INNOVATIVE TRAFFIC LIGHT SYSTEM

A

PROJECT REPORT

Submitted In Partial Fulfillment of Requirements for the Award of the Degree of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted To

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE AND TECHNOLOGY, MURTHAL, SONIPAT

By

Rahul Dev(15001003042)

Rajkumar(15001003045)

Under the Guidance of

Ms. Kusum Dalal

(AP,ECED,DCRUST)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGYMURTHAL, SONIPAT-131039

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGYMURTHAL, SONEPAT-131039
Department of Electronics and Communication Engineering

CERTIFICATE

This is to certify that the project entitled **“Innovative Traffic Light System”** submitted by **RAHUL DEV(15001003042), RAJKUMAR(15001003045)** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Electronics and Communication Engineering**, in **Deenbandhu Chhotu Ram University of Science and Technology, Murthal** is an authentic work carried out by them under my supervision and guidance.

The project report submitted by **RAHUL DEV(15001003042), RAJKUMAR(15001003045)** is an authenticated work and has not been submitted to any other university/institute for the award of any degree.

Ms. Kusum Dalal
Project Supervisor

It is certified that the project viva-voce examination of **RAHUL DEV(15001003042), RAJKUMAR(15001003045)** has been held on dated _________________

Project Coordinator **Chairman, ECE Deptt**. **External Examiner**

DECLARATION

We hereby declare that the work which is being presented in this project report entitled **"Innovative Traffic Light System"** in partial fulfilment of requirements for the award of degree of **Bachelor of Technology** in **Electronics and Communication Engineering** submitted to the Department of Electronics and Communication Engineering, **Deenbandhu Chhotu Ram University of Science and Technology Murthal, Sonipat (Haryana),** is an authentic record of work carried out during a period from July 2018 to June 2019 under the supervision of **Ms. Kusum Dalal.** The matter presented in this report has not been submitted to any other University/Institute for the award of B.Tech or any other Degree/Diploma.

This is to certify that the above statement made by us is correct to the best of our knowledge and belief. If anything found incorrect in future, we will be responsible for the same.

Date: __/__/____ **Rahul Dev(15001003042)**

Rajkumar(15001003045)

This is to certify that above statement made by the candidates is correct to the best of my knowledge and belief.

Ms. Kusum Dalal
Project Supervisor

ACKNOWLEDGMENT

It fills our heart with immense pleasure to mention the name of our project supervisor **Ms. Kusum Dalal** for her supervision, advice and regular support right through our project work. We would like to thank him/her for being our supervisor.

Next we want to express our greetings to **Dr. Manoj Duhan (Chairman, ECE Department)** for teaching us and also helping us to discover how to learn. He has been a source of enormous inspiration for us and we are thankful to him from the bottom of our heart.

We would like to show appreciation to our Project & B.Tech Coordinator **Dr. Rajeshwar Dass** for his reliable support and effective communication methodologies without which it would have been a dream to complete the project on exact time.

We also express our thankfulness to other faculty and staff members of Department of Electronics and Communication Engineering, DCRUST, Murthal,Sonipat for their intellectual support during the course of this work.

We would like to show gratitude to all our classmates and friends for all the detailed and motivating discussions we had, which encouraged us to think beyond obvious. We have enjoyed their companionship so much during our stay at Deenbandu Chhotu Ram University of Science and Technology, Murthal.

Rahul Dev(15001003042)

Rajkumar(15001003045)

ABSTRACT

The project has a sole reason to structure a density based traffic light system where the signal will consequently change the timing interval of the signal on detecting the

traffic density in any direction of the intersection. Traffic clog is one of the most serious issues in significant urban communities over the world and hence there is a need to move to manual modes or a fixed clock mode utilizing a framework having decision making capabilities. Nowadays, traffic signal system allots fixed time in all the directions which leads to wastage of time if one path is more busy than others. To improve this issue we have implemented a structure for a clever traffic control system. Now and again higher traffic thickness at one side of the intersection requests longer green time when contrasted with standard dispensed time. Here a system is proposed in which the time frame of green light and red light is doled out based on the density of the traffic which is present at the moment. In this venture, a framework to distinguish vehicles and in this way decide the magnitude of the density in every road (or path), using Image-processing techniques has been created.

The pictures utilized for traffic light handling can be taken by pre-introduced traffic observation cameras that are fixed at the highest point of the current traffic lights or fixed some place near them.

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List of Abbreviations

PC	Personal Computer
MATLAB	Matrix Laboratory
CMOS	Complimentary Metal Oxide Semiconductor

CHAPTER 1

INTRODUCTION

Chapter 1

Introduction

1.1 Introduction

Traffic lights, commonly known as traffic signals. Traffic lights, flag lights, robots are flagging gadgets situated at or close street convergences and other places to control flows of traffic.Traffic lights were first introduced in 1868 in London, United Kingdom; presently utilized in pretty much every corner of the world. Traffic lights substitute the option to proceed agree to street clients by showing lights of a standard shading (red, yellow/golden, and green) following a universal shade code.

1.2 History

Before the implementation of traffic lights, traffic progression is controlled by traffic police. A well-recorded model is that on London Bridge in 1722. Three men were given the undertaking of coordinating traffic coming all through either London or Southwark. Each officer would help direct traffic leaving Southwark into London and he ensured all traffic remained on the west end of the extension. A second officer would coordinate traffic on the east end of the scaffold to control the progression of individuals leaving London and going into Southwark.

On 9 December 1868, the first non-electric gas-lit traffic lights were introduced outside the Houses of Parliament in London to control the traffic in Bridge Street, Great George Street, and Parliament Street. They were proposed by the railroad engineer J. P. Knight of Nottingham who had adjusted this thought from his plan of railroad flagging systems and built by the railroad flag specialists of Saxby and Farmer.

Figure 1.1 Traffic Light

The first traffic light in South India was installed at Egmore Junction, Chennai in 1953. The city of Bangalore installed its first traffic light at Corporation Circle in 1963.

Countdown timers on traffic lights were introduced in the 1990s. Timers are useful for pedestrians, to plan whether there is enough time to cross the intersection before the end of the walk phase, and for drivers, to know the amount of time before the light switches. In the United States, timers for vehicle traffic are prohibited, but pedestrian timers are now required on new or upgraded signals on wider roadways. In some cities, including Philadelphia, pedestrian timers can be used by motorists as well to know how much time remains in the green cycle, because when the pedestrian timer reaches zero, the signal will simultaneously turn yellow.

1.3 Traffic Light System

Traffic signals consist of an arrangement of different coloured lights which are collectively called traffic lights. The traffic lights are signaling devices positioned at road intersections to control the flow of traffic. Depending upon the intensity of vehicles arriving at the junction, the number and positions of the traffic light arrangement may vary.

The traffic light system usually consists of three types of traffic lights each representing three different colours.

They are as follows:

I) Red

II) Yellow

III) Green

I) Red

The red light is used to indicate the vehicles to stop at traffic junction. The main reason to choose red light for this purpose was that the colour red mainly represent danger or warning. Apart from this, the red light can be distinguished very correctly from a great distance and even under poor visibility conditions such as during fog.

