Chapter 1

Introduction

1.1 Motivation

Car accidents have a great effect on the average of total fatalities every year all over the world, most of these accidents are due to excessive speed as drivers do not commit to the highway speed limit. Every year 1.3 Million people die in car accidents [30-40%] due to excessive speed. While driving on highway, motorists should not exceed the maximum speed limit permitted for their vehicle to maintain road safety. However, accidents keep occurring due to speed violations since the drivers tend to ignore their speedometer. This system will come handy for highway traffic police.

1.2 Scope of the Project

We intend to design a system to detect over speeding vehicles and to take video of these vehicles. Then use this video to acquire the picture of the number plate and to use the information linked to the number plate through the database i.e. the mobile number linked with that particular over speeding vehicle and to send a fine ticket for breaking the road speed limit.

1.3 Organization of the Project

- Literature survey
- Software and Hardware Support
- Theoretical Background
- Result and Discussion
- Conclusion and Future Work

Chapter 2

Literature Survey

In this Chapter, we will study the basic methodology and review different parameters associated with various design formulae.

2.1 RELATED WORK

In metropolitan cities, traffic management plays an important role. For these various works have to be done and it can be explained as follows: Non-edge specific adaptive scheme (NEAS) is proposed to remove the blind motion blur which is adapted to frames that is taken from natural images. This scheme has more advantages when compared to the state of the art method [2]. In this paper, the blurry image itself encodes information by using blur kernel parameter. It uses familiar method, i.e. For example, if the image is considered to be the sharp images, then it is in high pass often, but it is in low pass for blurry images. This kernel can be notified by detecting and estimate the convolution operator changes before and after blurring [1]. Principal of visual word and bag of words are used to detect the license plate image automatically. Here BoW is applied in partial-duplicate image search. PVW discovers and matching the local feature and it also automatically characterized by geometric context [3]. To solve the deblurring problem special camera hardware is constructed which can record an auxiliary lower solution blur higher frame rate video. For this, the combination of deconvolution and super resolution method is approached [4].

2.2 Maximum speed of motor vehicles in kilometers per hour on different categories of roads.

TABLE 1

Maximum speed per hour in kilometers on roads in India					
S. No.	**Class of Motor Vehicles**	**Expressway with Access Control**	**4 lane and above divided carriageway (roads with Median strips/Dividers)**	**Road within Municipal Limits**	**Other Roads**
(1)	(2)	**(3)**	**(4)**	(5)	(6)
1.	Motor vehicles used for carriage of passengers comprising not more than eight seats in addition to the driver’s seat (Ml category vehicles)	120	100	70	70
2.	Motor vehicles used for carriage of passengers comprising nine or more seats in addition to the driver’s seat (M2 and M3 category Vehicles)	100	90	60	60
3.	More vehicles used for carriage of goods (All N category Vehicles)	80	80	60	60
4.	Motor Cycles	80*	80	60	60
5.	Quadricycle	–	60	50	50
6.	Three wheeled vehicles	–	50	50	50

Chapter 3

Software and Hardware Support

3.1 Matlab

Matlab is a multi-paradigm numerical computing environment and proprietary programming language developed by Mathworks. Matlab allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces and interfacing with programs written in other languages, including C,C++,C#, Java and python. Although Matlab is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

3.2 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language(based on Wiring), and the Arduino Software (IDE), based on Processing. Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50. The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows. The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

3.3 GSM

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection. A GSM modem can also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. GSM modem is usually preferable to a GSM mobile phone. The GSM modem has wide range of applications in transaction terminals, supply chain management, security applications, weather stations and GPRS mode remote data logging.

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3.4 Camera

A Digital Camera is a camera that captures photographs in digital memory. Most cameras produced today are digital, and while there are still dedicated digital cameras, many more are now incorporated into devices ranging from mobile devices to vehicles.] However, professionals still commonly use high-end, high-definition dedicated cameras. Digital and movie cameras share an optical system, typically using a lens with a variable diaphragm to focus light onto an image pickup device. The diaphragm and shutter admit the correct amount of light to the imager, just as with film but the image pickup device is electronic rather than chemical. However, unlike film cameras, digital cameras can display images on a screen immediately after being recorded, and store and delete images from memory. Many digital cameras can also record moving videos with sound. Some digital cameras can crop and stitch pictures and perform other elementary image editing. Overall final image quality is more dependent on the image processing capability of the camera, than on sensor type. The resolution of a digital camera is often limited by the image sensor that turns light into discrete signals. The brighter the image at a given point on the sensor, the larger the value that is read for that pixel. In case of a digital camera, the lens determines the maximum sharpness of the image while the image sensor determines the maximum resolution. The illustration on the right can be said to compare a lens with very poor sharpness on a camera with high resolution, to a lens with good sharpness on a camera with lower resolution. Shutter speed exists because of something known as your camera shutter – which, simply put, is a curtain in front of the camera sensor that stays closed until the camera fires. When the camera fires, the shutter opens and fully exposes the camera sensor to the light that has passed through your lens. After the sensor is done collecting the light, the shutter closes immediately, stopping the light from hitting the sensor. The button that fires the camera is also called “shutter” or “shutter button,” because it triggers the shutter to open and close. When you use a long shutter speed, you end up exposing your sensor for a significant period of time. The first big effect of shutter speed is motion blur. If your shutter speed is long, moving subjects in your photo will appear blurred along the direction of motion

