous section discusses how to detect object , object tracking , object labeling and center extraction . Hence by using these techniques of image processing we are able to perform speed calculation .

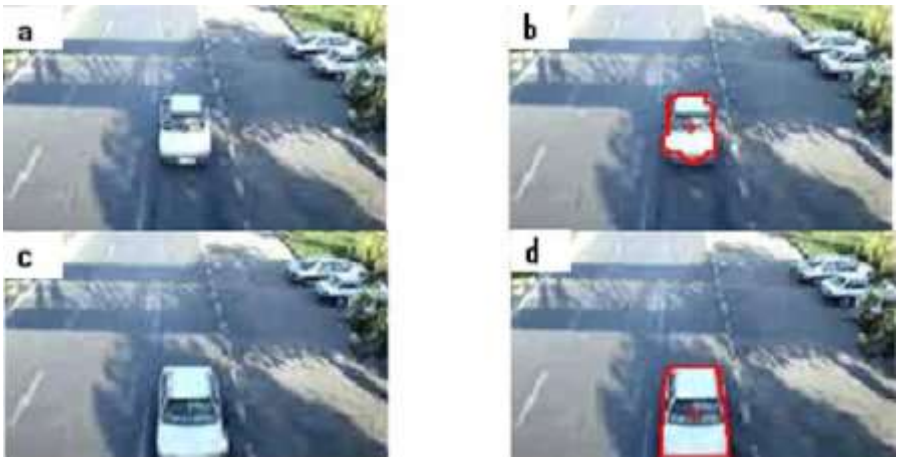


Figure5.7 bounding box of image

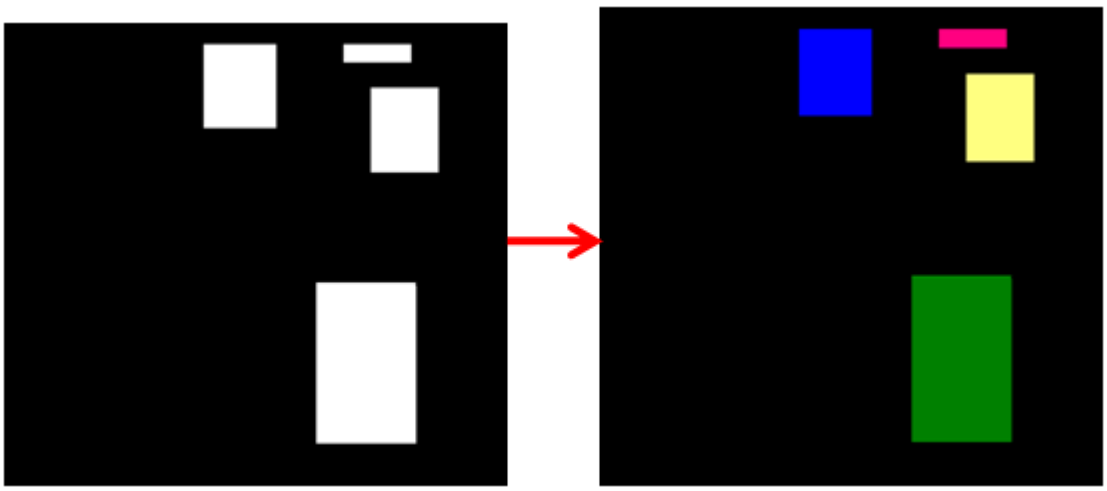


Figure 5.8 Labeling operation

5.3Automatic number plate recognition

Automated number plate recognition is unique characteristic of optical character recognition . License plate recognition is type of technology that allows user to read automatically the registration no. of vehicles. LPR is image processing based technique to read number of moving vehicles. This technology has its advantage in various traffic management and applications. LPR units works by reading images on front /rear number plates. A typical image captured by the single mounted high resolution camera is shown in the following image The information contained in the image is read by the LPR and automatically analysis is done .

Figure 5.9 Input Image

As the vehicle plate is made on different standard of different countries , difference in size , shape and material occurs . Hence the LPR systems are based on country , where they installed and used. This system works on the pattern of license plate used in India . The above image taken from the car's front side in figure is in form that is comprises of 256 gray level in a range from black to white . A typical format comprises of 768 X 288 pixels . Such huge information is handled by the recognizing software for the purpose to read number plate .

The image below is zoom image of above license plate. The process starts from some input image which zooms repeatedly with a factor of two up to the next pixel.

Figure 5.10 zoom input image

The computer processor needs to work on whole image to extract number plate , zoom it to observe the minute details and then finally reads the numbers of the plate . The recognition process result is contained in a string . conversion of the image to resultant string can be viewed as actual big compression of the input image .

Early license plate recognition systems has a drawback of recognition at very lower rates as compared to that of practical systems . Factors such as bad weather , heavy sunlight , bad plates & limitivity in different types of low recognition software& vision hardware often result in low quality system. Recently improving hardware and software made license plate recognition systems quite reliable and popular.

5.3.1Typical Applications of LPR:

Parking - Here by using LPR, the information of prepaid members and works for estimating parking fee for those who are not members Recognition of driver phase is optional to prevent fraud .

Access Control – With use of LPR the authorized members in a secured area gets access automatically . Hence it replaces the job of security guard.

Tolling - In this the plate is extracted when vehicle enters in the toll lane The information of vehicle is provided by the database and in case of new vehicle information can be entered.

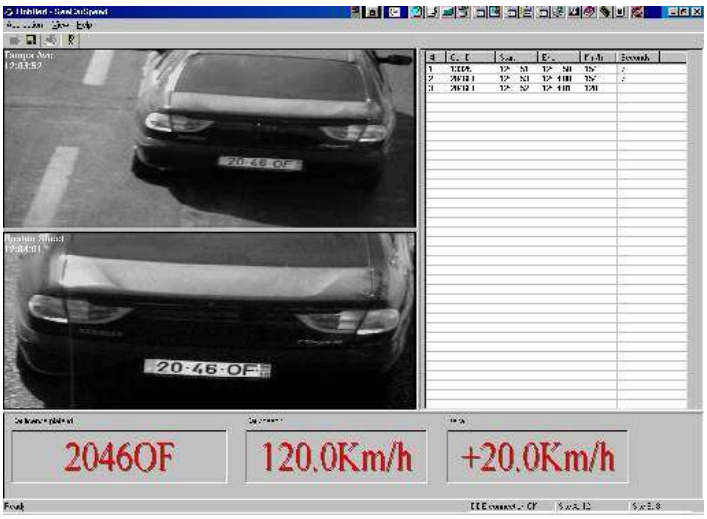
Border Control – the vehicle number is feed into the database at the entry or leaving the Country. It is very beneficial to manage border crossing activities .

Enforcement – by use of LPR this system is used to impose a fine for speed violation or for traffic light system .The old process of imposing fine is replaced.

here is an example of over speeding car whose image is captured by high resolution traffic camera traffic camera.

Traffic control - the vehicles are allowed their entry to different lanes based on their entry permits It helps in reducing traffic congestion

Travel - LPR systems at different cities in different crowded locations and the passing by vehicle number plates are matched taking two fixed points . The Travel time and average speed is calculated which helps to manage heavy traffic .



Airport Parking - To reduce ticket the LPR unit are installed to extract number plate and take image of the vehicles . This data may be further used to obtain parking time and also act as a proof of parking in case when a ticket is lost .

Automatic License Plate Recognition allows to read moving object or vehicle registered license plate and verify it against already updated database to perform identity verification. This system is also used to find stolen vehicles and check parking-ticket flaws . one of the rapid deployable alternate is to use cameras that work on infrared technology which is then connected to optical character recognition technology software that allows to carry out smart monitoring in varying light and in bad weather .