II) Yellow

The amber or yellow light is used to indicate that the red light is about to glow next at any instant. The yellow colour is generally used as a warning or caution symbol. Besides, it contrasts well with the colors green and red, and is easily visible to the vehicle riders.

III) Green

The green light is used to indicate the vehicles to move across the junction if they were previously stopped.

In short green light means 'go' and red light means 'stop'. The basic structure of a traffic light is shown in Figure 1.4.

- R represents Red light.

- Y represents Yellow or Amber light.

- G represents Green light.

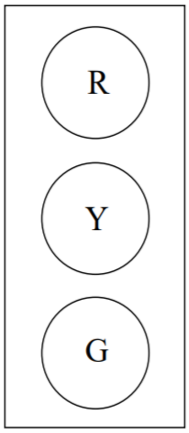

Figure 1.2 Basic structure of traffic light

1.4 Traffic Management System

In general, the traffic management system comprises the traffic lights fixed permanently at appropriate places at the traffic junction and a control system designed to operate them, which may be kept in the vicinity of the traffic lights or somewhere remotely located. The vehicles should move (or stop) in accordance with the traffic signal produced by the traffic light(s). Although traffic lights have been installed at various traffic junctions throughout the urban areas of Kathmandu valley, they do not yield optimum outputs for effective traffic management for various reasons. As a result, the task of traffic management is assigned to the traffic personnel mobilized by the Metropolitan Traffic Police Division. Apart from this, the traffic system of a country is either right handed or left-handed. Despite some exceptional cases such as the segment of road that lies between Rani Pokhari and Ratna Park which is right-handed, Nepal has left-handed traffic system i.e. the traffic moves forward along the left side of the road.

In Nepal, no separate lanes have been designed for the four wheelers and two wheelers. Both four and two wheelers share the same lane such that no distinct rules to overtake vehicles have been specified by the Metropolitan Traffic Police Division as well.

The pedestrians are allowed to cross the road using the zebra-crossing or the sky bridge. Unlike the sky bridge, which is accessible to the pedestrians at all times as it is built above the roads, the zebra-crossings are often placed at the traffic junctions and hence, can be used only when the vehicles along the lane which has the zebra-crossing are stopped as per the traffic signals.

1.5 Light Design

In the United States, traffic lights are as of now structured with lights roughly 12 inches (300 mm) in width. Already the standard had been 8 inches (200 mm), anyway those are gradually being eliminated for the bigger and increasingly obvious 12 inch lights. Varieties utilized have likewise incorporated a cross breed plan, which had at least one 12 inch lights alongside at least one lights of 8 inches (200 mm) on a similar light. For instance, these "12-8-8" (alongside 8-8-8) lights are standard in many purviews in Ontario, Manitoba, and British Columbia (that, is, the red light is 12 and others 8, making the red increasingly conspicuous). In the United Kingdom, 12 inch lights were executed just with Mellor Design Signal heads structured by David Mellor. These were intended for representative optics to adjust for the light misfortune brought about by the image. With the development of against apparition, exceptionally obvious SIRA focal points, lights of 8 inches (200 mm) could be intended to give a similar yield as plain focal points, so a bigger surface region was superfluous. Subsequently lights of 12 inches (300 mm) are never again affirmed for use in the UK and all lights introduced on new establishments must be 200 millimeters (8 in) as per TSRGD (Traffic Signs Regulations and General Directions). Exceptions are made for impermanent or substitution signals.

1.6 Types of traffic control system

1.6.1 Manual controlling

Manual controlling the name occasion it require labor to control the traffic. Contingent upon the nations and states the traffic polices are apportioned for a required region or city to control traffic. The traffic polices will convey sign board, sign light and whistle to control the traffic. They will be told to wear explicit regalia so as to control the traffic.

1.6.2 Automatic controlling

Programmed traffic light is constrained by clocks and electrical sensors. In rush hour gridlock lights each stage a consistent numerical esteem stacked in the clock. The lights are consequently jumping ON and OFF contingent upon the clock esteem changes. While utilizing electrical sensors it will catch the accessibility of the vehicle and flags in each stage, contingent upon the flag the lights consequently turn ON and OFF.

1.7 Drawbacks

In the manual controlling system we need more labor. As we have poor quality of traffic police we can't control traffic physically in all territory of a city or town. So we need a superior answer for the traffic. On the opposite side, programmed traffic controlling a traffic light uses clock for each stage. Utilizing electronic sensors is another route so as to distinguish vehicles, and produce flag that to this technique the time is being squandered by a green light on a vacant street. Traffic clog additionally happened while utilizing the electronic sensors for controlling the traffic. Every one of these downsides should be disposed of by utilizing picture preparing.

1.8 Image Processing in Traffic Light System

We use image processing to control traffic light system. The vehicles are recognized by the system through pictures as instead to utilizing electronic sensors installed in the asphalt. A camera will be set alongside the traffic light. It will catch image groupings. Image processing is a superior method to control the state change of the traffic light. It demonstrates that it can diminish the traffic congestion and stays away from the time being wasted by a green light on a vacant street. It is likewise increasingly solid in assessing vehicle presence since it utilizes real traffic pictures. It pictures the common sense, so it works much superior to those system that depend on the identification of the vehicles metal substance.

1.9 Problem Formulation

In modern life we are facing a lot of different problems one of which is traffic jam becoming more serious day after day. Now a day's traffic problems are increasing because of growing number of vehicles which was caused by the population. The increase in urban traffic brings with it the problem of frequent traffic jams at major traffic junctions. This requires for an efficient traffic management system to be implemented at such places.

Depending upon the vehicle traffic, the traffic personnel allow the vehicles from different streets to move across junction (to another street) for different time intervals. Thus, they attempt to avoid any instantaneous traffic jam(s) at the junction.

Automatic traffic management system can be achieved through one or the integration of the following systems: wireless communications, computational technologies, floating cellular data, sensing technologies, inductive loop detection, and video vehicle detection. In this project, the automation of the traffic control system has been implemented on the basis of the digital image processing.

Digital image processing is associated with the various operations that are performed to process the digital images for various purposes such as image enhancement, image restoration and likewise. In context of this project, it has been extensively employed to process the real-time images of the vehicles that constitute the road traffic and on the basis of the density of the vehicles in the road, the appropriate traffic signals are generated.

1.10 Objectives

The project objective is to implement Innovative traffic light system in an optimum way in terms of run time. Various algorithms and methodologies are studied and hardware resources planning will be done to achieve the goal. This kind of Innovative traffic light system system can be used widely in our daily life in different sectors. We hope that human life can be greatly helped with this technology.

1.11 Challenges

The white spots or lines that have been painted by the Traffic Police Department is sometimes also detected as an vehicles. These lines can be removed by using line as a structuring element while doing image processing.

1.12 Software and Tools Used

1.12.1 Webcam

A webcam is a camcorder that feeds or streams its picture progressively to or through a PC to a PC organize. The expression "webcam" (a cut compound) may likewise be utilized in its unique feeling of a camcorder associated with the Web constantly for an uncertain time, instead of for a specific session, by and large providing a view for any individual who visits its website page over the Internet. Some of them, for instance, those utilized as online traffic cameras, are costly, tough expert camcorders.

