INTELLIGENT AMBULANCE TRAFFIC CONTROL SYSTEM USING IMAGE PROCESSING AND IOT

A PROJECT REPORT

Submitted by

S. VARSHA [Reg No: RA1411004010023]
R. YAZHINI PRIYADHARSHINI [Reg No: RA1411004010070]

Under the guidance of

Mr. S. Yuvaraj

(Assistant Professor (O.G), Department of Electronics and Communication Engineering)

in partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

of

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM
UNIVERSITY
(Under section 3 of UGC Act 1956)

S.R.M. Nagar, Kattankulathur, Kancheepuram District

MAY 2018

SRM UNIVERSITY

(Under Section 3 of UGC Act, 1956)

BONAFIDE CERTIFICATE

Certified that this project report titled "**INTELLIGENT AMBULANCE TRAFFIC CONTROL SYSTEM USING IMAGE PROCESSING AND IOT**" is the bonafide work of " **S. VARSHA [Reg No: RA1411004010023], R. YAZHINI PRIYADHARSHINI [Reg No: RA1411004010070]**", who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

SIGNATURE

Mr. S. Yuvaraj
GUIDE
Assistant Professor (O.G)
Dept. of Electronics and Communication Engineering

SIGNATURE

Dr. Rama Rao
HEAD OF THE DEPARTMENT
Dept. of Electronics and Communication Engineering

Signature of the Internal Examiner

Signature of the External Examiner

SMART TRAFFIC CONTROL WITH AMBULANCE DETECTION

Varsha Srinivasan [1], Yazhini Priyadharshini Rajesh [2], S Yuvaraj [3] and M Manigandan[4]

[1] Final Year Student, Department of ECE, SRM University, Chennai, India
[2] Final Year Student, Department of ECE, SRM University, Chennai, India
[3] Assistant Professor (O.G), Department of ECE, SRM University, Chennai, India
[4] Assistant Professor (O.G), Department of ECE, SRM University, Chennai, India
Email: varshu.md@gmail.com [1], yazhini321@gmail.com [2], yuvasivasanthi@gmail.com [3], manigandan.m@ktr.srmuniv.ac.in [4]

Abstract. The problem of urban traffic congestion is constantly spreading. The increase in traffic is due to the growing number of vehicles and the limited expansion of roads. We propose a system for reducing traffic congestion using image processing by detecting blobs and tracking them. The system will detect vehicles through images instead of using electronic sensors embedded in the pavement. We also plan to provide a suitable solution for emergency vehicles stuck in traffic to clear the route by using Bluetooth, thus assuring timely help to those in need.

INTRODUCTION

One of the many problems that the world faces with increased population and rapid growth in the number of vehicles is traffic congestion. In countries such as India, the rate of road expansion is just one-third the vehicular growth rate. Statistics show that the current annual growth of vehicles is around 11% while the annual road extension remains to be only around 4%. The effects of increased traffic congestion are many. Congestion hinders economic growth through delayed services, wastage of fuel and adversely affects the environment. Studies say that in one day, traffic congestion causes wastage of 2.5 lakhs of liters of non-renewable fuel.

Our project focuses on the severe impact caused by traffic congestion on the emergency vehicle transportation system. In places such as India and Thailand where the road width and length prove to be impossible to create a separate lane for emergency vehicles, it is difficult for ambulances to navigate through the traffic.

Existing ideas include controlling a traffic light using timers for each phase or employing electronic sensors to detect vehicles and produce signal that cycles. These systems however require the presence of traffic policemen during the hours of peak traffic. Also, above methods do not cater to the necessities of emergency vehicles such as ambulances with lives at stake.
The main objectives of our project are as follows:
• Calculate the vehicle density based on image processing techniques to detect vehicles.
• To regulate the traffic signal timings based on a threshold value of traffic.
• Implementing a safe and reliable method to ensure emergency vehicles can meander through gridlocked roads thus saving the seconds that count.

Advantages of using Blob Detection are exact vehicle detection is possible, easy to implement and the method is fast. Canny edge detection isn't used because while the method is suitable for balancing noise and preserving edges, it has a problem with detecting the exact location as the gaussian smoothing blurs the edges making it tough to detect the location of the vehicle. It also requires complex computation which is time consuming and not suitable for real time image processing.

METHODOLOGY

Our project consists of three phases.

1. Vehicle Detection and Counting
2. Ambulance Detection
3. Decisions Based on Data

1. Vehicle Detection and Counting

Following are the steps involved in this phase:

1. Camera Positioning
2. Image Subtraction
3. Blob Detection
4. Blob Analysis
5. Blob Tracking
6. Vehicle Counting
7. Data Processing

Procedure:

Step 1: Camera Positioning is a crucial step in detecting vehicles. The camera is to be positioned such that it covers the entire lane. For example, in the below videos we tested, the camera is approximately set at height of 25 feet and 23 feet respectively. For the software to detect the incoming vehicles, the camera is to be positioned at an optimum height i.e., approximately within 25 feet. The angle is chosen such that at a certain distance is covered and the threshold line is distinctly visible.

Base Angle = $7°$ and Rise $=7.62$

$$\text{Base} = \frac{7.62}{\tan(7)}$$

$$\text{Top angle} = (90° - 7°) = 83°$$

$$\text{Diagonal} = \frac{7.62}{\sin(7)}$$

Figure 1- Camera Calculation

Step 2: Image Subtraction is where the frames from the video are compared with one another to find the difference between them. The difference is then used to detect blobs.

Step 3: By using the image subtraction results, changes in the two frames are noted. If there are any changes, those are the moving blobs i.e., vehicles. The remaining is the background which are stationary and are excluded as they are not moving objects.

Step 4: Analysis of these blobs are required. If at all any pedestrians are caught in the video, they mustn't be considered as blobs. For this, the size of the blobs is taken into consideration. If they are too small, these objects are ignored.

Step 5: After they are analyzed, the vehicles are tracked. A threshold line is formed which is used to calculate the number of cars. The line is drawn at an optimum level next to the traffic signal. Only when the vehicle crosses the line, it is counted.

Step 6: Vehicle Counting keeps a track of the number of cars crossing the threshold line. The car count is important to estimate the density of the traffic.