Chapter 4

Theoretical Background

4.1 Design Methodology

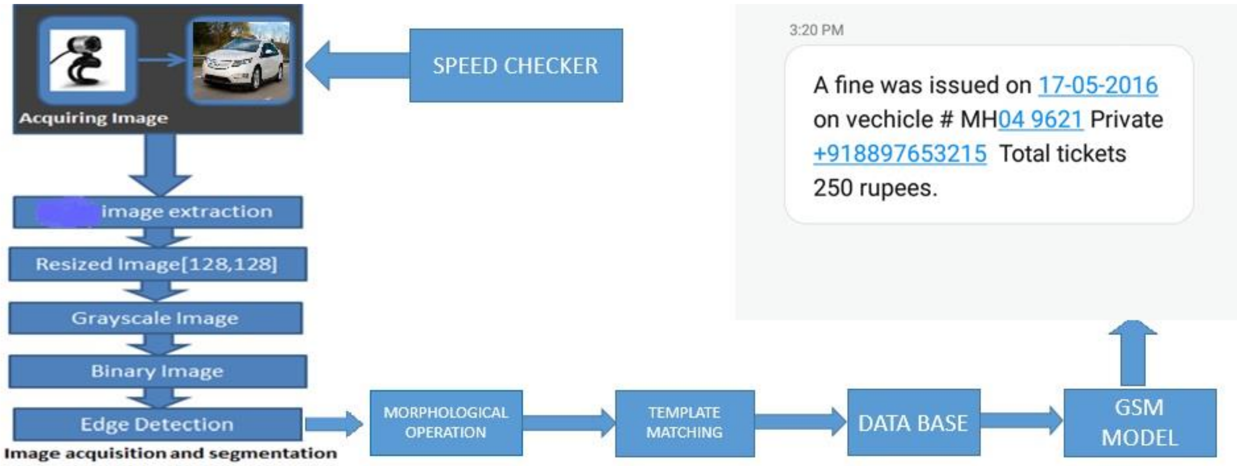

Figure 4.1: Basic flow and design methodology

In the proposed Project, speed checker using Arduino and IR sensors are used to detect speed of the vehicle. When the vehicle crosses the speed limit then the Arduino will trigger the camera to take the frame of the over speeding vehicle from the video and acquire the required frame where number plate is visible. After the number plate is acquired from the video, it undergoes image processing. The number plate undergoes the following steps:

1. Anti-blurring
2. Noise removal using Median filter,
3. Segmentation
3. Morphological operation
4. Feature extraction
5. Template matching
6. GSM Module

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4.1.1 Speed checker

The system comprises Arduino and two IR sensors, which are installed on the highway 100 meters apart. The system displays the speed at which the vehicle in crossing this 100m distance from one pair to the other with a resolution of 0.01 second.

Speed= Distance/Time

Time= Distance/Speed

=Distance*0.001/speed

Using this above formula, we can calculate the minimum time required to travel 100 meter, which can be fixed for a particular road and based on this timing system, can measure if the car is over speeding or no.

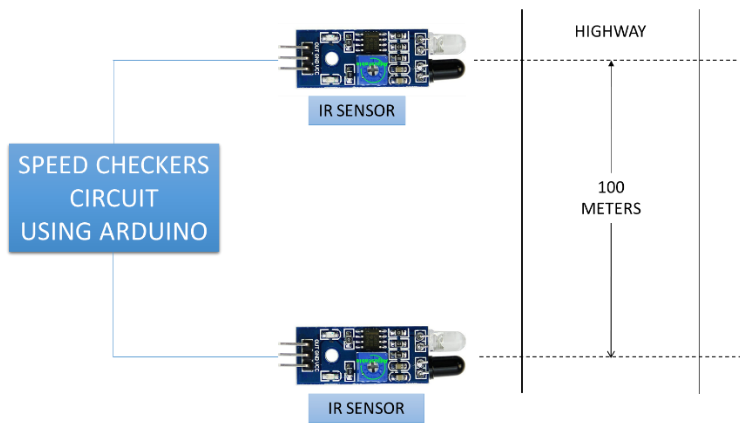


Figure 4.1.1: Method of detecting speed of the car

4.1.2 Acquiring Image

The frontal or backend of the vehicle are first taken from a surveillance camera. In this video, each vehicle has the license plate with peculiar number. Then camera permits the sample video to the system. Here the sample video Camera has fixed at a various height and angle and it can be placed at various locations such as parking areas, most traffic streets in cities, accident zones, etc. However, in this method, work has been done upon 1to 2 minute video clip. The videos are taken using the web camera of Logitech at a resolution of 1024 x 768 pixels. The Video file is taken from the surveillance camera, which is read in MATLAB by using a video reader. The Information about the video such as height, width, etc. can be obtained by using get (object name). It displays all information in the command window. The video is converted into several frames of the same size by using the MATLAB function.

Figure 4.1.2: Acquiring image of the speedy vehicle

4.1.3 Anti-blurring

1. **Blur effect**: The greatest difficulty in image processing is deblurring an image without any artifact from theoretical as well as from the practical point of view. The image is also corrupt by noise so that denoising also has to be done to enhance the image. Image denoising is also one of the parts of image deblurring process. The image is degraded by different types of the blur effect. (a) Average Blur: Average blur occur due to the distribution of blur in the form of horizontal, vertical and circular direction by radius. The radius can be calculated by using the below formula.

R = h2+v2

Where, h is the horizontal direction v is the vertical direction R is the radius of the circle.

2. **Gaussian blur**: Blur effect in an image can be controlled by Gaussian blur. Bell-shaped curve is obtained by increment the number of pixels in the Gaussian filters.