1.12.2 MATLAB

MATLAB (network research center) is a multi-worldview numerical figuring condition and restrictive programming language created by MathWorks. MATLAB permits lattice controls, plotting of capacities and information, execution of calculations, making of UIs, and interfacing with projects written in different dialects, including C, C++, C#, Java, Fortran and Python.

CHAPTER 2

LITERATURE SURVEY

Chapter 2
Literature Survey

The projects addressing similar problems have been done at both national and international levels. Those projects also perform the automatic control of traffic on the basis of digital image processing. The projects that were done at national level include "**Model Based Automatic Traffic Control System**" by Indu Bhandari and Kamal K.C. and "Traffic Control and Surveillance System" by Niraja Shakya, Sujana Gurung and Vandana Dhakal.

The project entitled "**Model Based Automatic Traffic Control System**" employed the DIP algorithms such as background subtraction and basic global thresholding to accomplish the task of automatic vehicle detection. This system produced satisfactory results on the prototype of the traffic intersection that used miniature toy vehicles on the prototype to simulate the traffic and the traffic density was determined after analyzing the video taken by the web-camera.

The project entitled "**Traffic Control and Surveillance System**" implemented the DIP algorithms such as edge detection and background subtraction to detect vehicles. This system also consists of a buzzer system which is blown to indicate the pedestrians that it is safe to cross the road. In both the projects mentioned above, MATLAB was used as the tool for DIP.

In international level, many research works have been carried out for the automatic detection of vehicles using DIP algorithms. Some of such works include **"Image Processing Based Intelligent Traffic Controller"** done by Vikramaditya Dangi, Amol Parab, Kshitij Pawar and S.S Rathod, and **"Image Processing Algorithms for Detecting and Counting Vehicles Waiting at a Traffic Light"** done by Ernesto de la Rocha, Rafael Palacios. Basically, the research work of Ernesto de la Rocha, Rafael Palacios has provided a great help and guidance to develop the concept about the necessary image processing algorithms that could be implemented for the automatic detection of vehicles using DIP approach.

Chapter 3

Component Used

Chapter 3

Component Used

3.1 Webcam

A webcam is a video camera that captures picture continuously to or through a PC to a PC organize.

The expression "webcam" (a cut compound) may likewise be utilized in its unique feeling of a video camera associated with the Web constantly for an inconclusive time, as opposed to for a specific session, for the most part providing a view for any individual who visits its site page over the Internet. Some of them, for instance, those utilized as online traffic cameras, are costly, rough proficient camcorders.

In webcam their is a lens, an image sensor, support electronics, and may also includes microphones for sound.

3.1.1 Image Sensor

Image sensors can be CMOS or CCD, the previous being overwhelming for minimal effort cameras, yet CCD cameras don't really beat CMOS-based cameras in the low-value go. Most customer webcams are equipped for giving VGA-goals video at a casing rate of 30 outlines for every second. Numerous more up to date gadgets can deliver video in multi-megapixel goals, and a couple can keep running at high casing rates, for example, the PlayStation Eye, which can create 320×240 video at 120 edges for every second. The Wii Remote contains a image sensor with a goals of 1024×768 pixels.

3.1.2 Optics

Different focal points are available, the most well-known in customer grade webcams being a plastic focal point that can be physically moved in and out to center the camera. Fixed-center focal points, which have no arrangement for alteration, are likewise accessible. As a camera framework's profundity of field is more prominent for little picture organizes and is more noteworthy for focal points with a substantial f-number (little gap), the frameworks utilized in web cams have an adequately huge profundity of field that the utilization of a fixed-center focal point does not affect picture sharpness as it were.

3.1.3 Characteristics

Web cams are known for their low assembling expense and their high flexibility,[1] making them the most reduced cost type of videotelephony. In spite of the minimal effort, the goals offered at present (2015) is fairly noteworthy, with low-end web cams offering goals of 320×240, medium web cams offering 640×480 goals, and top of the line web cams offering 1280×720 (otherwise known as 720p) or even 1920×1080 (otherwise known as 1080p) resolution.[2][3][4]

They have additionally turned into a wellspring of security and protection issues, as some inherent web cams can be remotely initiated by spyware.

3.1.4 Uses

The most mainstream utilization of webcams is the foundation of video joins, allowing PCs to go about as videophones or video conference stations. Other prevalent utilization incorporate security observation, PC vision, video broadcasting, and for account social recordings.

The video streams given by webcams can be utilized for various purposes

Figure 3.1 Webcam

3.2 MATLAB

MATLAB is a multi-worldview numerical figuring condition and restrictive programming language created by Math Works. MATLAB permits network controls, plotting of capacities and information, usage of calculations, formation of UIs, and interfacing with projects written in different dialects, including C, C++, C#, Java, Fortran and Python.

Figure 3.2 MATLAB Logo

Despite the fact that MATLAB is expected essentially for numerical figuring, a discretionary tool kit utilizes the MuPAD emblematic motor, enabling access to representative processing capacities. An extra bundle, Simulink, includes graphical multi-area reproduction and model-based structure for dynamic and installed system.

3.2.1 History

Cleve Moler, the administrator of the software engineering division at the University of New Mexico, began creating MATLAB in the late 1970s.[8] He planned it to give his understudies access to LINPACK and EISPACK without them learning Fortran. It before long spread to different colleges and found a solid gathering of people inside the connected arithmetic network. Jack Little, a designer, was presented to it amid a visit Moler made to Stanford University in 1983. Perceiving its business potential, he united with Moler and Steve Bangert. They reworked MATLAB in C and established MathWorks in 1984 to proceed with its improvement. These modified libraries were known as JACKPAC.[9] In 2000, MATLAB was changed to utilize a more current arrangement of libraries for lattice control, LAPACK.

3.2.2 Interfacing with other Languages

MATLAB can call capacities and subroutines written in the programming dialects C or Fortran. A wrapper work is made permitting MATLAB information types to be passed and returned. MEX documents (MATLAB executables) are the progressively loadable item records made by ordering such functions.Since 2014 expanding two-path interfacing with Python was being added.

Libraries written in Perl, Java, ActiveX or .NET can be straightforwardly called from MATLAB, and numerous MATLAB libraries (for instance XML or SQL support) are actualized as wrappers around Java or ActiveX libraries. Calling MATLAB from Java is progressively convoluted, yet should be possible with a MATLAB toolbox which is sold independently by Math Works, or utilizing an undocumented system called JMI (Java-to-MATLAB Interface),(which ought not be mistaken for the disconnected Java Metadata Interface that is likewise called JMI). Official MATLAB API for Java was included 2016.

3.2.3 Graphics and graphical user interface programming

MATLAB bolsters creating applications with graphical UI (GUI) highlights. MATLAB incorporates GUIDE (GUI improvement condition) for graphically structuring GUIs. It additionally has firmly coordinated diagram plotting highlights. For instance, the capacity plot can be utilized to create a chart from two vectors x and y.