Step 7: The car count is used to find if the density is high or low and is used to alter the timings of the traffic signal. A threshold is set which forms the maximum number of cars, say around 40, before which the traffic is too high.

Figure 2- Block Diagram

2. Ambulance Detection

Detecting the Ambulance: This phase involves a Bluetooth module and a phone whose Bluetooth is active. Once the ambulance is near the signal, the person driving the emergency vehicle can send a command to the Bluetooth module thereby guiding the traffic signal to change accordingly.
However, there is a security-accessibility trade-off in this system. To overcome this, we should make sure the code with which the ambulance can connect to a traffic signal is unique and is replaced every 24 hours. This would make the system more secure and reliable.

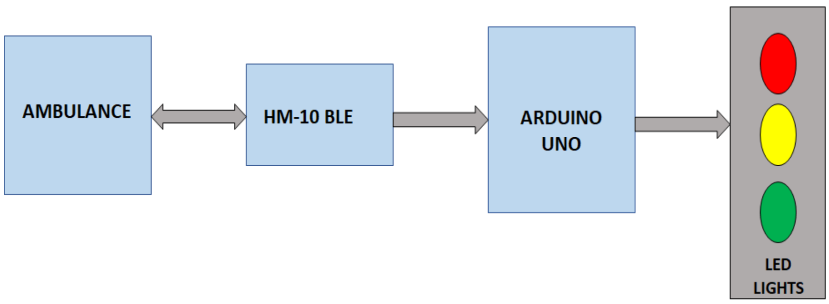


Figure 3- Ambulance Detection

3. Decisions Based on Data

The processed information is passed onto an Arduino and decisions are made accordingly.

- If the car count exceeds the threshold level set (which changes at every signal depending on daily car count), the data given to the Arduino is 'f' i.e., full. Once the Arduino receives it, it changes the timings of the LEDs accordingly.
- If the car count remains to be less than the threshold level set for a pre-determined time (no data is passed onto the Arduino), it automatically sets the green signal.
- If an Ambulance is present and a code is received by the Arduino, for example, "switch", it automatically switches on the green light. If the green light is already switched on, it delays the light for an extra 10 seconds.

RESULTS OBTAINED

We obtained the following results through our project. The Bluetooth interface used for commanding the Bluetooth module is as shown below:

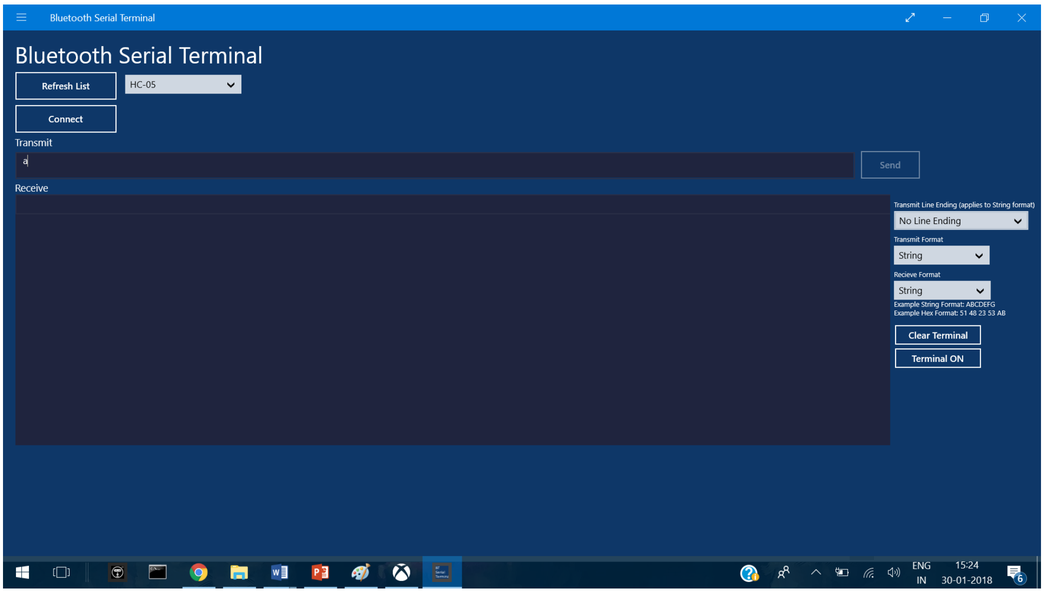


Figure 4- Bluetooth Interface from PC/ Phone

The following images are the results obtained using OpenCV for processing a sample video file