5.3.2Optical Character recognition

OCR is a technique to convert printed images containing text from text format .The source can be scan image , screenshots , photos etc . A typical Optical character recognition system comprises of three logical components – source image , OCR software , hardware and a

output interface. The OCR captures the input image to be recognized .It fetches the text images . These Text images are then processed with OCR software & hardware. This process is done in three steps: document analysis , recognizing of images , contextual processing that is either to correct any miss classifications made by the recognizing algorithm or to limit recognizing choices .

CHAPTER-6

Results & Discussion

6.1 Results of Speed detection at Linear Path:

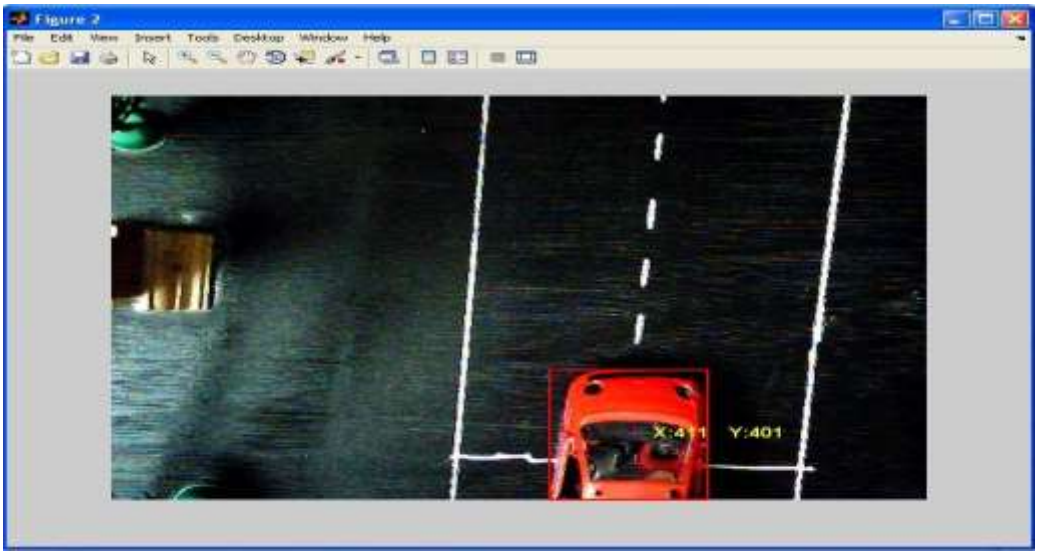


Figure 6.1Starting frame coordinates of vehicle

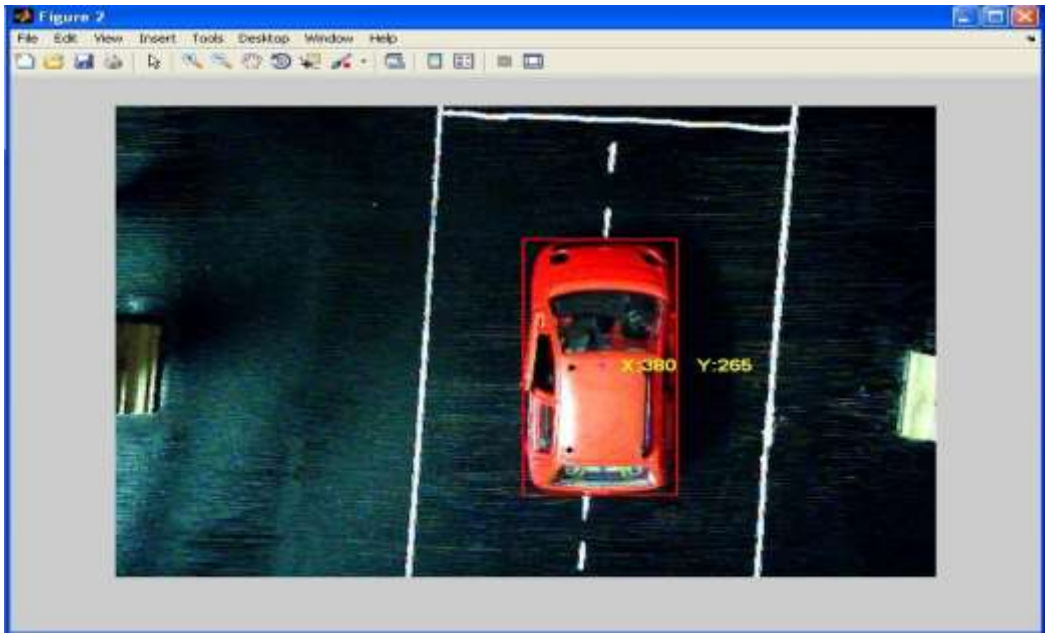


Figure 6.2Vehicle tracking by bounding box , labeling and centroid

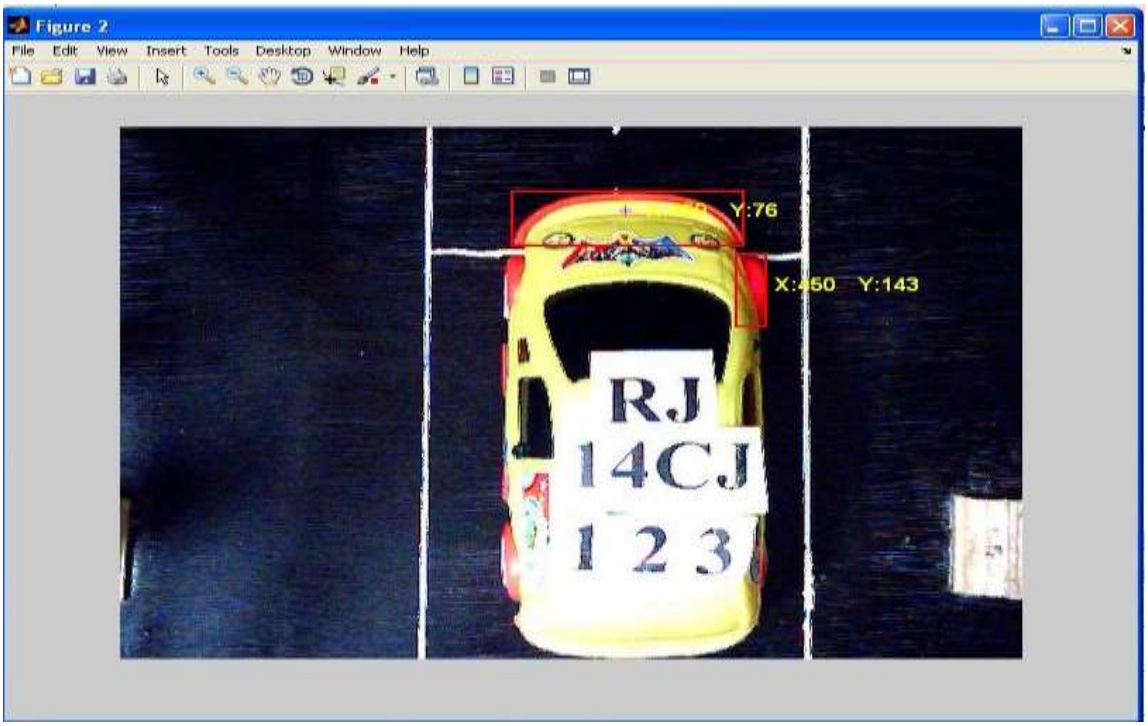


Figure 6.3Same rule is applicable to Big vehicles

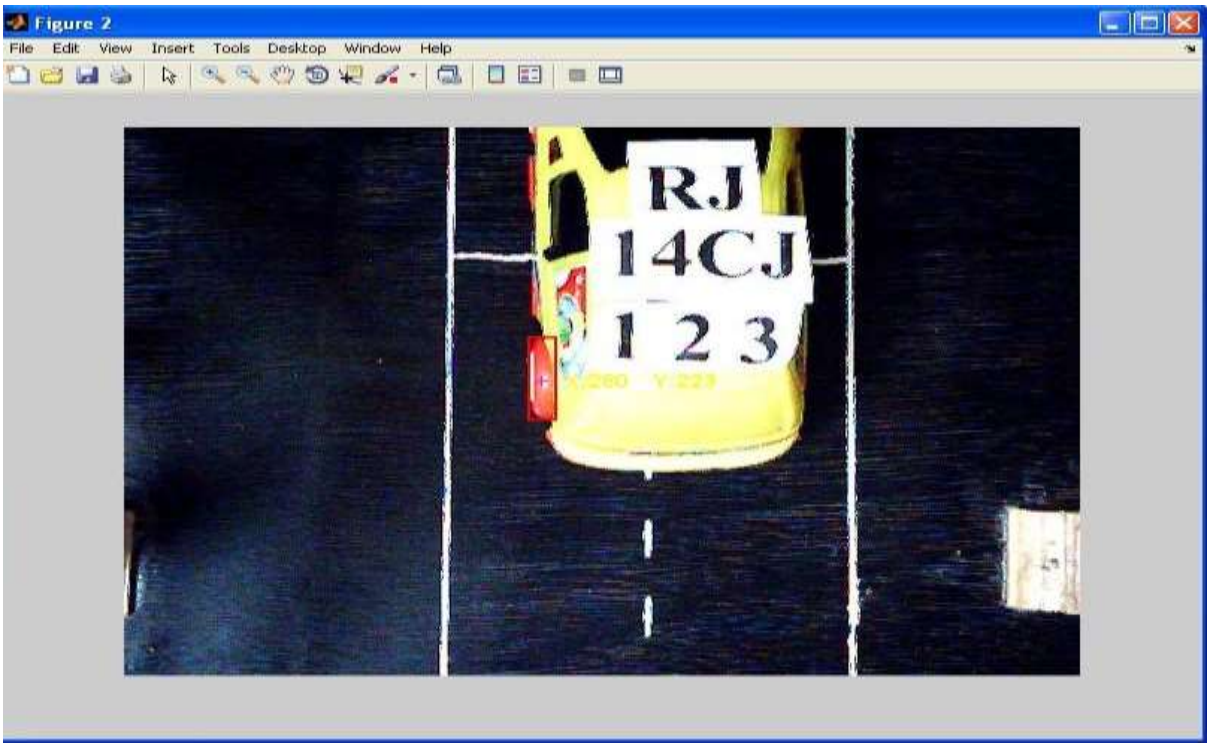


Figure 6.4Capturing frame of speed violating vehicle with its number plate for real time number plate detection