Chapter 4

Project Design and Working

Chapter 4

Project Design and Working

4.1 Block Diagram

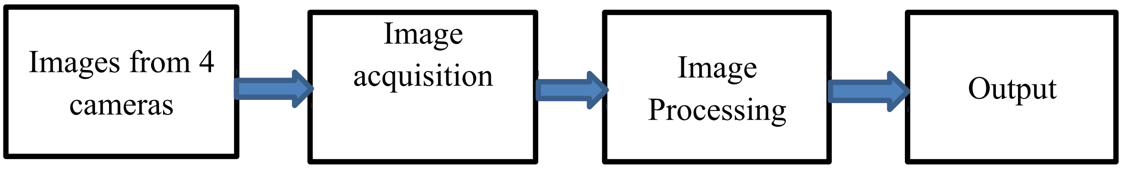

Figure 4.1 Block Diagram of Innovative Traffic Light System

4.1.1 Images from 4 cameras

A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. Take pictures from it of different lanes from the given directions. At an instant only one of the camera captures an image for a defined interval of time then this procedure is repeated for each of the camera. The camera used is a webcam which is connected to the PC or a laptop to provide high quality images for further processing to the succeeding unit.

4.1.2 Image acquisition

As our webcam is attached to our system. All the captured images will be saved in the location where main program is saved.

4.1.3 Image Processing

Image Processing comprises the algorithms that make necessary changes to the original images so that they can be made more useful for further processing. Apart from this, it is used to make the lighting adjustments in the images that are taken under unfavourable lighting conditions such as during gloomy day or in a poorly illuminated room. The processed images taken by webcam are used to find out their individual densities. Now the density of objects in the images are taken by webcam, now these images are compared with each other. The green light will glow for the maximum time in the direction where the image density is highest.

4.1.4 Output

The traffic will start moving according to the duration for which the green traffic light glows.

4.2 Working

The web cams serves as the major input to the system. These web cams can either be a normal digital camera or special CC camera. During the course of this project, a normal digital web cam has been used to obtain the images of the road traffic.Web cams are used to capture images of different lanes from different directions. Their are 4 web cams which are attached to laptop or PC. All the captured images will be saved in the location where main program is saved.

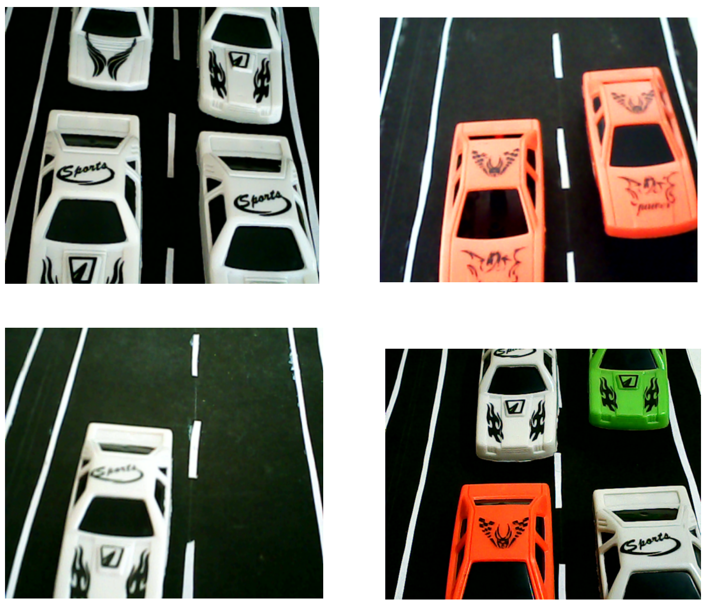

Figure 4.2 Image of 4 different lanes from different camera's

4.2.1 Image processing

As images of different lanes from different camera's have been obtained. Now image processing can be done on these images. Image processing is the backbone of this project. It has been implemented to detect the vehicles present on the road.

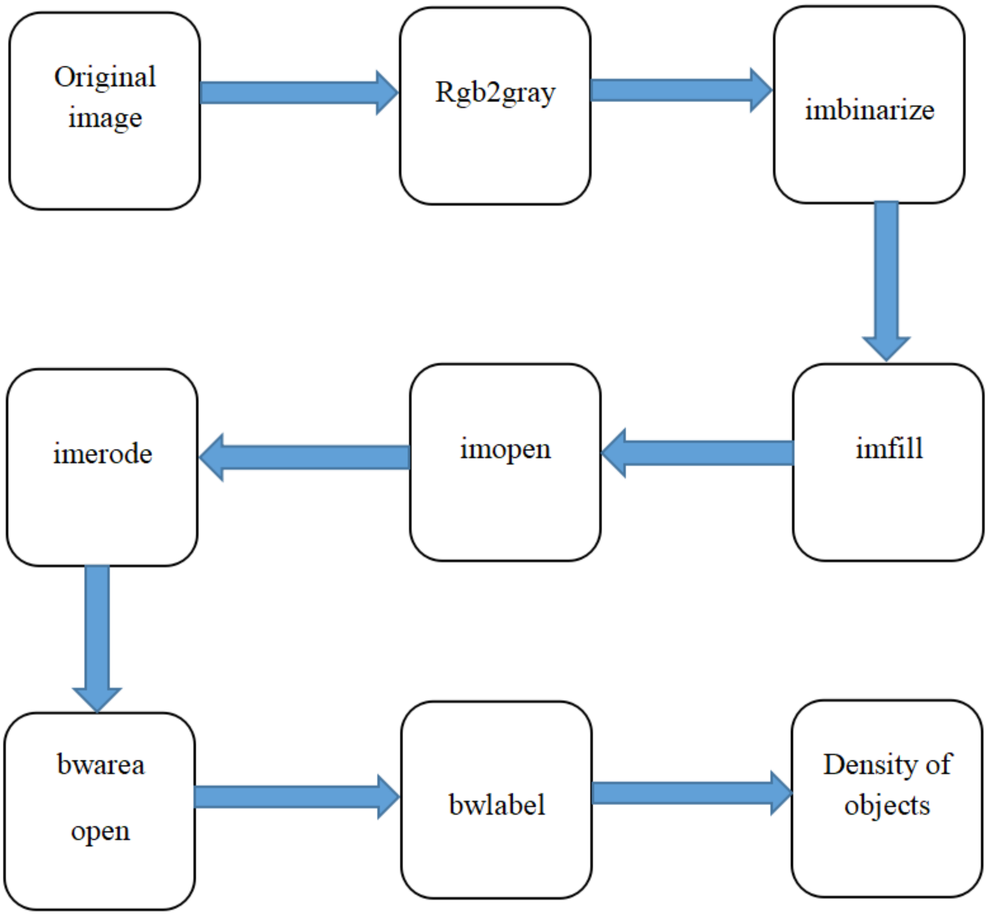

Figure 4.3 Block diagram of image processing

4.2.1.1 Original image

Here original image refers to the image which are take by the web cams and stored at the location where the program is saved. Now all the further operations will be held on these images.

Here image processing is shown on only one image. Similarly this process of image processing is done on rest of images.

Figure 4.4 Image taken by webcam

4.2.1.2 rgb2gray

In this section the image taken by the camera have the color combination of RCB in it. Here the image is converted from RCB to grayscale. The rgb2gray function converts RGB image to grayscale by removing the hue and saturation information while retaining luminance.