3. **Motion blur**: In the proposed scheme discussed the motion blur. Movement of camera or object causes motion blur due to the spreading of pixel over a distance in the direction of motion. It is much more complex when compared to other blur. This type of problem commonly seen in fast moving vehicles videos which are captured by camera held in traffic zones, parking zones, toll gates and so on... This blurred image has less amount of information so the restoration of blurred image plays a vital role in tracking and identification of criminals. Point Spread Function (PSF) is one of the characters of a motion blur. Image is deblurred by different type of filter.

a. Deblurring with Lucy-Richardson Filter Algorithm: Lucy Richardson algorithm provides an iterative method of image restoration for a given Point Spread Function (PSF). This is a Bayesian Based Iterative method and it is also known as the Richardson-Lucy Deconvolution method in which the PSF is known. PSF describes the impulse response of an image. Using this algorithm, we can 1. Reduce the noise effect on image restoration. 2. Non uniform quality of the image can be accounted. 3. Camera read-out and background noise can be handled. 4. Resolution of restored image can be improved by sub sampling.

b. Deblurring with Regularized Filter: The smallest amount of noise information is obtained when impulses are forced into an unnatural manner in such a case regularized filter is used. This type of filter is used to restore blurred and noisy image. In Matlab the function called deconverge is used to deblur an image.

c. Deblurring with Wiener Filter: Wiener filter is one of the best filters to restore an image from blur and noise. In the proposed scheme, deconvwnr Matlab function is used to deblur an image by using wiener filter. The Small amount of frequency characteristics of the image and additive noise are known then such a case wiener filter is used. The PSF value is known exactly then the deblurring can be effective. It is the best way for the reconstruction of noisy signal.

- It applies in orthogonal function in different basis gives different results.
- If the signal separate from the noise it will be best.
- Noisy components are moving towards zero by the universal wiener filter.
- It is usually applied between the difference of image and a levelled image.
- Wiener filter act as a low pass filter on spatial basis

4.1.4 Noise removal using Median filter

The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median see median for more details.

4.1.5. Segmentation

Conversion to grayscale:-

Since red color has more wavelength of all the three colors, and green is the color that has not only less wavelength then red color but also green is the color that gives more soothing effect to the eyes. It means that we have to decrease the contribution of red color, increase the contribution of the green color, and put blue color contribution in between these two.

Therefore, the form is
Grayscale image = ((0.3 * R) + (0.59 * G) + (0.11 * B))

According to this equation, Red has contribute 30%, Green has contributed 59% which is greater in all three colors and Blue has contributed 11%. Applying this equation to the image, we get this

It is used to convert 3D image to 1D image.

Figure 4.1.5(a): Original image

Figure 4.1.5(b): Grayscale image

Threshold:

- In very basic terms, thresholding is like a Low Pass Filter by allowing only particular color ranges to be highlighted as white while the other colors are suppressed by showing them as black.
- In image processing, the balanced histogram thresholding method (BHT) is a very simple method used for automatic image thresholding. Like Otsu's Method and the Iterative Selection Thresholding Method, this is a histogram based thresholding method.

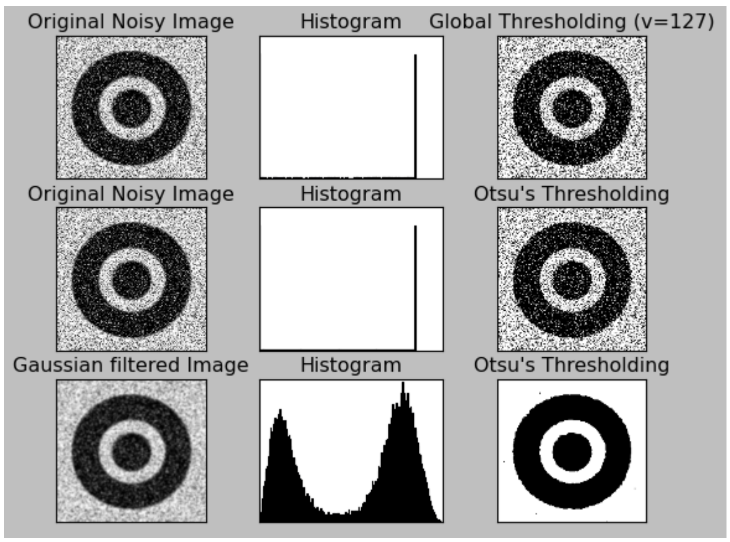


Figure 4.1.5(c): Conversion of original image into threshold image

The function transforms a grayscale image to a binary image according to the formulae:

- **THRESH_BINARY**

$$dst(x,y) = \begin{cases} \texttt{maxValue} & \text{if } src(x,y) > T(x,y) \\ 0 & \text{otherwise} \end{cases}$$

- **THRESH_BINARY_INV**

$$dst(x,y) = \begin{cases} 0 & \text{if } src(x,y) > T(x,y) \\ \texttt{maxValue} & \text{otherwise} \end{cases}$$

where $T(x,y)$ is a threshold calculated individually for each pixel (see adaptiveMethod parameter).

Edge (Sobel):

BW = edge (I) returns a binary image BW containing 1s where the function finds edges in the input image I and 0s elsewhere. 'Sobel':-Finds edges at those points where the gradient of the image I is maximum, using the Sobel approximation to the derivative.

Sobel Edge Detection:-

Sobel method is applied to perform edge detection. The Sobel edge detector use two masks with 3x3 sizes, one estimating the gradient in the x-direction and the other estimating the gradient in the y-direction. The mask is slid over the image, manipulating a square of pixels at a time. The algorithm calculates the gradient of the image intensity at each point, and then gives the direction to increase the image intensity at each point from light to dark. Edges areas represent strong intensity contrasts which are darker or brighter. Sobel algorithms work using a mathematical procedure called convolution and commonly analyze derivatives or second derivatives of the digital numbers over space. We implement the Sobel method for edges detection, which is based on a 3 by 3 array that is moved over the main image. The Sobel convolution kernels are designed to respond to edges vertically and horizontally. These masks are each convolved with the image. It calculates horizontal and vertical gradient (Gx and Gy), then combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient.