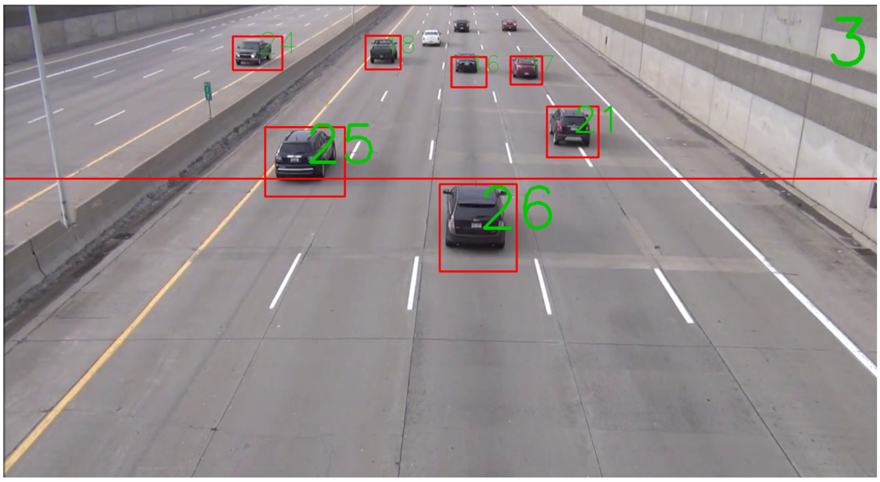


Figure 5- Car Count Displayed on Screen

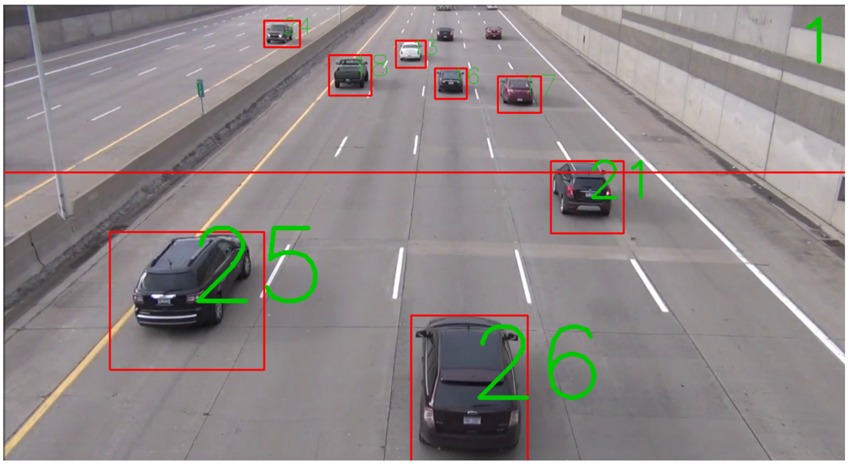


Figure 6- When the Count = 5, count automatically initializes

Table 1- Input and Output Analysis

Input	Output
Car Count remains less than threshold	If time elapsed for the red signal is more than 30 seconds, automatically turn green
Car count greater than threshold	Signal turn yellow followed by green for 20s[1]
Ambulance sends out the command and signal is red.	Signal turns yellow followed by green for 30 seconds
Ambulance sends out command and signal is green.	Signal remains green for an extra 10 seconds.

[1] The above-mentioned timings are chosen for the traffic in the sample video input file. However, for real-time traffic, by observing traffic patterns, we can calculate the time required.

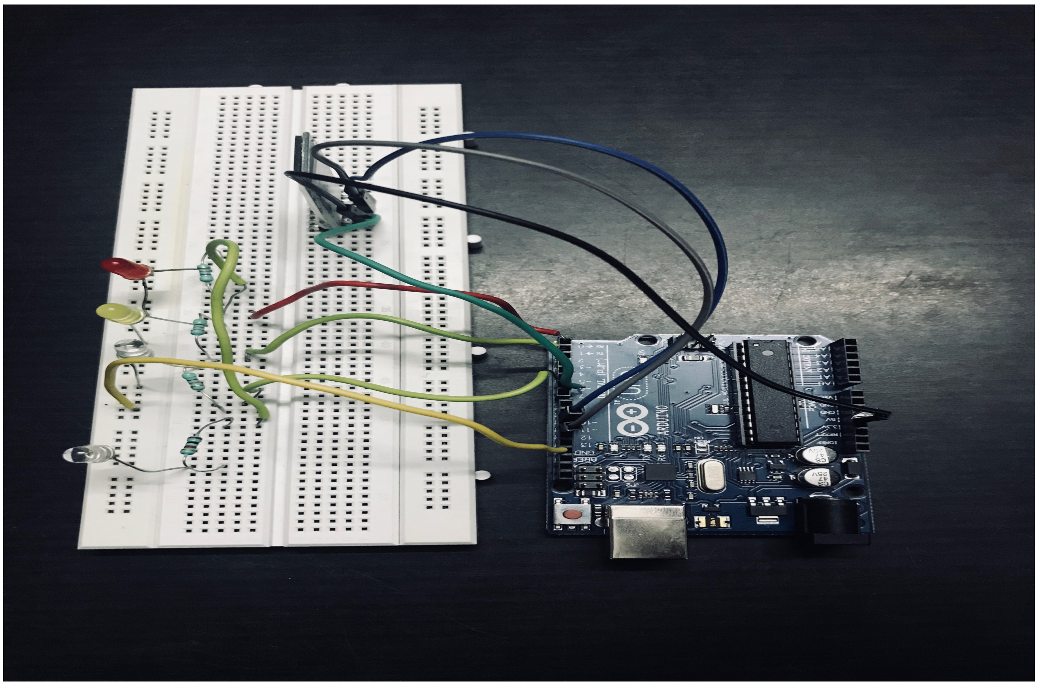


Figure 3- Traffic lights assembly

CONCLUSION

By following the above-mentioned steps and performing image processing, we were able to achieve the following results:

- Vehicle counting by choosing a suitable threshold count (for a sample video of a four-lane road and maximum traffic density 10 at a time, we chose the threshold to be 6) and altering the timing of the signals accordingly. When the traffic density exceeds the threshold, the duration of green light is extended by 20 seconds.
- When an ambulance is detected, and the signal is green, the timing is extended by 20 seconds and if the signal is red, the timing is extended for a longer duration of 40 seconds. This can be extended to any number of signals along the ambulance's path so that the emergency cases can be served immediately.
- The timing for the signals can be decided upon analyzing the traffic pattern in an area for a fixed amount of time and calculating the extended time for which the signal lights have to be switched on accordingly.

This idea can be implemented for a larger network by using encryption algorithms to ensure safety and stability of systems. Also, the extended time can be calculated by the system itself. By keeping records of traffic patterns and using an algorithm, the timing can be chosen according to the traffic patterns Through this paper we have been able to present and implement a smart solution for emergency cases in traffic to give maximum preference to lives at stake.

REFERENCES

1. Ravi Patel, Dr. Tejas Shah, '*Traffic Routing Control at Cross Road Using Image Processing Techniques',* IJSETR, Vol. 6, 2017, 694-697.

2. MohhamadShahab Uddin, Ayon Kumar Das, Md. Abu Taleb, '*Real - time Area Based Traffic Density Estimation by Image Processing for Traffic Signal Control System: Bangladesh P erspective*'. IEEE 2nd International Conference on Electrical Engineering and Information & Communication Technology, May 2015.

3. P. Srinivas, Y.L Malathilatha, Dr. M.V.N.K Prasad, *'Image Processing edge detection technique used for traffic control problem'*, IJCSIT, Vol. 4, 2013, 17-20.

4. Laganière, Robert, *'OpenCV 2 Computer Vision Application Programming Cookbook'*, Packt Publishing, 2011.

5. Gary Bradski and Adrian Kaehler, *'Learning OpenCV Computer Vision with OpenCV Library',* O'Reilly, 2008.

ACKNOWLEDGEMENTS

First of all, we would like to express our sincere thanks to our Head of Department, Dr. Rama Rao, and all the faculty in the department of Electronics and Communication for their support and guidance in completing this project.