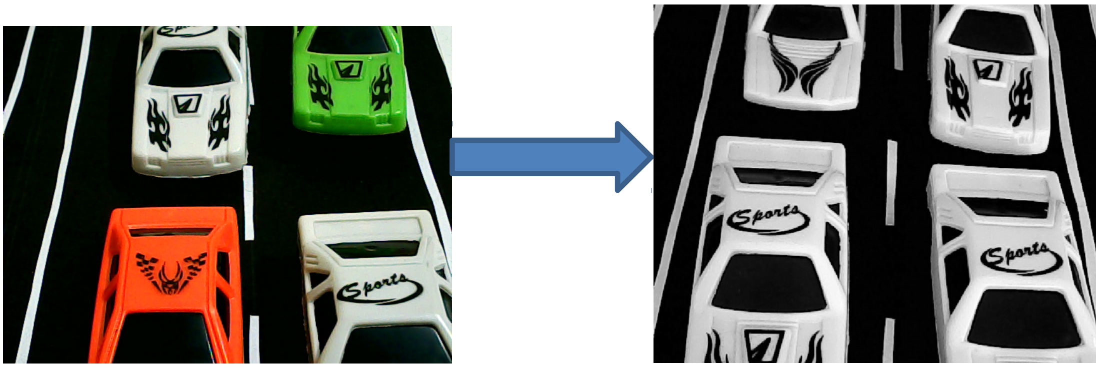

Figure 4.5 Original image converted to grayscale image

4.2.1.3 imbinarize

Imbinarize function is a function that makes a binary image from the grayscale image using the threshold value. The value of threshold should be between 0 and 1.The value of threshold is taken with accordance illumination of light on the grayscale image.

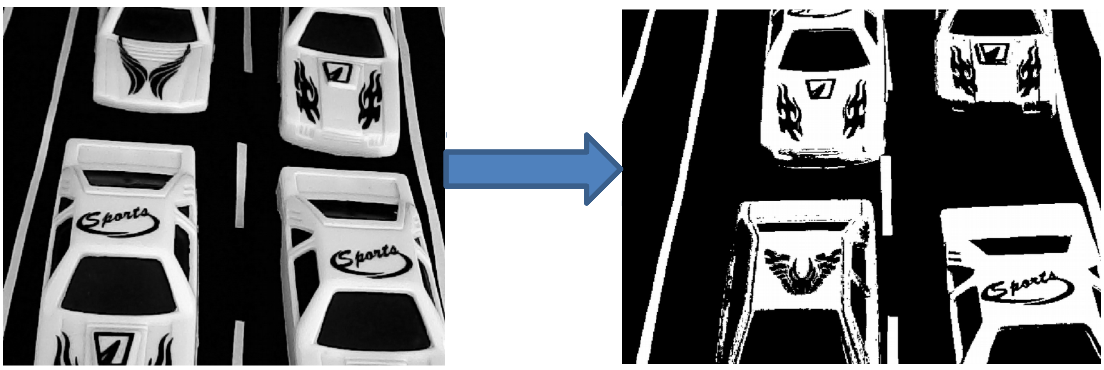

Figure 4.6 grayscale image converted to binary image

4.2.1.4 imfill

Binary image is taken as an input image. Now imfill function will be operated on this binary image. imfill function fills the holes of a binary image. Filling holes means those small areas which are similar to the background pixels are filled such that we can detect the object easily.

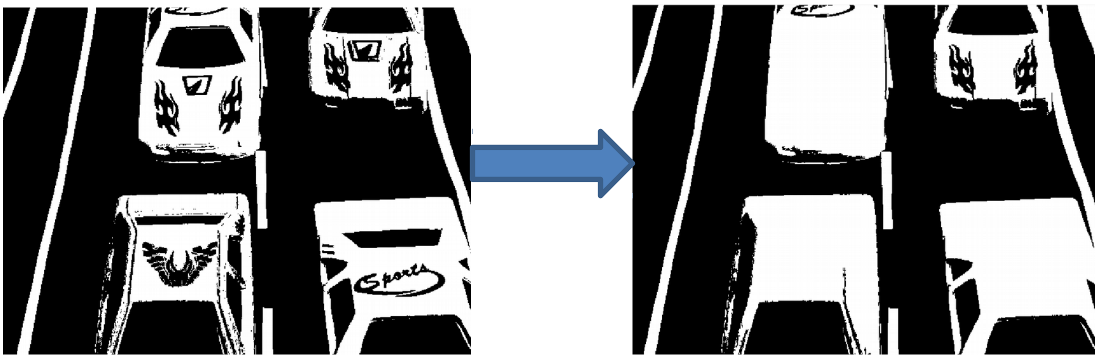

Figure 4.7 binary image after filling holes

4.2.1.5 imopen

In this grayscale or binary image is taken as input. This operation is an erosion followed by a dilation. In this function a structuring element is used to perform both the operations on the image. In this function any of the structuring element can be used according to our requirements. Final image is returned after performing all the operations.

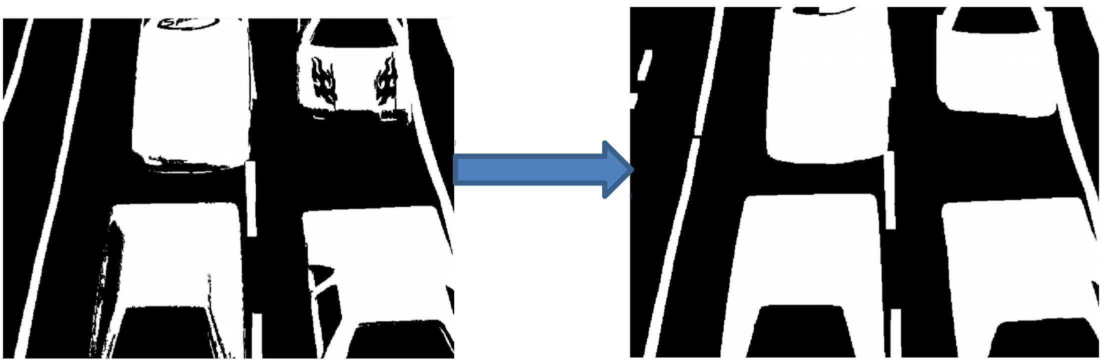

Figure 4.8 Image after using imopen function

4.2.1.6 imerode

This function erodes the grayscale or binary image and returns the eroded image. Here a structuring element is used to perform the erosion operation. The size of structuring element can be varied according to our requirements.

4.2.1.7 bwarea open

Here a fixed amount of pixel value is given. It removes all the areas or objects from the image which have smaller or fewer pixel value than the fixed amount of pixel value that is specified. So the new image is having all the objects whose area is greater than the specific fixed area.

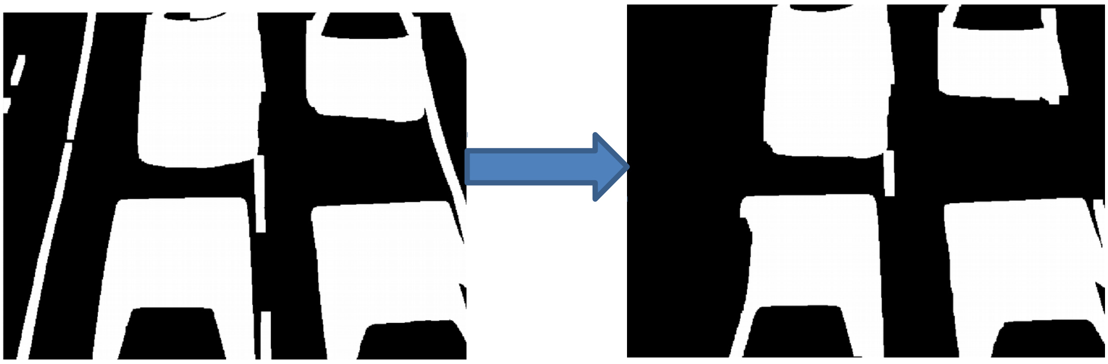

Figure 4.9 Image after removing small area objects from the image

4.2.1.8 Bwlabel

It returns the matrix that contains labels for eight connected objects found in the input image. It also returns the numbers of connected objects found in the input image. It returns a variable which contains total number of objects in the input image.