6.2 Speed detection on circular Track

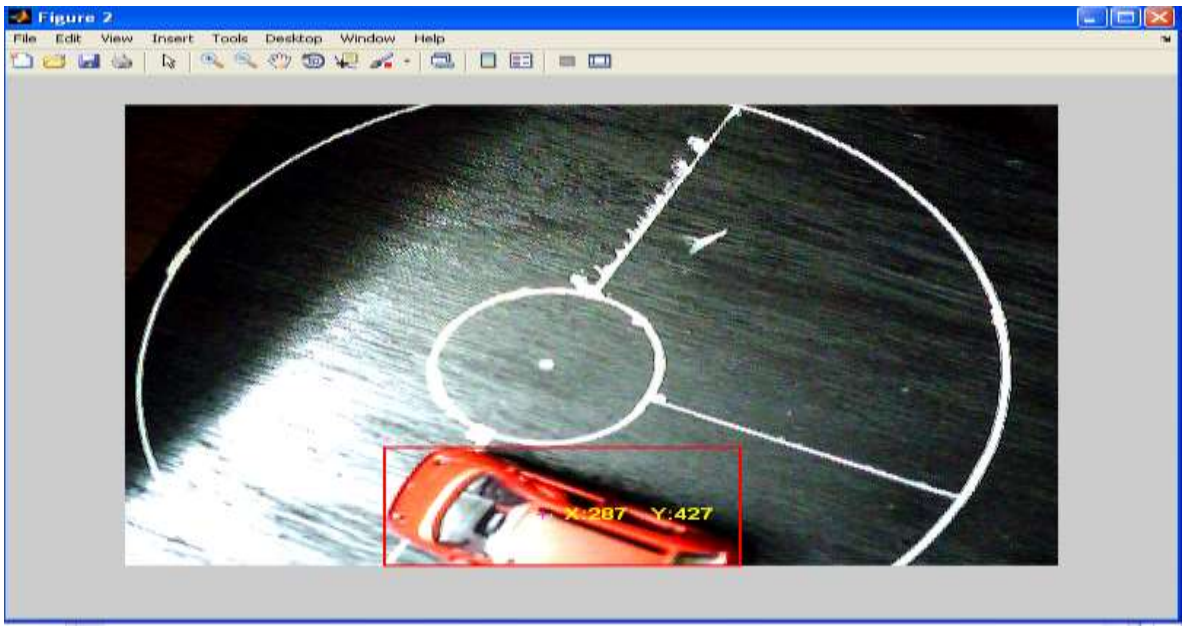


Figure 6.5Coordinates of Starting frame at Circular track

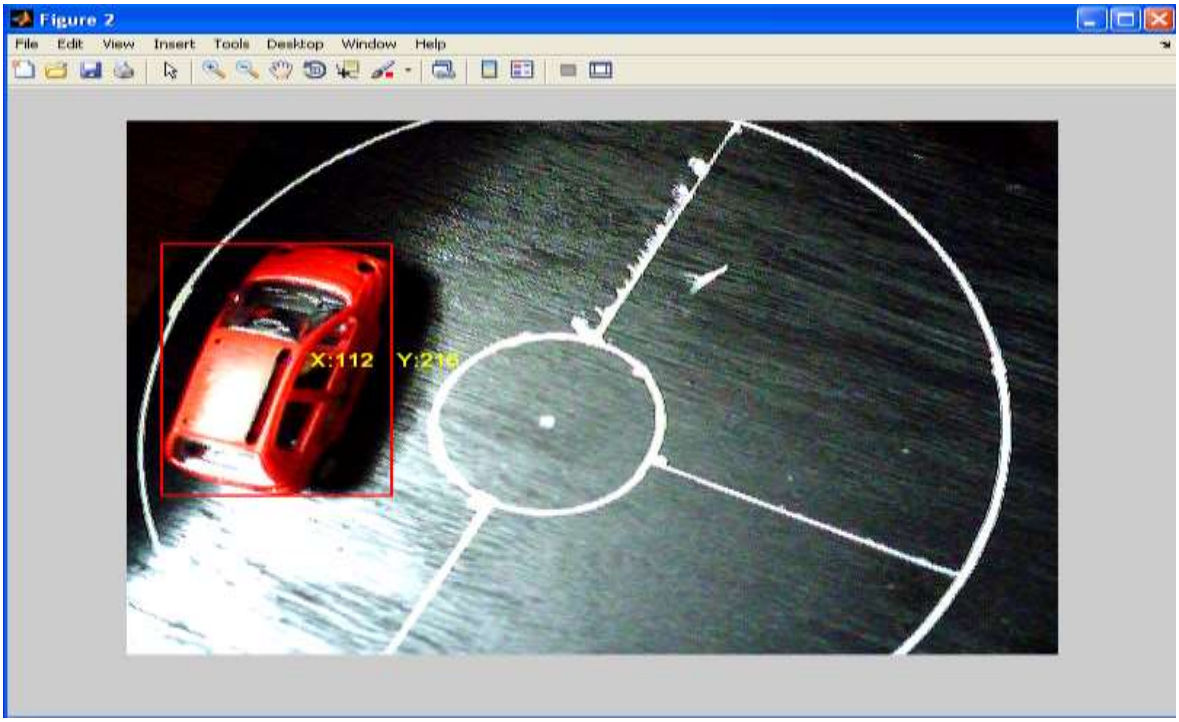