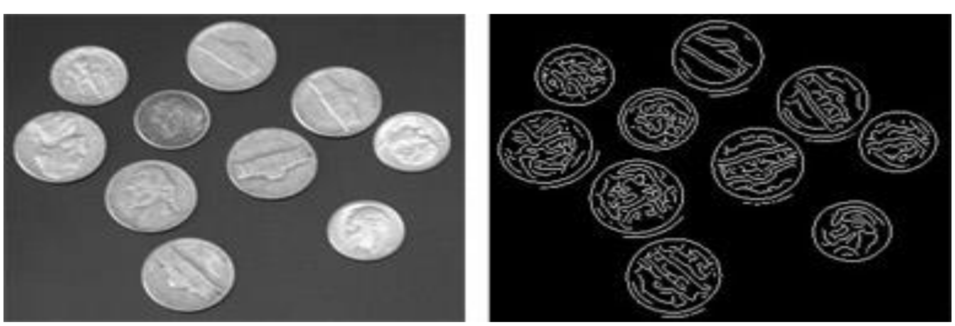


Figure 4.1.5(d): Original image and edge detected image using Sobel edge detection

4.1.6 Morphological operation

Dilation:

Dilation is one of the two basic operators in the area of mathematical morphology, the other being erosion. It is typically applied to binary images, but there are versions that work on grayscale images. The basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (i.e. white pixels, typically). Thus areas of foreground pixels grow in size while holes within those regions become smaller. Useful background to this description is given in the mathematical morphology section of the Glossary. The dilation operator takes two pieces of data as inputs. The first is the image which is to be dilated. The second is a (usually small) set of coordinate points known as a structuring element (also known as a kernel). It is this structuring element that determines the precise effect of the dilation on the input image. The mathematical definition of dilation for binary images is as follows: Suppose that X is the set of Euclidean coordinates corresponding to the input binary image, and that K is the set of coordinates for the structuring element. Let Kx denote the translation of K so that its origin is at x. Then the dilation of X by K is simply the set of all points x such that the intersection of Kx with X is non-empty. The mathematical definition of grayscale dilation is identical except for the way in which the set of coordinates associated with the input image is derived. In addition, these coordinates are 3-D rather than 2-D.

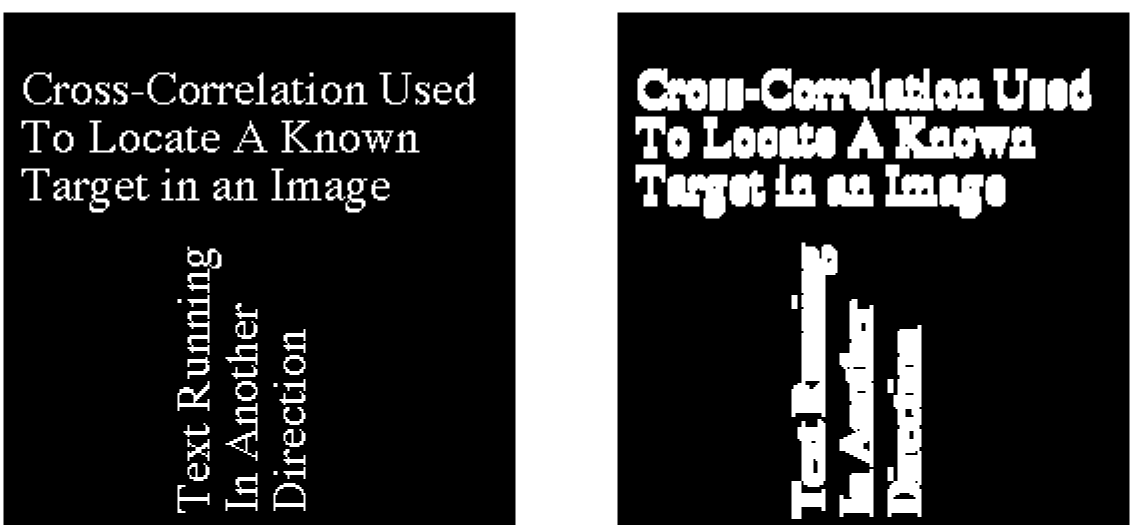


Figure 4.1.6(a): Original image and dilated image

Fill Holes:

The fill function performs a flood-fill operation on binary and grayscale images. For binary images, fill changes connected background pixels (0s) to foreground pixels (1s), stopping when it reaches object boundaries. For grayscale images, fill brings the intensity values of dark areas that are surrounded by lighter areas up to the same intensity level as surrounding pixels. In effect, fill removes regional minima that are not connected to the image border.

A common use of the flood-fill operation is to fill "holes" in images. For example, suppose you have an image, binary or grayscale, in which the foreground objects represent spheres. In the image, these objects should appear as disks, but instead are donut shaped because of reflections in the original photograph. Before doing any further processing of the image, you may want to first fill in the "donut holes" using fill. Because the use of flood-fill to fill holes is so common, fill includes special syntax to support it for both binary and grayscale images. In this syntax, you just specify the argument 'holes'; you do not have to specify starting locations in each hole.

Figure 4.1.6(b): Original image

Figure 4.1.6(c): Filling of holes in the original image

Erosion:

Erosion is one of the two basic operators in the area of mathematical morphology, the other being dilation. It is typically applied to binary images, but there are versions that work on grayscale images. The basic effect of the operator on a binary image is to erode away the boundaries of regions of foreground pixels (i.e. white pixels, typically). Thus areas of foreground pixels shrink in size, and holes within those areas become larger. Useful background to this description is given in the mathematical morphology section of the Glossary. The erosion operator takes two pieces of data as inputs. The first is the image which is to be eroded. The second is a (usually small) set of coordinate points known as a structuring element (also known as a kernel). It is this structuring element that determines the precise effect of the erosion on the input image. The mathematical definition of erosion for binary images is as follows: Suppose that X is the set of Euclidean coordinates corresponding to the input binary image, and that K is the set of coordinates for the structuring element. Let Kx denote the translation of K so that its origin is at x. Then the erosion of X by K is simply the set of all points x such that Kx is a subset of X. The mathematical definition for grayscale erosion is identical except in the way in which the set of coordinates associated with the input image is derived. In addition, these coordinates are 3-D rather than 2-D.