4.2.1.9 Density of objects

After doing all the processes of image processing the total number of objects in the image is found in each direction.

Now we know the density of images taken by webcam, now we compare these images with each other.The green light will glow for the maximum time in the direction where the image density is highest.

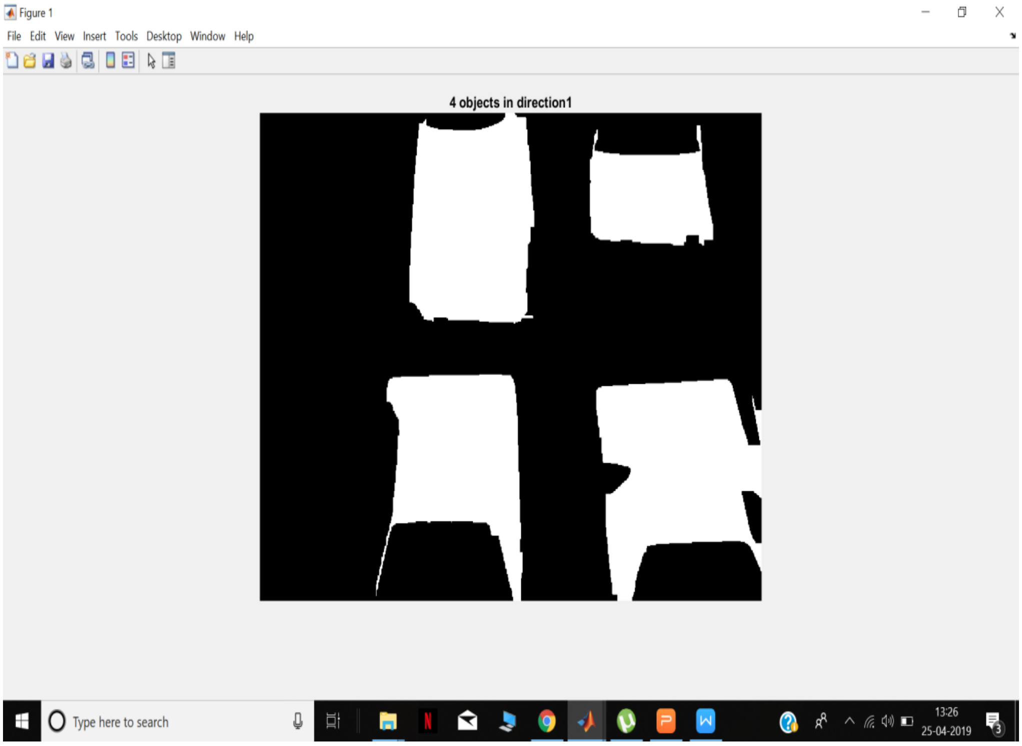

Figure 4.10 Total number of objects is counted

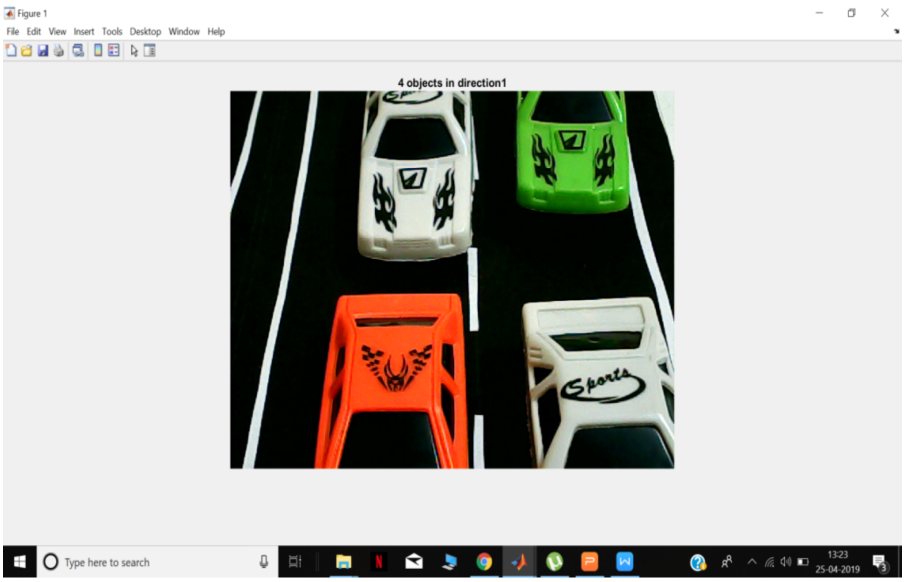

Figure 4.11 Original image with total number of objects

Chapter 5

Results and Simulations

Chapter 5

Results and Simulations

The total number of objects in each direction have been counted. Now we know the density of images taken by webcam, now we compare these images with each other.

The green light will glow for the maximum time in the direction where the image density is highest. A timer is placed on which time shows that for how much time green light will glow. We repeat this process after every fixed amount of time.

The output will be shown on the screen of laptop or PC itself. Their is no hardware attached to show the output of the program.