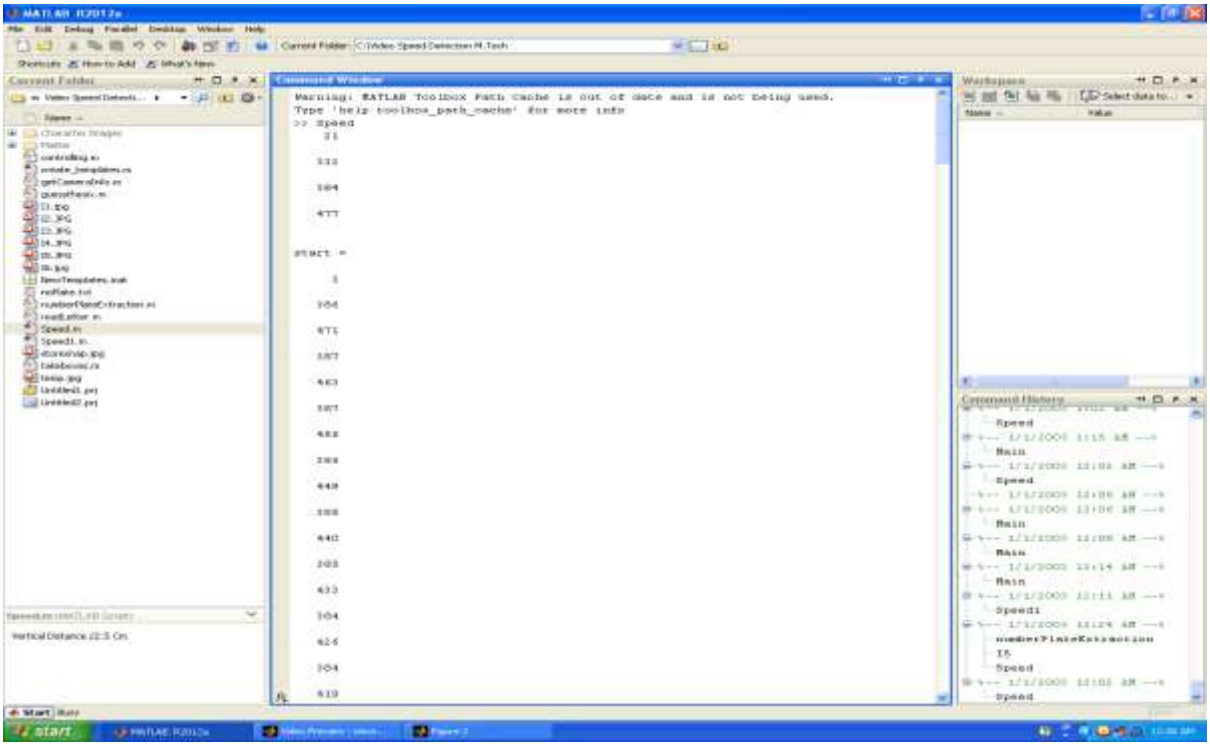
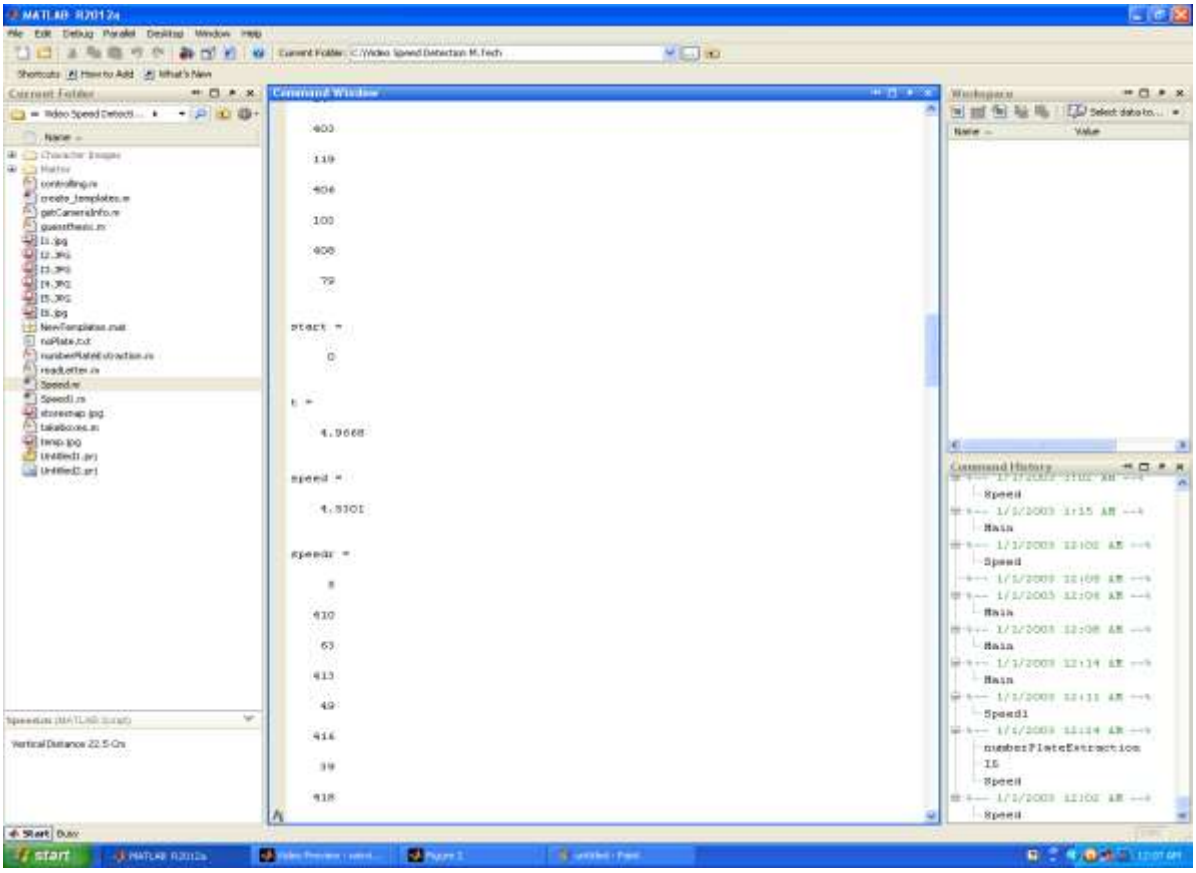
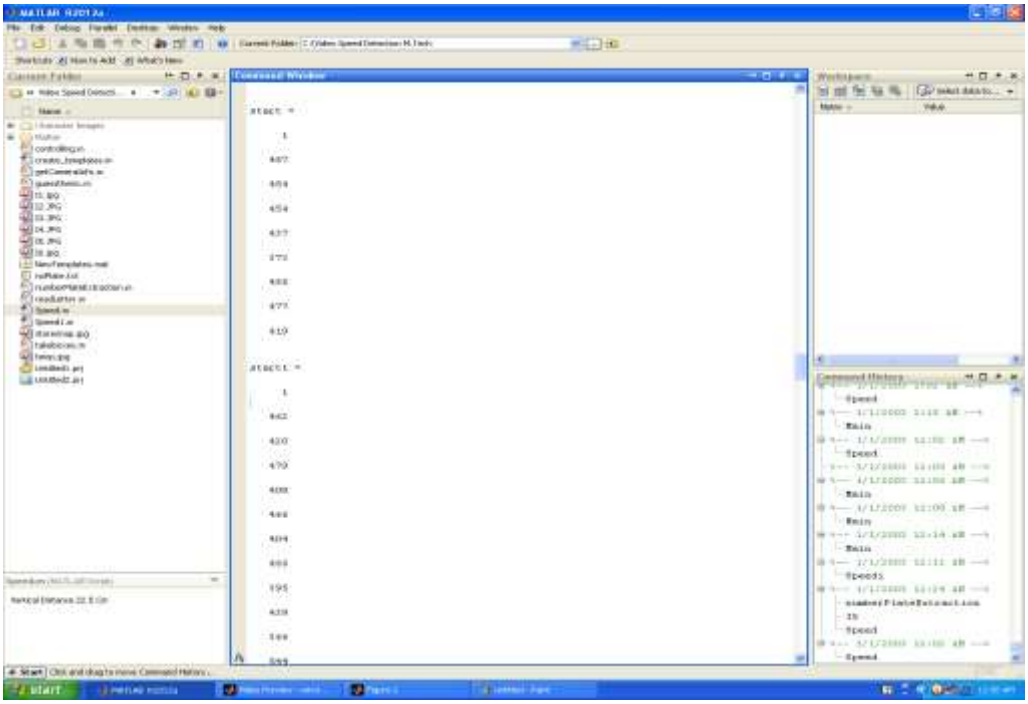
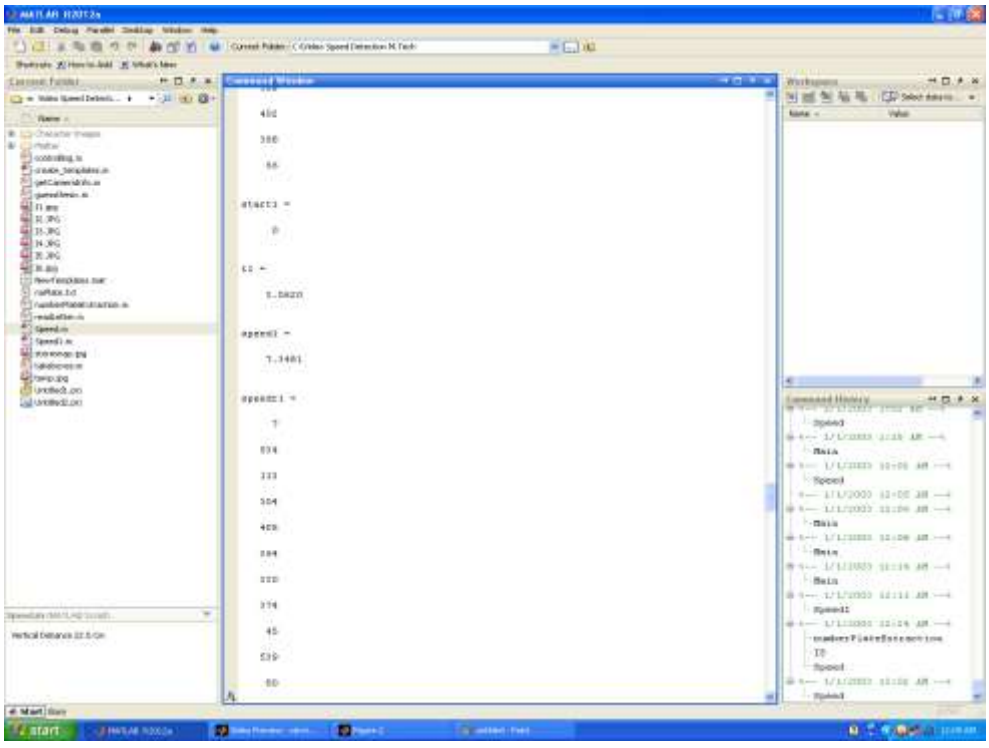