We would like to express our deepest gratitude to our guide, Mr. S. Yuvaraj and Mr. G. Manigandan for their valuable guidance, consistent encouragement, personal caring, timely help and providing us with an excellent atmosphere for doing research. All through the work, in spite of their busy schedule, they have extended cheerful and cordial support to us for completing this research work.

We would also like to thank our project coordinator Mrs. G. Kalaimagal, who helped in providing us guidance and motivation. We extend our sincere thanks to our panel members Mr. Elamaran and Dr. Vivek for their important advice during all the reviews.

Above all, no words can express our feelings to our family and friends and all those who patiently supported and instilled confidence in us.

Varsha Srinivasan and Yazhini Priyadharshini Rajesh

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The problem of urban traffic congestion is constantly spreading. The increase in traffic is due to the growing number of vehicles and the limited expansion of roads. We propose a system for reducing traffic congestion using image processing by detecting blobs and tracking them. The system will detect vehicles through images instead of using electronic sensors embedded in the pavement.Pre-hospital care, in the form of emergency services, plays a crucial role in saving patients' lives. Transportation remains as an important part of effective pre-hospital care. It helps in tackling emergencies where distance hinders an effective hospital care process. Often, in India, where it is difficult to implement an effective emergency pattern, it becomes necessary to look for smarter solutions to help ambulances navigate through the traffic. Also, current traffic scenarios create a pressing need for the introduction of advanced technology and equipment to improve traffic conditions. This increase is due to the growing number of vehicles and the limited resources provided by current infrastructures. We propose a system for reducing traffic congestion using image processing. The system will detect vehicles through images instead of electronic sensors. This paper aims to solve the above-mentioned problem using the concept of Image Processing and Internet of Things (IoT).

CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Statistics taken from the World Health Organization (WHO) indicate that almost 1.24 million people die annually across the globe. While identifying the potential risk factors, United Nations have pointed out that the [1]delay in provision of prompt medical care to victims results in the amplification of injuries. Also, one of the many problems that the world faces with increased population and rapid growth in the number of vehicles is traffic congestion. In countries such as India, the rate of road expansion is just one-third the vehicular growth rate. In one day, traffic congestion causes wastage of 2.5 lakhs of liters of non-renewable fuel. Our proposed idea

1. Calculate the vehicle density based on image processing techniques to detect vehicles and regulate vehicles based on a threshold set.

2. Allowing emergency vehicles to request traffic signals for path clearance using Bluetooth technology

3. Enable the exchange of commands between consecutive signals for further traffic clearance along the route using RF communication with the Internet of Things.

4. Ensuring that emergency cases are given the first priority thereby offering reliable emergency services.

Advantages of using Blob Detection are exact vehicle detection is possible, easy to implement and the method is fast. Canny edge detection isn't used because while the method is suitable for balancing noise and preserving edges, it has a problem with detecting the exact location as the Gaussian smoothing blurs the edges making it tough to detect the location of the vehicle. It also requires complex computation which is time consuming and not suitable for real time image processing.

CHAPTER 2

LITERATURE SURVEY

2.1 Traffic Pattern Analysis

Density, speed, and flow are the three critical parameters for road traffic analysis. High-performance road traffic management and control require real-time estimation of space mean speed and density as input for large spatial and temporal coverage of the roadway network. There are 3 major ways traffic patterns have been analyzed till now.

2.1.1 Embedded Systems

In Adaptive Traffic Control System where the system will receive information from the vehicle such as position and speed and then it utilize this data to optimize the traffic signal. Here, the system specifies the use of on board sensors such as IR (infrared) and built in 8 channels ADC are used. Drawback : IR sensors need to be secured in safe place. Hence this system is expensive to implement.

2.1.2 RFID and GSM Based

Data is collected from vehicles and is passed through GSM modules to nearby stations. Monitoring station collects and responds depending on the situation. Drawback: While it's quick, it's very costly to implement in crowded places.

2.2 Ambulance Detection

2.2.1 Sensor Based

Emergency vehicles are detected using programmable IR sensors. Drawback: Sensors need to be securely placed and is expensive to implement and take care of.

2.2.2 Wireless Sensor Networks

Fuzzy logic networks are used to define the direction of emergency vehicle. Collection of information and response in an effective way is done by central monitoring system. Drawback: Communication in Wireless Sensor Network is still a research field. In order to survive in weather situations in places like India, Sensors need to become robust.

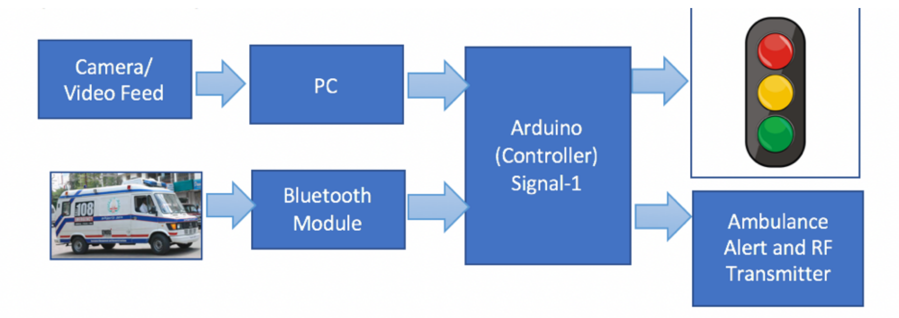
As such, it is becoming very crucial to device efficient, adaptive and cost-effective traffic control algorithms that facilitate and guarantee fast and smooth traffic flow that utilize new and versatile technologies.

CHAPTER 3

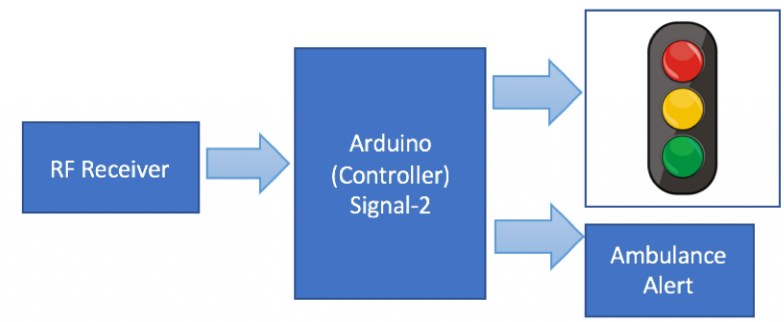
SYSTEM MODEL ANALYSIS

The block diagram of our project is as given below. Our input is given from both a video feed/camera and an ambulance. We will be using the following components.