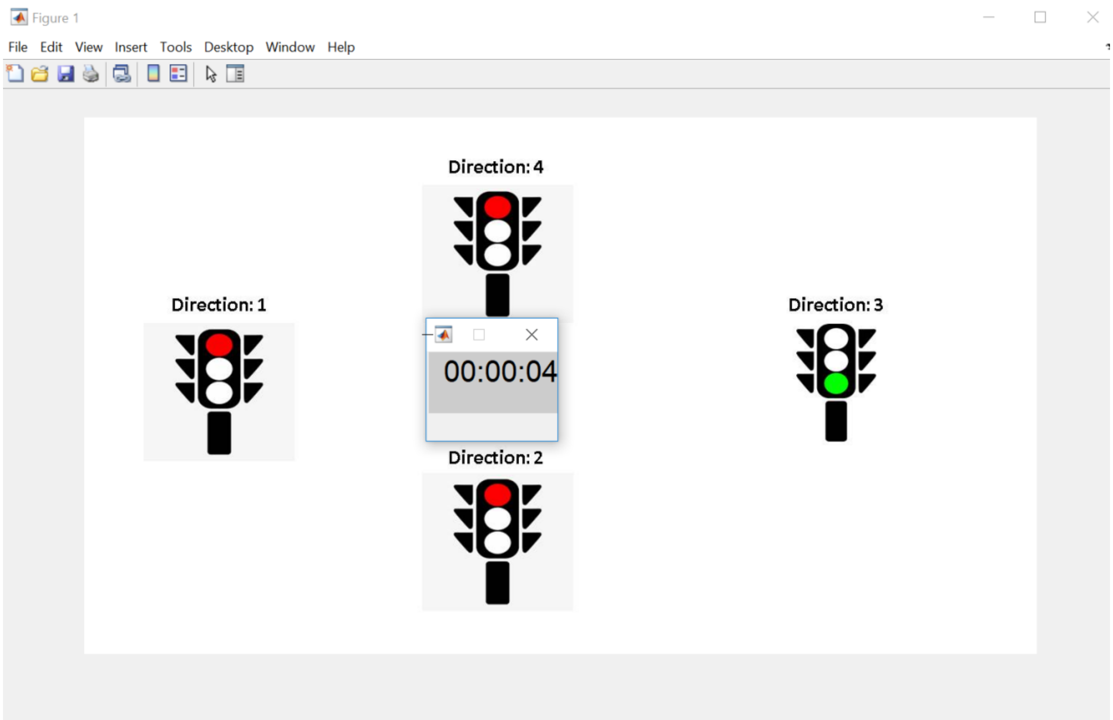

Figure 5.1 Final output

Chapter 6

Conclusion and Future Perspectives

Chapter 6

Conclusion and Future Perspectives

6.1 Conclusion

The project "Innovative Traffic Light System" using Image Processing" aims at automating the traffic management system. Although this system is not unique, it is an upgraded version to the similar systems developed in earlier projects.

The system emphasizes on the DIP algorithms for the detection of vehicles in the road.During the process of development, many research works and papers carried out in the respective fields were thoroughly studied. Based on the results and conclusions provided by such papers, the algorithms that best addressed the problem domain of this project were selected.

This project has not been tested in the actual field.But a small model of it have been created in MATLAB scenario and the results of simulation on this model are quite satisfactory. Hence, some modifications or changes might still be needed before it is tested in the actual field.There are still a few limitations that are to be overcome and few other enhancements that can be made in this system so that it can be effectively launched in the actual field.

6.2 Future Perspectives

i. Advanced image processing algorithms and libraries could be used so that the system can be used efficiently even during unfavourable lighting conditions and during the night time as well.

ii. Further improvements can be made in this project so that the system can determine the exact number of vehicles in the road.

iii. This system can be developed to read the numbers on the number plates of the vehicles and keep the record.

iv. This system can be further developed to detect the ambulances or fire-engines on the basis of their siren by integrating the audio processing mechanisms or by integrating the RFID approach to the present system.

v. All the transmissions in and out of the system developed in this project are wired. Hence, a wireless traffic control system can be developed.

References

[1] N.S. Kumar, M. Saravanan and S. Jeevananthan, Microprocessors and Microcontrollers, 5th Edition, Oxford University Press, 2012

URL:https://india.oup.com/product/microprocessors-and-microcontrollers-9780199466597?

[2] G. Singh, Highway Engineering, 5th Edition, Standard Publishers Distributors, 2006

URL:http://imageprocessingplace.com/downloads_V3/root_downloads/tutorials/Image%20Processing-Overview%20with%20Sample%20Applications.pdf

[3] Mathworks

URL:https://www.mathworks.com/matlabcentral/answers/389159-multiple-vehicle-detection-and-counting

[4] “Traffic light”