Figure 6.6Tracking of vehicle at circular track by its centered coordinates


Warning: MATLAB Toolbox Path Cache is out of date and is not being used.
Type 'help toolbox_path_cache' for more info
>> Speed
start =
speed =
speedr =


start =
t =
speed =
speedr =





6.3 Number plate Extraction :

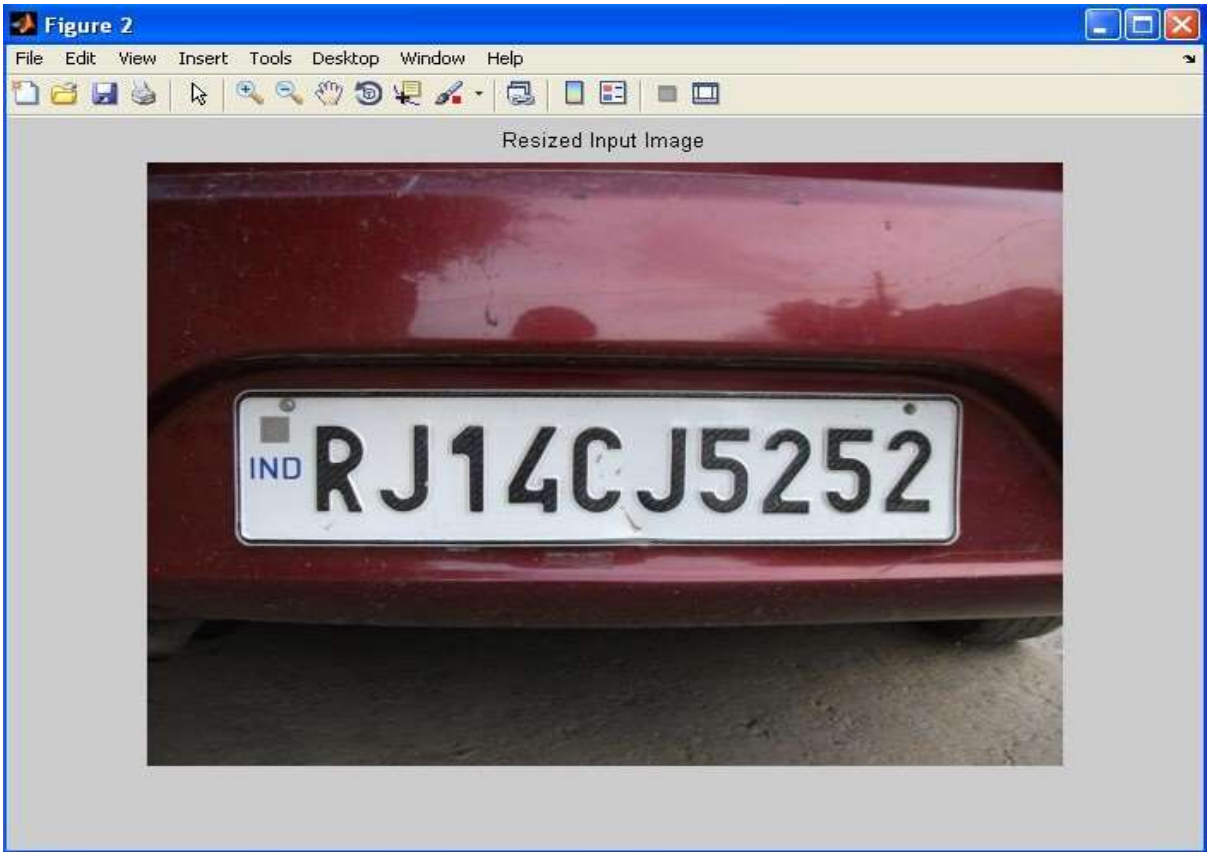



Figure 3
File Edit View Insert Tools Desktop Window Help
Grayscale Converted
IND RJ14CJ5252