Figure 4.1.6(c): Original image and eroded image

4.1.7. Feature extraction

The Video file is taken from the surveillance camera, which is read in MATLAB by using a video reader. The Information about the video such as height, width, etc. can be obtained by using get (object name). It displays all information in the command window. The video is converted into several frames of the same size by using the MATLAB function ‘frame2im’. Read the frame at different ways, either one-image frame can be read at a time or sequence of frame can be read at a time, which takes more memory and also read the frame at different intervals. The below images are selected frames from the video.

Frame1

Frame2

Frame3

Figure 4.1.7(a): Capturing video and converting it into frames so that it can be read in the matlab software

Frames	Speed Of The Cars (Km/ Hr)	Height Of The Camera (m) or (cm)	Angle Position Of Camera (Degree)
1	10-20	90cm	30
2	60-70	3m	30
3	60-70	3m	30

TABLE 2: Frames at different angles and different height

Region Property:

Measure properties of image regions

Area

The total number of 'ON' pixels in the image. The number of ones in the matrix is 8.

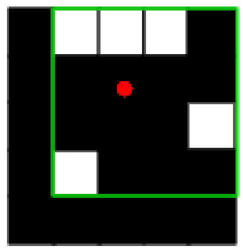


Figure 4.1.7(b): Measuring properties of the image

Bounding Box

Vector; the smallest rectangle containing the region

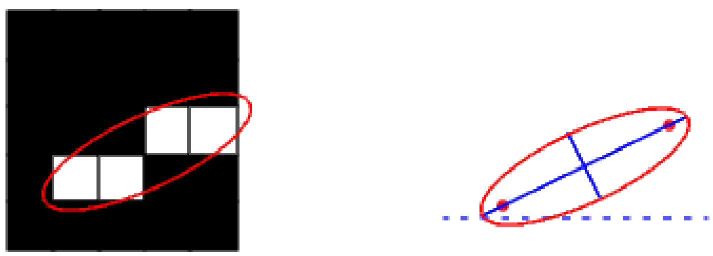


Figure 4.1.7(c): smallest rectangle containing the region

Image

Binary image (logical) of the same size as the bounding box of the region; the on pixels correspond to the region, and all other pixels are off.

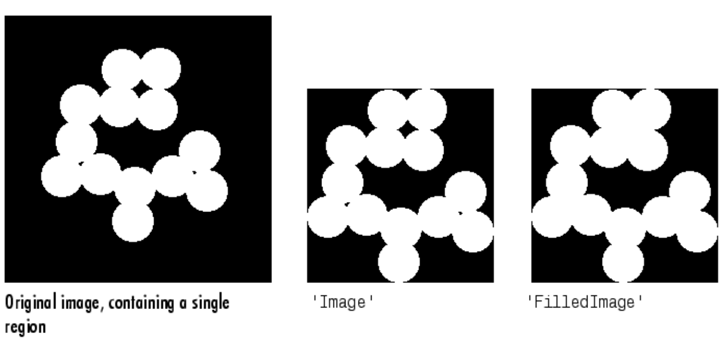


Figure 4.1.7(d): original image and filled region using bounded box

Open:

Opening and closing are two important operators from mathematical morphology. They are both derived from the fundamental operations of erosion and dilation. Like those operators they are normally applied to binary images, although there are also graylevel versions. The basic effect of an opening is somewhat like erosion in that it tends to remove some of the foreground (bright) pixels from the edges of regions of foreground pixels. However it is less destructive than erosion in general. As with other morphological operators, the exact operation is determined by a structuring element. The effect of the operator is to preserve foreground regions that have a similar shape to this structuring element, or that can completely contain the structuring element, while eliminating all other regions of foreground pixels.

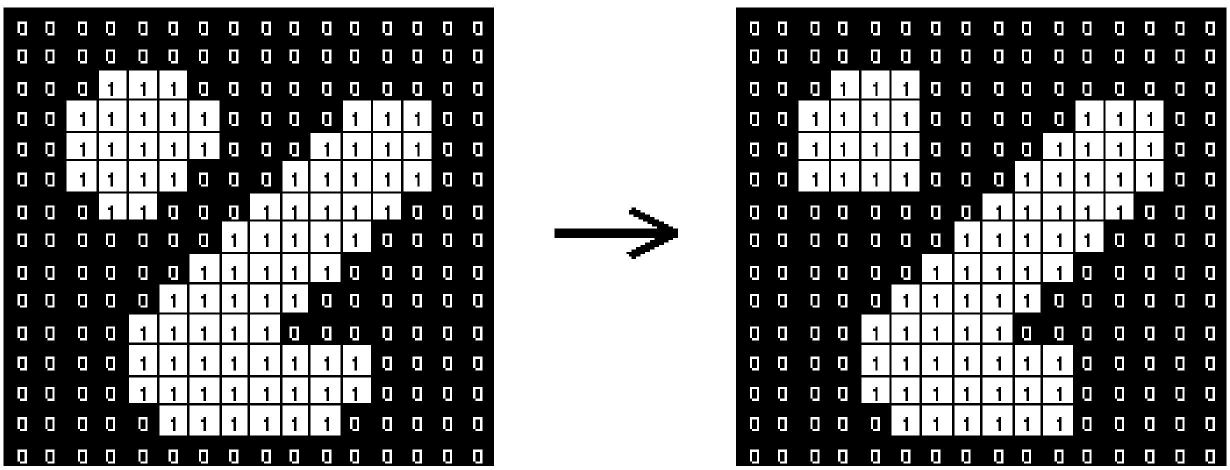


Figure 4.1.7(e): opening and closing operations on the given image

4.1.8. Template matching

The program finds the template image inside the target image using correlation.