1. Arduino Uno -2
2. Traffic signals
3. USB to Arduino Cable
4. RF Transmitter and Receiver
5. Camera/ Video Feed
6. Bluetooth Module
7. Ambulance Alert
8. Arduino: Arduino Uno coding
9. OpenCV: Image processing in PC



(a) Signal-1



(b) Signal-2

Figure 3.1: System Model Block Diagram

Realistic Constraints:

1. Despite improved security measures it still may be vulnerable to advanced security threats.
2. Cost-effective than present system

Area	Codes & Standards / Realistic Constraints
Economic	Targeted to maximum expense of Rs 12,000/.
Environmental	This project is not expected to entail any particular environmental consequences.
Social	This project aims for surveillance and security, hence for the Welfare of the society.
Ethical	This project is not expected to entail ethical constraints.
Health and Safety	This project is not expected to entail health and safety constraints except in the use of lead-bearing solder in its assembly.
Manufacturability	This project must be easily replicated. This requires *complete* schematics, *complete and documented* code listings, bill of materials, and circuit-board design - OpenCV and Arduino.
Sustainability	The resources used in this project (printed-circuit board material, solder, integrated circuits composed primarily of silicon and epoxy packaging) are essentially non-recoverable.

Figure 3.2: Realistic Constraints

Standards Referred/used: 1) Arduino Uno 2) Camera Calibration using OpenCV

Multidisciplinary tasks- Mechanical, instrumentation, electrical, Computational /IT involved

This project involves few mechanical designs including the position of cameras and extracting videos of vehicles. It also requires positioning of transmitters and receivers for implementing IOT between traffic signals.

Other Department	Utilized for	Remarks
Basic Sciences		
Mechanical Engineering		
Instrumentation and Control Engineering		
Electrical and Electronics Engineering	RF Transmitter and Receiver, Bluetooth	
Computational/IT	OpenCV and Arduino Microcontroller	
Biomedical Engineering		
Purchase Section	USB-Arduino	
Maintenance Department		
Desktop publications	Report	

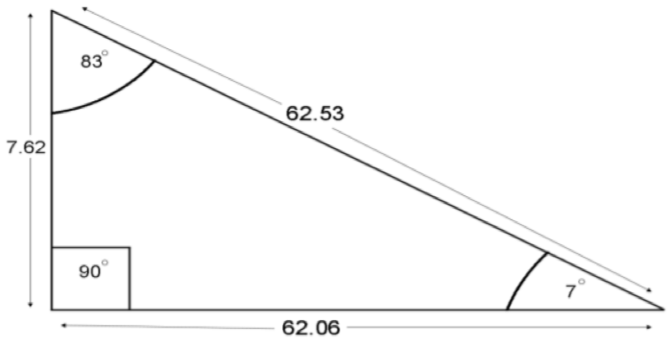
Figure 3.3: Multidisciplinary tasks involved

CHAPTER 4

SYSTEM DESIGN

4.1 Camera Calibration

The camera to be positioned such that it covers the entire lane. For example, in the below videos we tested, the camera is approximately set at 25 feet and 23 feet respectively. For the software to detect the incoming vehicles, the camera is to positioned at an optimum height i.e., approximately within 25 feet. The angle is chosen such at a certain distance is covered and the threshold line is distinctly visible. For the angle calculation, the formula is given.



Base Angle = 7° and Rise =7.62

$$\text{Base} = \frac{7.62}{\tan(7)}$$

Top angle = (90°- 7°) = 83°

$$\text{Diagonal} = \frac{7.62}{\sin(7)}$$

Figure 4.1: Camera Calibration

The angle of view for the first video camera is 87 degrees approximately which explains the wider field of view. This is why the vehicle passing the threshold line is incorrectly detected. In the second video, the angle of view for the camera is 83 degrees. Hence this fits the width of the road perfectly into the frame or the field of view which helped it in correctly distinguishing the threshold line. For the calculation purpose, we have used a base angle of 7 degrees and height of the traffic pole is 7.62 meters. Using the Pythagorean Theorem, we calculate the top angle of the camera to be 83 degrees and the minimum distance for the threshold line to be lesser than 62.06 meters.

4.2 Methodology

The methodology is broken into three parts- Image Processing, Ambulance detection and implementing Internet of Things to send data to the next signal. Looking first at the Image Processing- this is in the absence of emergency vehicles.

4.2.1 Image Processing

Step 1: Camera Positioning is a crucial step in detecting vehicles. The camera is to be positioned such that it covers the entire lane. For example, in the below videos we tested, the camera is approximately set at height of 25 feet and 23 feet respectively. For the software to detect the incoming vehicles, the camera is to be positioned at an optimum height i.e., approximately within 25 feet. The angle is chosen such that at a certain distance is covered and the threshold line is distinctly visible.
Step 2: Image Subtraction is where the frames from the video are compared with one another to find the difference between them. The difference is then used to detect blobs.
Step 3: By using the image subtraction results, changes in the two frames are noted. If there are any changes, those are the moving blobs i.e., vehicles. The remaining is the background which are stationary and are excluded as they are not moving objects.
Step 4: Analysis of these blobs are required. If at all any pedestrians are caught in the video, they mustn't be considered as blobs. For this, the size of the blobs is taken into consideration. If they are too small, these objects are ignored.
Step 5: After they are analyzed, the vehicles are tracked. A threshold line is formed which is used to calculate the number of cars. The line is drawn at an optimum level next to the traffic signal. Only when the vehicle crosses the line, it is counted.
Step 6: Vehicle Counting keeps a track of the number of cars crossing the threshold line. The car count is important to estimate the density of the traffic.
Step 7: The car count is used to find if the density is high or low and is used to alter the timings