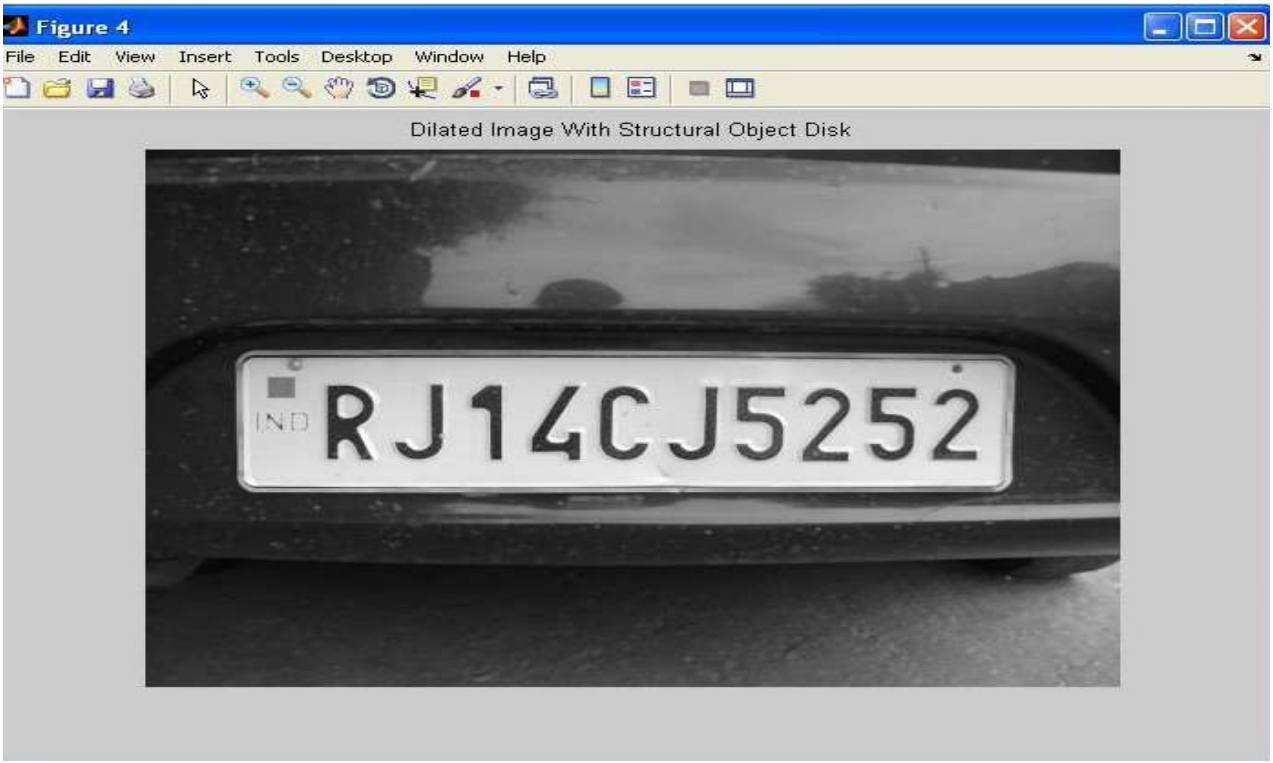


Figure 4
File Edit View Insert Tools Desktop Window Help
Dilated Image With Structural Object Disk
IND RJ14CJ5252

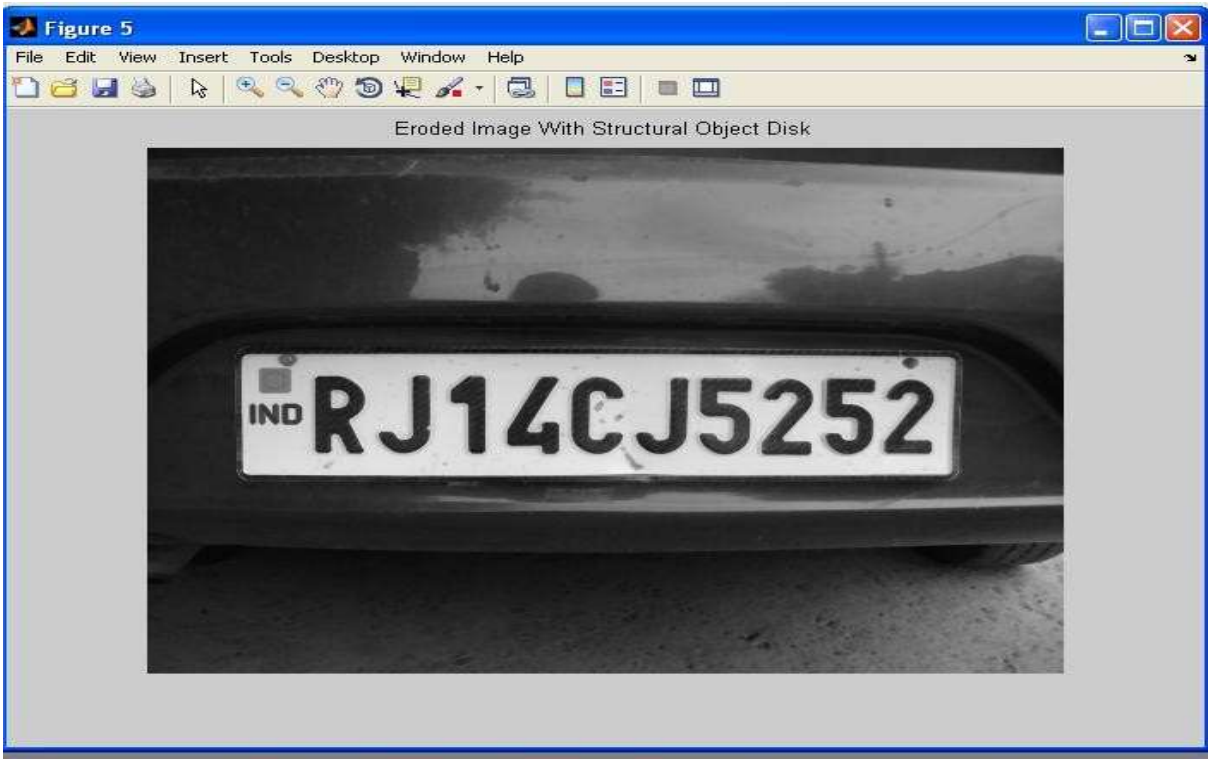


Figure 5
File Edit View Insert Tools Desktop Window Help
Eroded Image With Structural Object Disk
IND RJ14CJ5252


Figure 6
File Edit View Insert Tools Desktop Window Help
Morphological Gradient
IND RJ14CJ5252