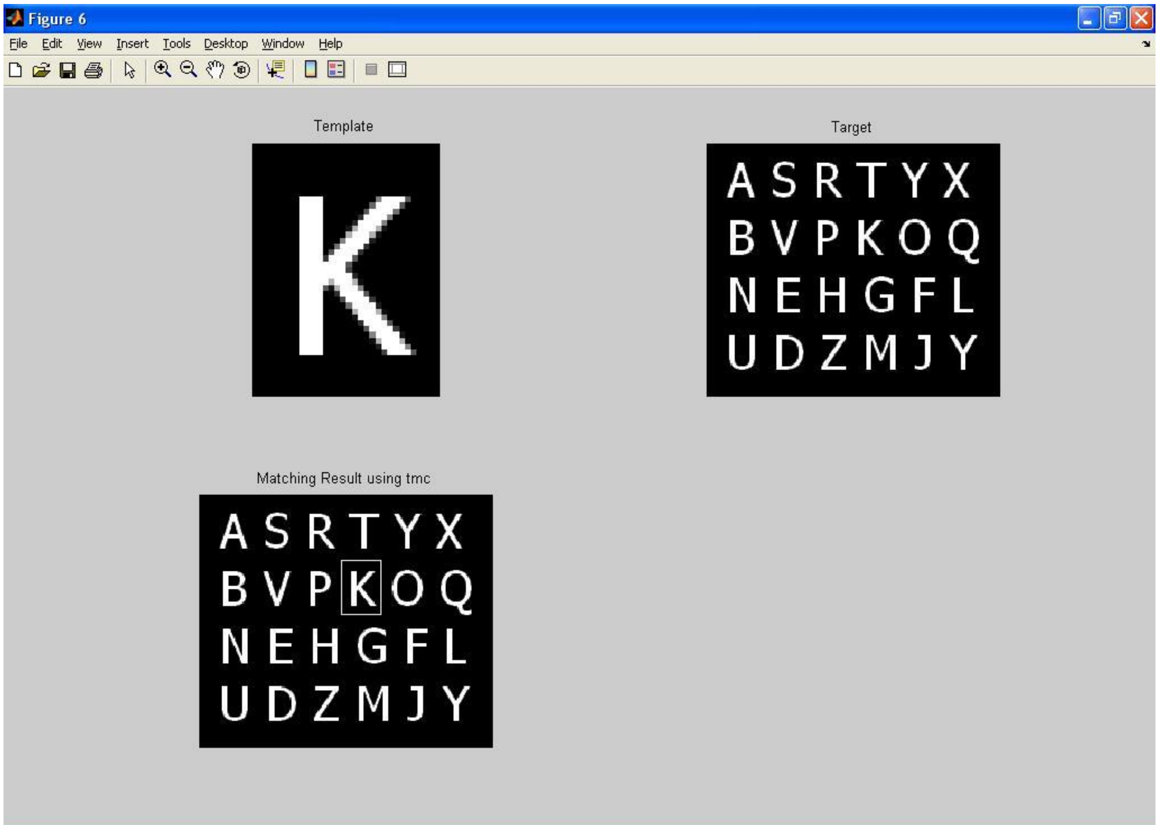


Figure 4.1.8: Template matching of the vehicle in the MATLAB software

4.1.9. GSM Module

After the information is acquired from the number plate i.e. the number written on the number plate this number will be used to find which mobile number is linked with it in the database. Then using GSM model a message will be sent to the acquired mobile number that will include the speed at which vehicle was travelling and the fine amount the driver has to pay for breaking the speed limit.

Chapter 5

Results and Discussion

This chapter is dedicated to a discussion of simulations performed and the results thereof. We have used Matlab software for image processing and other simulations.