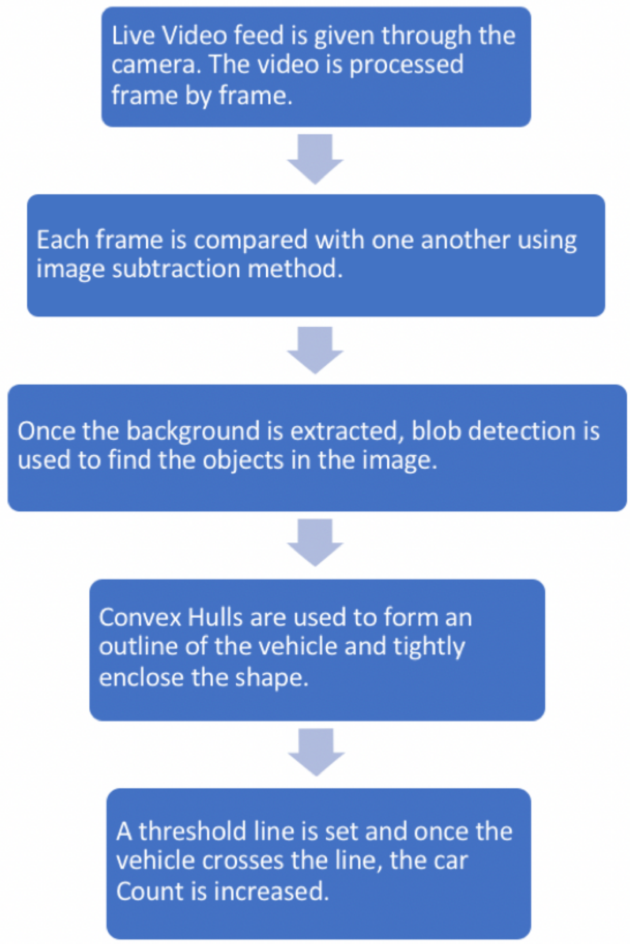


Figure 4.2: Image Processing Flow

of the traffic signal. A threshold is set which forms the maximum number of cars, say around 40, before which the traffic is too high.

4.2.2 Ambulance Detection and Tracking

In the presence of Ambulances,not only must the current traffic signal change to green for a pre-determined amount of time but should simultaneously switch on the transmitter which sends out a signal to the next traffic light ensuring it turns green too to clear the traffic.

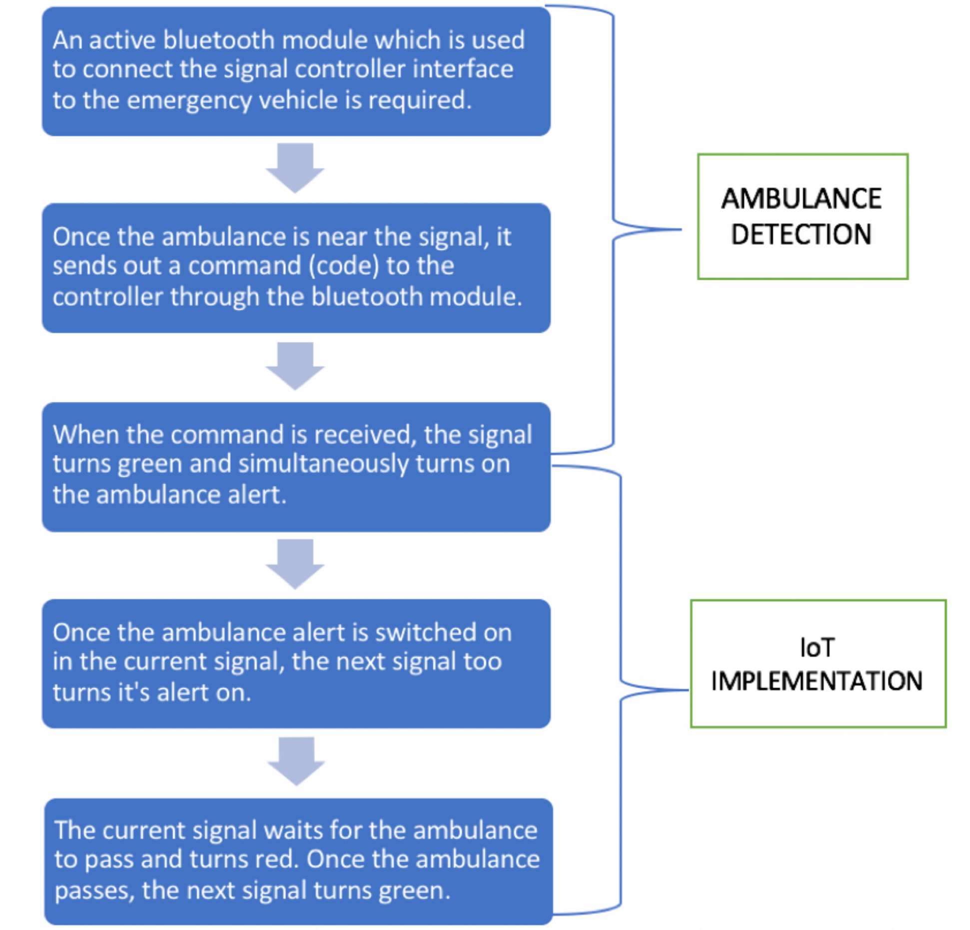


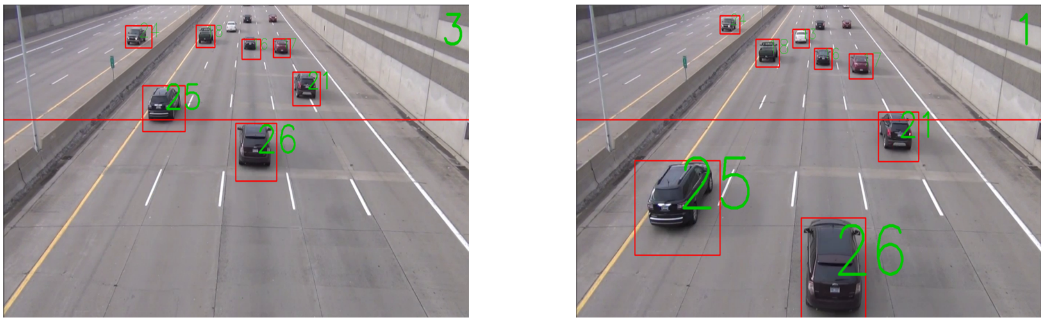
Figure 4.3: Ambulance Detection and tracking Flow

CHAPTER 5

CODING, TESTING

The coding was split into two parts. For the image processing part, coding was done using OpenCV C++ language and Arduino coding was performed separately for the two Arduinos (Signal 1 2) in Arduino IDE software.