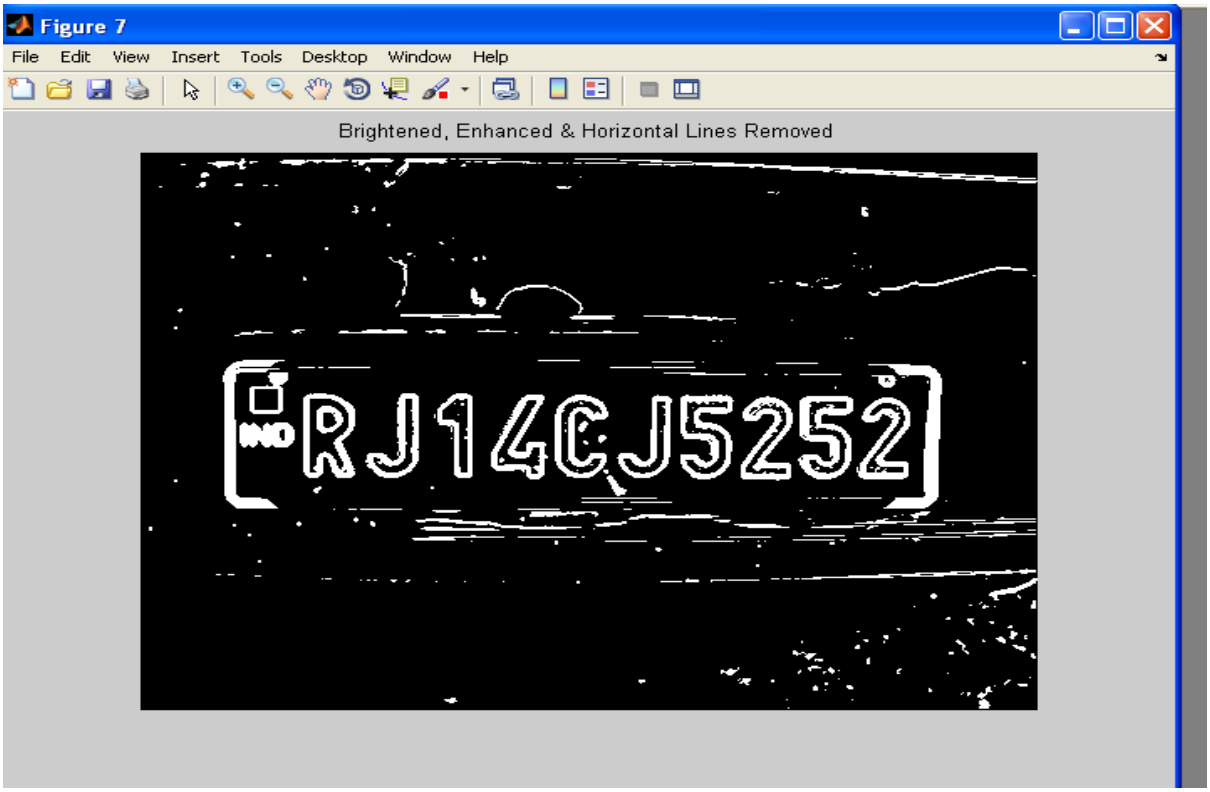


Figure 7
File Edit View Insert Tools Desktop Window Help
Brightened, Enhanced & Horizontal Lines Removed
RJ14CJ5252

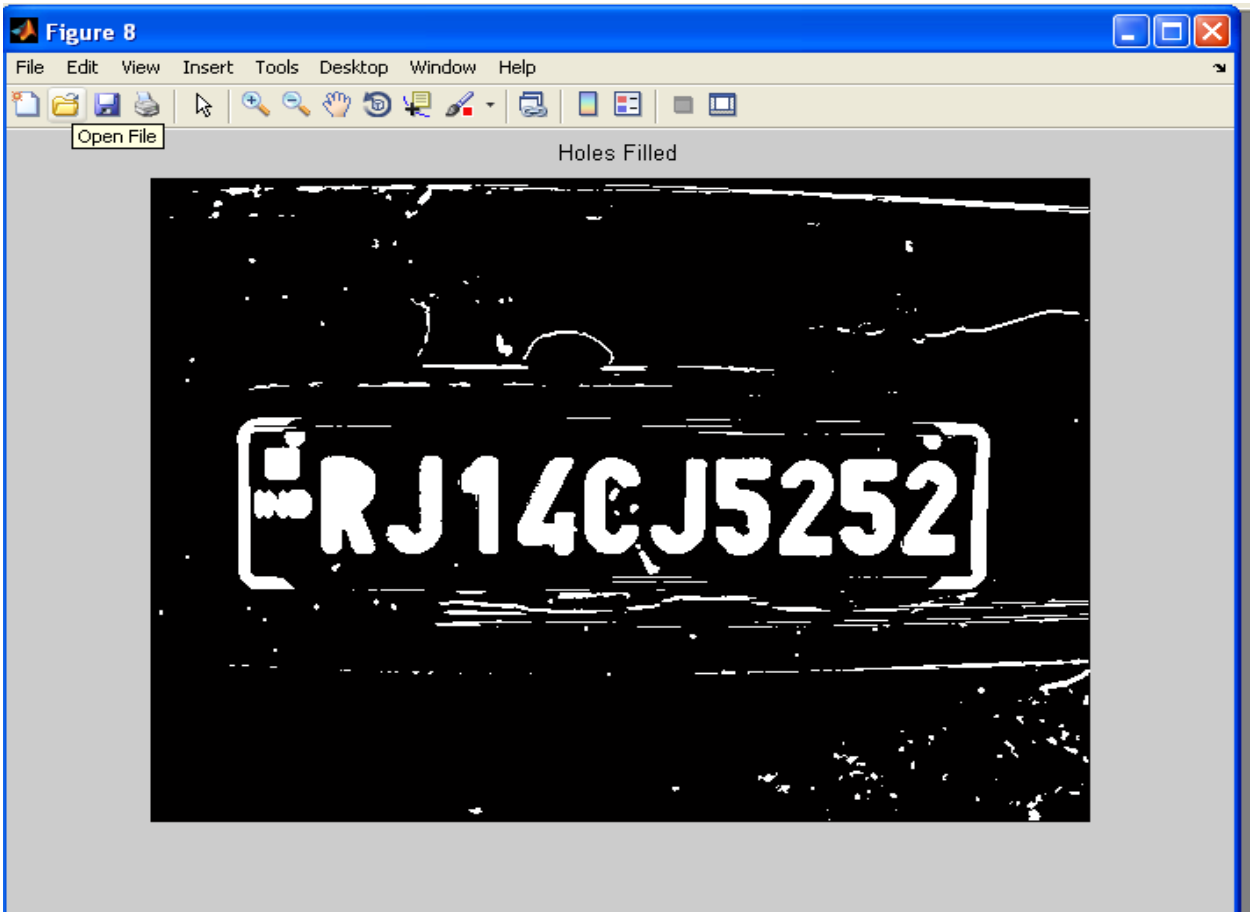


Figure 8
File Edit View Insert Tools Desktop Window Help
Open File
Holes Filled
RJ14CJ5252

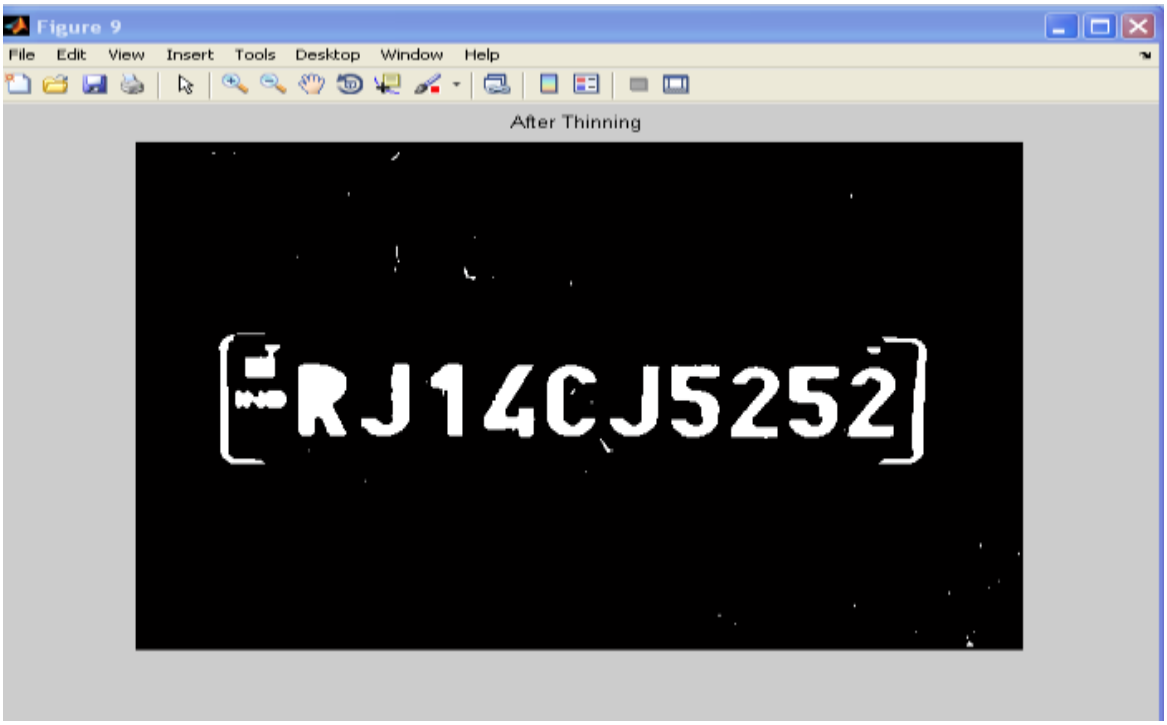


Figure 9
File Edit View Insert Tools Desktop Window Help
After Thinning
RJ14CJ5252