5.1 Original image.

Figure 5.1: Original image

5.2 Segmentation

5.2.1 Grayscale image

Figure 5.2.1: Grayscale image

5.2.2 Edge

Figure 5.2.2: Edge detection of the image

5.3 Morphological operation

5.3.1 Dilation

Figure 5.3.1: Dilated image

5.3.2 Fill holes

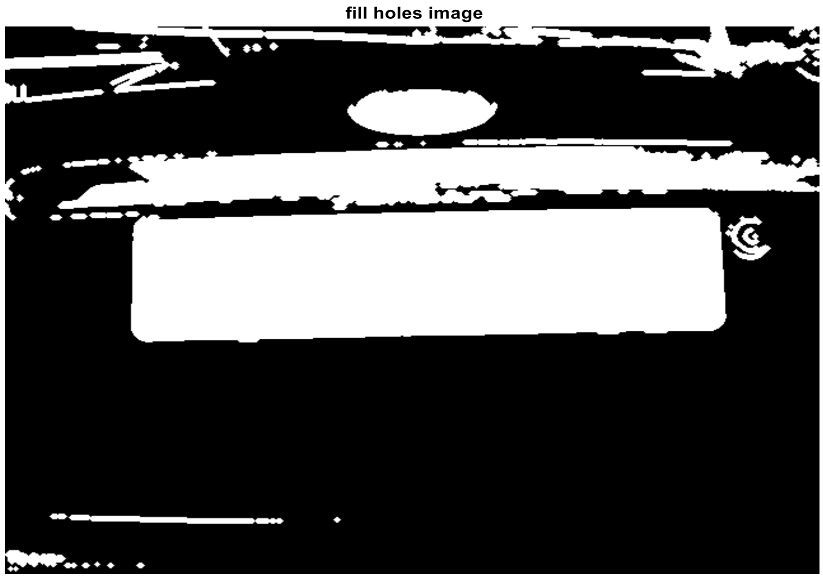


Figure 5.3.2: Filling of holes and regions in the dilated image

5.3.3 Erosion

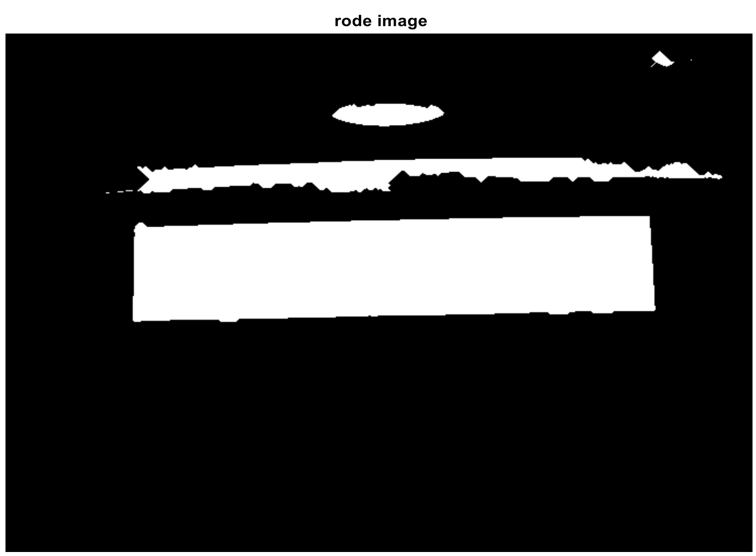


Figure 5.3.3: Performing erosion on the image filled with holes and regions

5.4 Feature extraction

5.4.1 Bounded image

Figure 5.4.1: Feature extraction (bounded image)

5.4.2 Resized image

Figure 5.4.2: Resizing the image for template matching

5.5 Template Matching

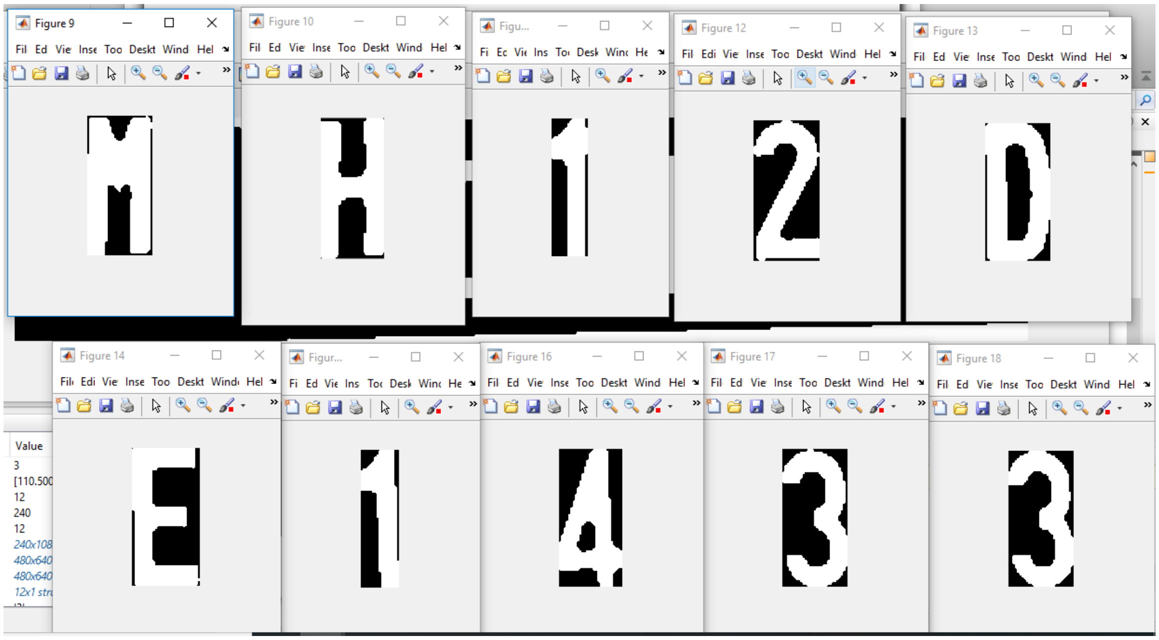


Figure 5.5: Template matching

5.6 Workspace

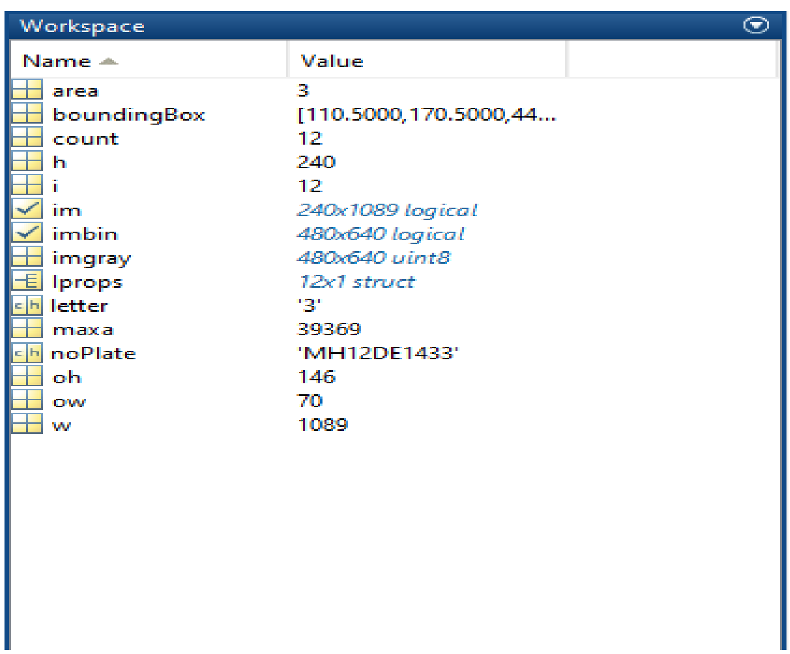


Figure 5.6: MATLAB workspace

Chapter 6

Conclusion and Future Work

6.1 Conclusion

In this course, the issues that arise in ending a project have been examined, and ways of evaluating a project have been discussed. The key components of project closure have been identified and discussed and their importance in ensuring that the aims and objectives of a project have been successfully attained, have been explored.