While running OpenCV, a sample video file was chosen and run. When the car passes the threshold line set, it automatically increments the car count while is shown on screen. Once the car count is greater than the threshold value set (in this case 5), it automatically sets back to zero.

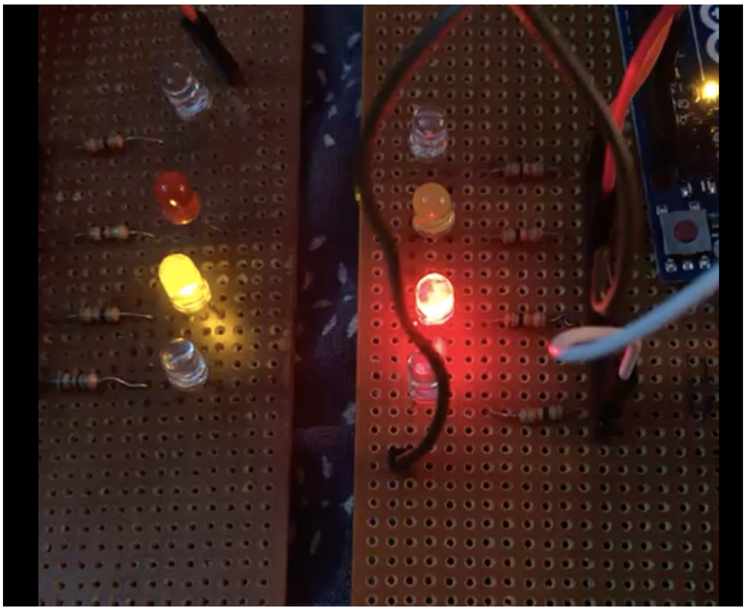


(a) Car Count increases

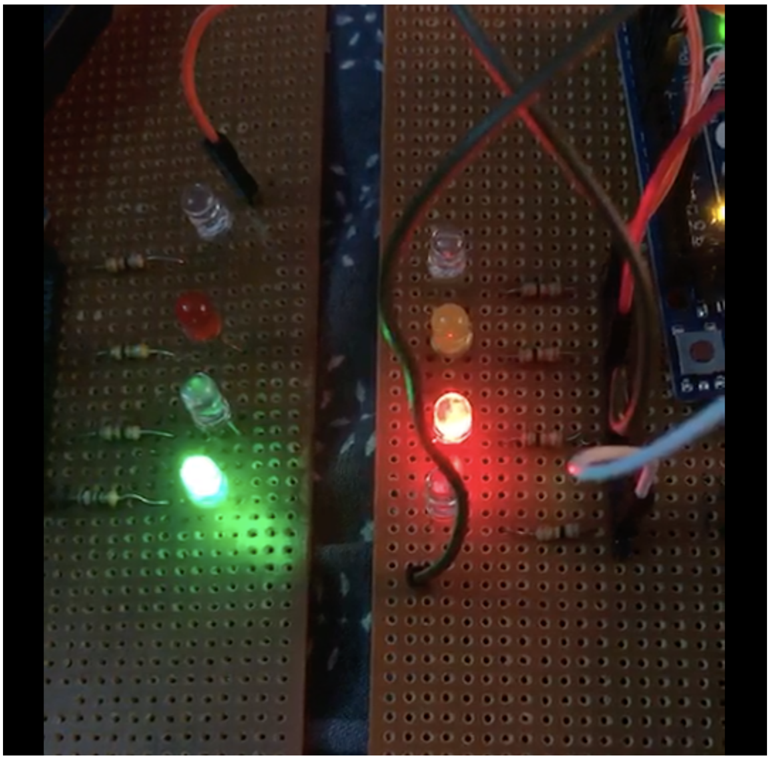
(b) Initializes to 0 after reaching threshold

Figure 5.1: Image Processing Output

This information is relayed to the Arduino through serial port communication. Once the car count increases, the signal turns yellow followed by green.
Now, if the ambulance sends out the signal, before the signal turns red, the ambulance alert is switched on the the green light is extended for a few seconds.