URL: https://en.wikipedia.org/wiki/Traffic_light

Appendix

- Code of the project.

```
cam2 = webcam(1);
preview(cam2);
img = snapshot(cam2);
imwrite(img,'C:\Users\Rahul Dev\Desktop\final project\1.png','png');
pause(1);
clear('cam2');
cam3 = webcam(3);
preview(cam3);
img = snapshot(cam3);
imwrite(img,'C:\Users\Rahul Dev\Desktop\final project\2.png','png');
pause(1);
clear('cam3');
cam4 = webcam(4);
preview(cam4);
img = snapshot(cam4);
imwrite(img,'C:\Users\Rahul Dev\Desktop\final project\3.png','png');
pause(1);
clear('cam4');
cam5 = webcam(5);
preview(cam5);
img = snapshot(cam5);
imwrite(img,'C:\Users\Rahul Dev\Desktop\final project\4.png','png');
pause(1);
clear('cam5');
hold on;
IE = imread('1.png');
IgrayE = rgb2gray(IE);
level = 0.45;
IthreshE = imbinarize(IgrayE,level);
IfilledE = imfill(IthreshE,'holes');
se = strel('square',13);
se1 = strel('line',15,0);
IopennedE = imopen(IfilledE,se);
IopennedE1=imfill(IopennedE,'holes');
IopennedE2=imerode(IopennedE1,se1);
IopennedE3=bwareaopen(IopennedE2,5000);
[labeled,a] = bwlabel(IopennedE3,4);
IW = imread('2.png');
IgrayW= rgb2gray(IW);
level = 0.60;
IthreshW = imbinarize(IgrayW,level);
IfilledW = imfill(IthreshW,'holes');
se = strel('square',10);
se1 = strel('line',15,0);
IopennedW = imopen(IfilledW,se);
IopennedW1=imfill(IopennedW,'holes');
IopennedW2=imerode(IopennedW1,se1);
```

```
IopennedW3=bwareaopen(IopennedW2,5000);
[labeled,b] = bwlabel(IopennedW3,4);
IN = imread('3.png');
IgrayN = rgb2gray(IN);
level = 0.4;
IthreshN = imbinarize(IgrayN,level);
IfilledN = imfill(IthreshN,'holes');
se = strel('square',13);
se1 = strel('line',15,0);
IopennedN = imopen(IfilledN,se);
IopennedN1=imfill(IopennedN,'holes');
IopennedN2=imerode(IopennedN1,se1);
IopennedN3=bwareaopen(IopennedN2,5000);
[labeled,c] = bwlabel(IopennedN3,4);
IS = imread('4.png');
IgrayS = rgb2gray(IS);
level = 0.55;
IthreshS = imbinarize(IgrayS,level);
IfilledS = imfill(IthreshS,'holes');
se = strel('square',13);
se1 = strel('line',15,0);
IopennedS = imopen(IfilledS,se);
IopennedS1=imfill(IopennedS,'holes');
IopennedS2=imerode(IopennedS1,se1);
IopennedS3=bwareaopen(IopennedS2,5000);
[labeled,d] = bwlabel(IopennedS3,4);
subplot(3,3,4),imshow(IE);
title([num2str(a),' objects in direction1']);
subplot(3,3,8),imshow(IW);
title([num2str(b),' objects in direction2']);
subplot(3,3,6),imshow(IN);
title([num2str(c),' objects in direction3']);
subplot(3,3,2),imshow(IS);
title([num2str(d),' objects in direction4']);
pause(10);
close all;
z=[a b c d];
x = sort(z);
for i=1:4
   if a==x(i)
    break
   end
end
for j=1:4
   if b==x(j)
    break
   end
end
for k=1:4
   if c==x(k)
    break
```

```
   end

end
for l=1:4
   if d==x(l)
    break
   end
end
stopwatch(i,j,k,l);
function stopwatch(i,j,k,l)
I1=imread('direction1.jpg');
imshow(I1);
T1 = clock;
STOPPED = 0;
TIME = 3*i+1;
% Figure Window
hfig = figure('Name','Stopwatch',...
   'Numbertitle','off',...
   'Position',[520 300 1 80],...
   'Menubar','none',...
   'Resize','off');
% Stopwatch Time Display
DISPLAY = uicontrol(hfig,'Style','text',...
   'Position',[3 25 130 55],...
   'BackgroundColor',[0.8 0.8 0.8],...
   'FontSize',20);
set(hfig,'HandleVisibility','off');
% Start the Timer
htimer = timer('TimerFcn',@timerFcn,'Period',1,'ExecutionMode','FixedRate');
start(htimer);
 function timerFcn(varargin)
      if ~STOPPED
         time_elapsed = etime(clock,T1);
         str = formatTimeFcn(TIME - time_elapsed);
      if time_elapsed>3*i+1
         close(hfig);
          close all;
          hello(j,k,l);
         return
      end
         set(DISPLAY,'String',str);
      end
 end
   function str = formatTimeFcn(float_time)
      % Format the Time String
      float_time = abs(float_time);
      hrs = floor(float_time/3600);
      mins = floor(float_time/60 - 60*hrs);
      secs = floor(float_time - 60*(mins + 60*hrs));
      h = sprintf('%1.0f:',hrs);
      m = sprintf('%1.0f:',mins);
      s = sprintf('%d',secs);
```

```
        %{
        if secs>3*i
            close(hfig);
             close all;
             hello(j,k,l);
            return
        end
        %}
        if hrs < 10
            h = sprintf('0%1.0f:',hrs);
        end
        if mins < 10
            m = sprintf('0%1.0f:',mins);
        end
        if secs < 10
            s = sprintf('0%d',secs);
        end
        str = [h m s];
    end
end
function hello(j,k,l)
I1=imread('direction2.jpg');
imshow(I1);
T1 = clock;
STOPPED = 0;
TIME = 3*j+1;
% Figure Window
hfig = figure('Name','Stopwatch',...
    'Numbertitle','off',...
    'Position',[520 300 1 80],...
    'Menubar','none',...
    'Resize','off');
% Stopwatch Time Display
DISPLAY = uicontrol(hfig,'Style','text',...
    'Position',[3 25 130 55],...
    'BackgroundColor',[0.8 0.8 0.8],...
    'FontSize',20);
set(hfig,'HandleVisibility','off');
% Start the Timer
htimer = timer('TimerFcn',@timerFcn,'Period',1,'ExecutionMode','FixedRate');
start(htimer);
  function timerFcn(varargin)
        if ~STOPPED
            time_elapsed = etime(clock,T1);
            str = formatTimeFcn(TIME - time_elapsed);
        if time_elapsed>3*j+1
            close(hfig);
             close all;
             hi(k,l);
            return
        end
            set(DISPLAY,'String',str);
```

```
        end
  end
    function str = formatTimeFcn(float_time)
        % Format the Time String
        float_time = abs(float_time);
        hrs = floor(float_time/3600);
        mins = floor(float_time/60 - 60*hrs);
        secs = floor(float_time - 60*(mins + 60*hrs));
        h = sprintf('%1.0f:',hrs);
        m = sprintf('%1.0f:',mins);
        s = sprintf('%d',secs);
       %{
        if secs>3*j
            close(hfig);
             close all;
             hi(k,l);
            return
        end
      %}
        if hrs < 10
            h = sprintf('0%1.0f:',hrs);
        end
        if mins < 10
            m = sprintf('0%1.0f:',mins);
        end
        if secs < 10
            s = sprintf('0%d',secs);
        end
        str = [h m s];
    end
end
function hi(k,l)
I1=imread('direction3.jpg');
imshow(I1);
T1 = clock;
STOPPED = 0;
TIME = 3*k+1;
% Figure Window
hfig = figure('Name','Stopwatch',...
    'Numbertitle','off',...
    'Position',[520 300 1 80],...
    'Menubar','none',...
    'Resize','off');
% Stopwatch Time Display
DISPLAY = uicontrol(hfig,'Style','text',...
    'Position',[3 25 130 55],...
    'BackgroundColor',[0.8 0.8 0.8],...
    'FontSize',20);
set(hfig,'HandleVisibility','off');
% Start the Timer
htimer = timer('TimerFcn',@timerFcn,'Period',1,'ExecutionMode','FixedRate');
start(htimer);
```

```
 function timerFcn(varargin)
      if ~STOPPED
          time_elapsed = etime(clock,T1);
          str = formatTimeFcn(TIME - time_elapsed);
      if time_elapsed>3*k+1
          close(hfig);
           close all;
           bye(l);
          return
      end
          set(DISPLAY,'String',str);

      end
 end
   function str = formatTimeFcn(float_time)
      % Format the Time String
      float_time = abs(float_time);
      hrs = floor(float_time/3600);
      mins = floor(float_time/60 - 60*hrs);
      secs = floor(float_time - 60*(mins + 60*hrs));
      h = sprintf('%1.0f:',hrs);
      m = sprintf('%1.0f:',mins);
      s = sprintf('%d',secs);
     %{
      if secs>3*k
          close(hfig);
           close all;
           bye(l);
          return
      end
     %}
      if hrs < 10
          h = sprintf('0%1.0f:',hrs);
      end
      if mins < 10
          m = sprintf('0%1.0f:',mins);
      end
      if secs < 10
          s = sprintf('0%d',secs);
      end
      str = [h m s];
   end
end
function bye(l)
I1=imread('direction4.jpg');
imshow(I1);
T1 = clock;
STOPPED = 0;
TIME = 3*l+1;
% Figure Window
hfig = figure('Name','Stopwatch',...
   'Numbertitle','off',...
```

```
    'Position',[520 300 1 80],...
    'Menubar','none',...
    'Resize','off');
% Stopwatch Time Display
DISPLAY = uicontrol(hfig,'Style','text',...
    'Position',[3 25 130 55],...
    'BackgroundColor',[0.8 0.8 0.8],...
    'FontSize',20);
set(hfig,'HandleVisibility','off');
% Start the Timer
htimer = timer('TimerFcn',@timerFcn,'Period',1,'ExecutionMode','FixedRate');
start(htimer)'
  function timerFcn(varargin)
        if ~STOPPED
            time_elapsed = etime(clock,T1);
            str = formatTimeFcn(TIME - time_elapsed);
        if time_elapsed>3*l+1
            close(hfig);
             close all;
            return
        end
            set(DISPLAY,'String',str);
        end
  end
    function str = formatTimeFcn(float_time)
        % Format the Time String
        float_time = abs(float_time);
        hrs = floor(float_time/3600);
        mins = floor(float_time/60 - 60*hrs);
        secs = floor(float_time - 60*(mins + 60*hrs));
        h = sprintf('%1.0f:',hrs);
        m = sprintf('%1.0f:',mins);
        s = sprintf('%d',secs);
        %{
        if secs>3*l
            close(hfig);
             close all;
            return
        end
      %}
        if hrs < 10
            h = sprintf('0%1.0f:',hrs);
        end
        if mins < 10
            m = sprintf('0%1.0f:',mins);
        end
        if secs < 10
            s = sprintf('0%d',secs);
        end
        str = [h m s];
    end
end
```