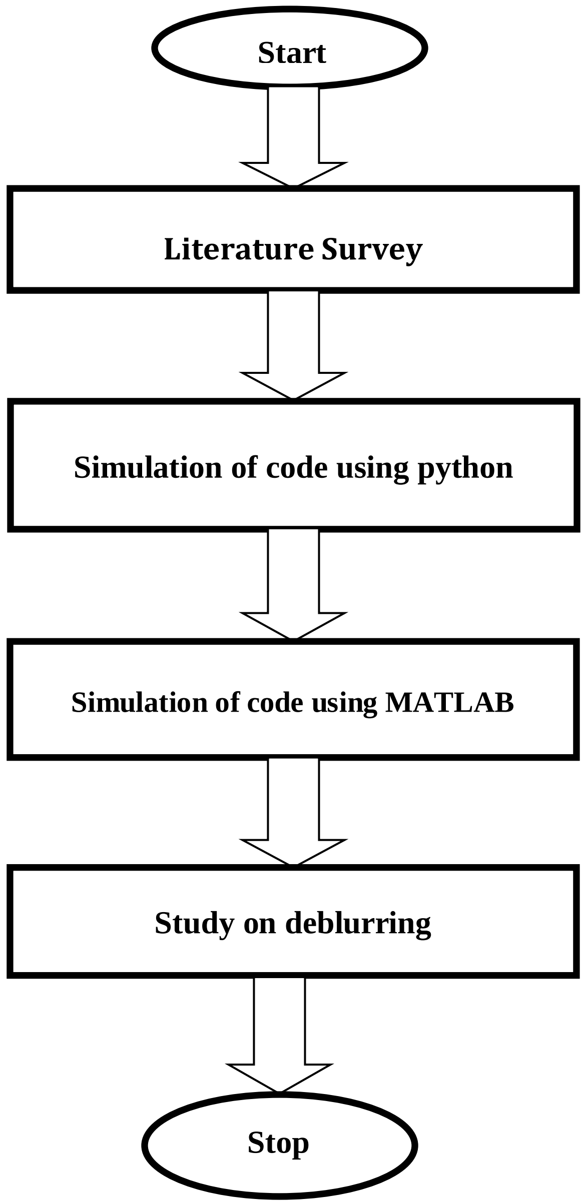
We have proposed an approach for capturing image and capturing video and converting it into frames using various Matlab functions. We have also performed various morphological operations and image extraction operations. In this, deblurring process includes frame coherence, erosion, and dilation and subtraction process. We have used Weiner filter for image deblurring to produce the best result than other techniques because it exhibits the high quality result. In other process due to the fast motion there is an motion blur occur and they predict that much blur only, but here we also process the morphological operation for better result. For further process we just to do the character segmentation if needed.

6.2 Future Work

We have to implement deblurring part and store the details of the vehicle number plate in the database. Based on the database, the phone number associated with that vehicle number plate will receive notification of over speed limit using GSM.

APPENDIX

Flow chart of the Project (Stage- I)



APPENDIX B

Targets	July				August				September				October			
	w 1	w 2	W 3	W 4	w 1	w 2	w 3	w 4	w 1	w 2	w 3	w 4	w 1	w 2	w 3	w 4
Deciding the project																
Project Acceptance																
Project planning																
Literature Survey																
Implementing on PYTHON																
Implementation using MATLAB																
Deblurring (Theory)																
Report for sem VII																

REFERENCES

[1] G. Liu, S. Chang, and Y. Ma, “Blind image deblurring using spectral properties of convolution operators,” IEEE Transactions on Image Processing (TIP), vol. 23, no. 12, pp. 5047–5056, Dec 2014.

[2] C. Wang, Y. Yue , F. Dong, Y. Tao, X. Ma, G. Clapworthy, H. Lin, and X. Ye, “Nonedge-specific adaptive scheme for highly robust blind motion deblurring of natural images,” IEEE Transactions on Image Processing (TIP), vol. 22, no. 3, pp. 884–897, Mar 2013.

[3] Amir Hossein Ashtari, Jan Nordin and MahmoodFathy “Iranian License Plate Recognition System Based on Color Features” IEEE Journals ,vol 33,no.9,2014 .

[4] A. Levin, Y. Weiss, F. Durand, and W. T. Freeman, “Understanding blind deconvolution algorithms,” IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), vol. 33, no. 12, pp. 2354–2367, 2011.

[5]Rectify the blurred license plate image from fast moving vehicles using morphological process **DOI:** 10.1109/ICEICE.2017.8191940

[6]Qingbo Lu, Wengang Zhou, Lu Fang, and Houqiang Li, Senior Member ,” Robust Blur Kernel Estimation for License Plate Images from Fast Moving Vehicles”,IEEE Transactions on Image processing (TIP). 2016.2535375,2016.

[7]J. Oliveira, M. Figueiredo, and J. Bivouacs-Dias, “Parametric blur estimation for blind restoration of natural images: linear motion and out of-focus,” IEEE Transactions on Image Processing (TIP), vol. 23, no. 1 pp. 466–477, Jan 2014

[8]G. Liu, S. Chang, and Y. Ma, “Blind image deblurring using spectral properties of convolution operators,” IEEE Transactions on Image Processing (TIP), vol. 23, no. 12, pp. 5047–5056, Dec 2014.

[9]Anat Levin, Yair Weiss, Fredo Durand, and William T. Freeman, Fellow, IEEE,IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 33, NO. 12, DECEMBER 2011