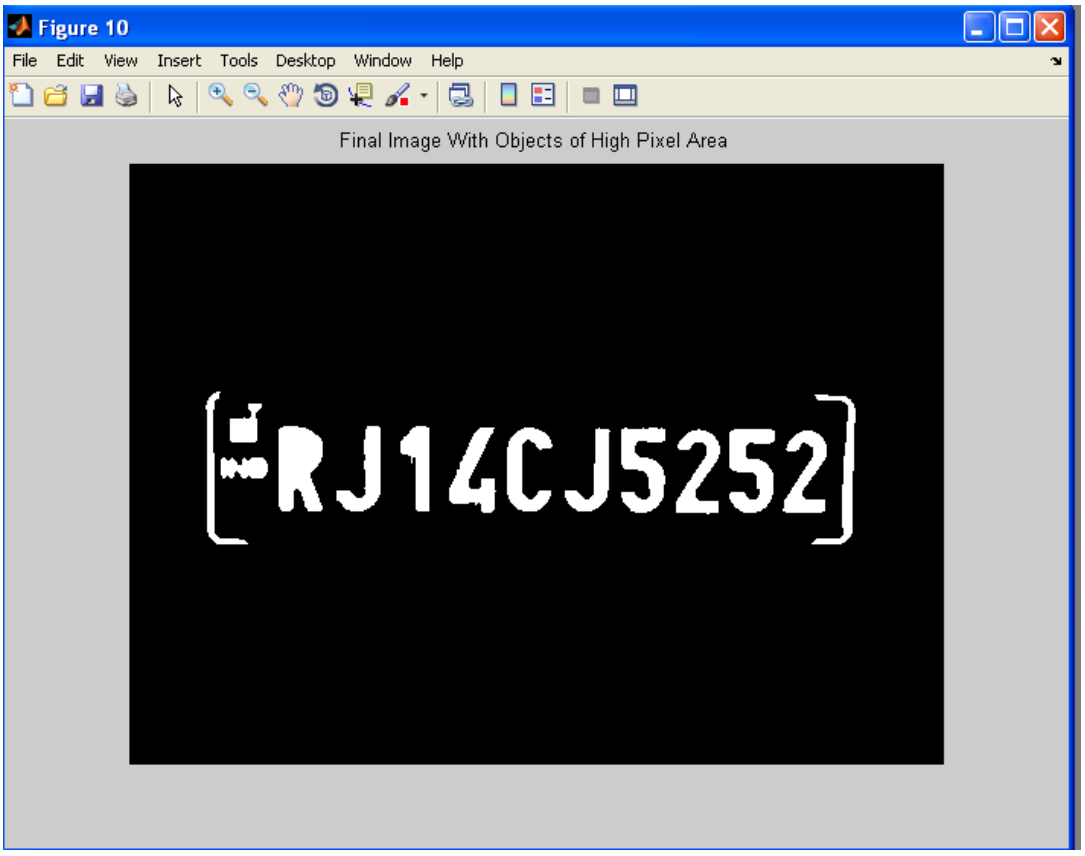
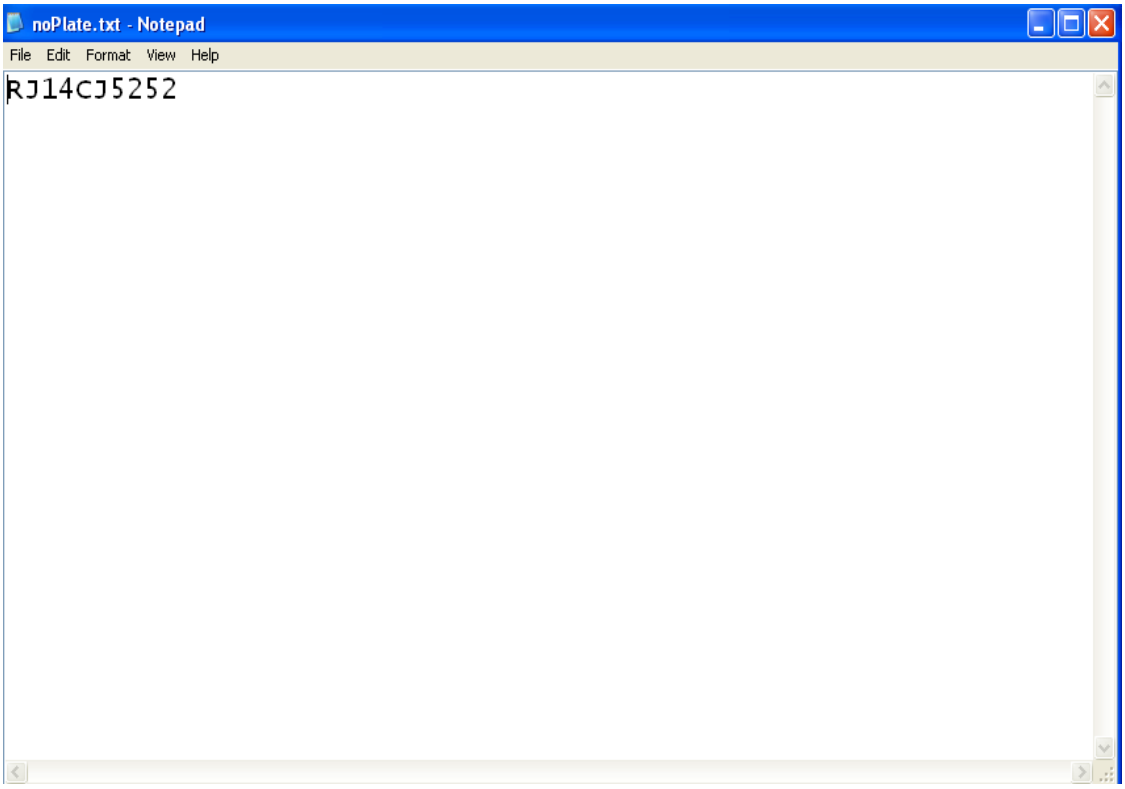


Figure 10
File Edit View Insert Tools Desktop Window Help
Final Image With Objects of High Pixel Area
RJ14CJ5252


noPlate.txt - Notepad
File Edit Format View Help
RJ14CJ5252

CHAPTER–7

Conclusion & future Scope

7.1 Conclusion

In this research work a new method for real time video surveillance system for automated speed detection and law enforcement using automatic number plate recognition system has been developed that uses image processing technique and is easily implemented using MATLAB. System measures the speed of vehicle on curved path as well as on linear path . once the vehicle is found over speeding the system captures its image at an instant of time and returns the number of license plate.

The research uses various concept of image processing and tools of matlab to detect a vehicle under the range of high resolution camera to retrieve its number plate . The use of high resolution camera has overcome traditional sensor based system for speed detection . this research work Is outcome of an integrated system that integrates video surveillance system for speed Detection and its law enforcement using automatic number plate recognition. The system detects moving objects on the road , derive its other parameters , label all its connected components which helped in obtaining the centroid of the moving object at last the speed of vehicle is calculated using various matlab functions and is based on the imaging geometry and camera pose of the image . The system works in a fine way for speed determination of local as well as highway traffic . The system uses various techniques of image processing such as background subtraction , binary image formation , grey scale image formation etc . For license plate detection it uses OCR technique . The research work is proven with implementation on hardware set up which makes it a real time solution for commercial traffic control system .

7.2 Future Scope :

- Speed detection with help of neural networks.
- Future work can be done on labeling of very close components .
- Efficiency of system can be increased by use of neural networks.