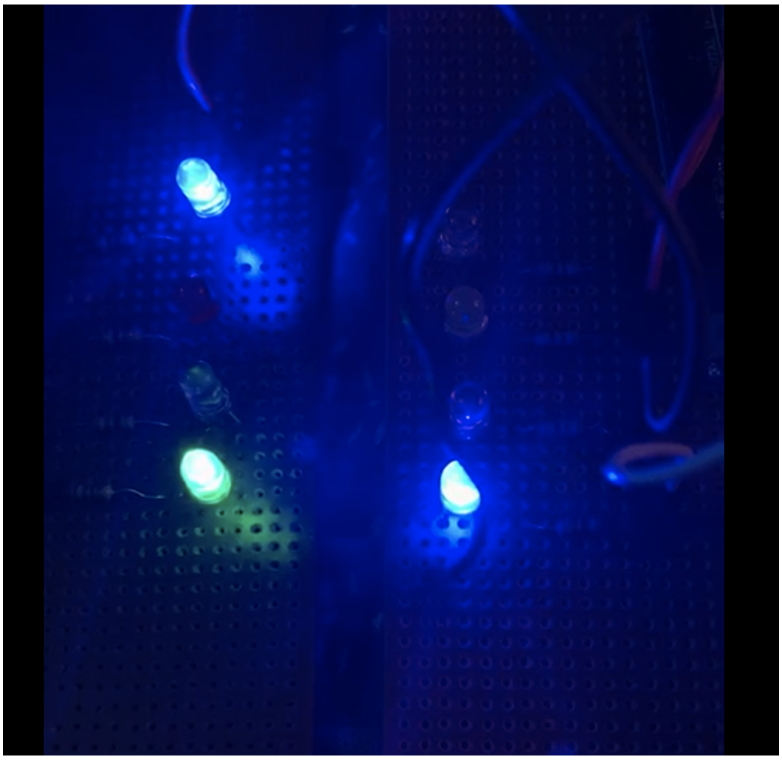


(a) Yellow Light in Signal 1

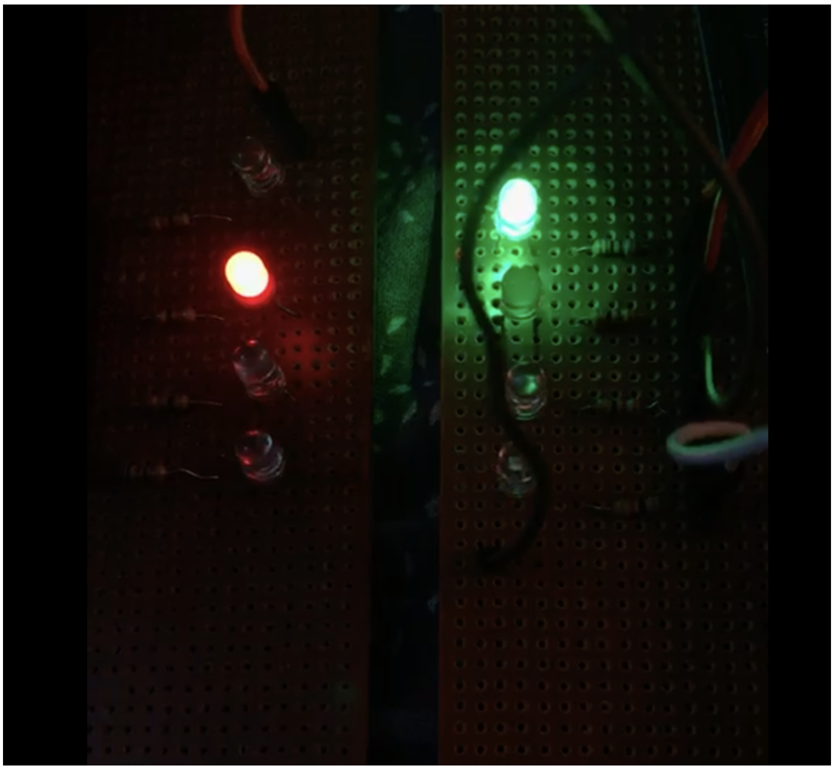


(b) Green Light in Signal 1

Figure 5.2: In the absence of Ambulance



(a) Ambulance Alert ON



(b) Green Light in Signal 2

Figure 5.3: In the presence of Ambulance

CHAPTER 6

CONCLUSION

The output is provided in the form of a table below.

Table 6.1: Input vs Output

Given Input		Output Received	
Traffic Density	Presence of Ambulance	Signal 1	Signal 2
Density >5	No Ambulance	Green for 20 seconds	Not affected
Density <5	No Ambulance	if time elapsed >30 sec, change to Green	Not affected
Green is ON	Ambulance Present	RF signal ON, Green for 10 seconds extra	Green ON
Red is ON	Ambulance Present	RF signal ON, Green ON for 30 seconds	Green ON

By following the above-mentioned steps and performing image processing, we were able to achieve the following results:

1. Vehicle counting by choosing a suitable threshold count (for a sample video of a four-lane road and maximum traffic density 10 at a time, we chose the threshold to be 6) and altering the timing of the signals accordingly. When the traffic density exceeds the threshold, the duration of green light is extended by 20 seconds.
2. When an ambulance is detected, and the signal is green, the timing is extended by 20 seconds and if the signal is red, the timing is extended for a longer duration of 40 seconds. This can be extended to any number of signals along the ambulance's path so that the emergency cases can be served immediately.
3. The timing for the signals can be decided upon analyzing the traffic pattern in an area for a fixed amount of time and calculating the extended time for which the signal lights have to be switched on accordingly.

The efficiency of our project is laid out below:

1. The computer system, which runs the image processing code, analyzes the data and automatically makes second-by-second adjustments, using a trove of past data to predict where traffic could snarl.

2. The concept of IoT which has been implemented using Bluetooth and RF communication, provides a reliable and cost-effective system. This enables emergency vehicles to navigate through traffic along the route.

3. Our system does not require the use of any noise filter as it involves authentication by the central controller with the direct exchange of a code between the emergency vehicle and traffic signal.

Through this paper we have been able to present and implement a smart solution for emergency cases in traffic to give maximum preference to lives at stake.

CHAPTER 7

FUTURE ENHANCEMENT

1. The timing for the signals can be decided upon analyzing the traffic pattern in an area for a fixed amount of time and calculating the extended time for which the signal lights have to be switched on accordingly.

2. This idea can be implemented for a larger network by using encryption algorithms to ensure safety and stability of systems. Also, the extended time can be calculated by the system itself. By keeping records of traffic patterns and using an algorithm, the timing can be chosen according to the traffic patterns.

3. An automatically regenerative code can be used for the secure communication between emergency vehicles and signals.

4. Also, the extended time can be calculated by the system itself. By keeping records of traffic patterns and using an algorithm, the timing can be chosen according to the traffic patterns.

APPENDIX A

OPENCV- IMAGE PROCESSING

A.1 Blob Detection

The class for extracting blobs from an image implements a simple algorithm for extracting blobs from an image: Convert the source image to binary images by applying thresholding with several thresholds from minThreshold (inclusive) to maxThreshold (exclusive) with distance thresholdStep between neighboring thresholds. Extract connected components from every binary image by findContours and calculate their centers. Group centers from several binary images by their coordinates. Close centers form one group that corresponds to one blob, which is controlled by the minDistBetweenBlobs parameter. From the groups, estimate final centers of blobs and their radiuses and return as locations and sizes of keypoints. This class performs several filtrations of returned blobs. You should set filterBy $\times$ to true/false to turn on/off corresponding filtration. Available filtrations:

1. By color. This filter compares the intensity of a binary image at the center of a blob to blobColor. If they differ, the blob is filtered out. Use blobColor = 0 to extract dark blobs and blobColor = 255 to extract light blobs.
2. By area. Extracted blobs have an area between minArea (inclusive) and maxArea (exclusive).
3. By circularity. Extracted blobs have circularity ($4\times$ pi $\times$Areaperimeter$\times$perimeter) between minCircularity (inclusive) and maxCircularity (exclusive).
4. By ratio of the minimum inertia to maximum inertia. Extracted blobs have this ratio between minInertiaRatio (inclusive) and maxInertiaRatio (exclusive).
5. By convexity. Extracted blobs have convexity (area / area of blob convex hull) between minConvexity (inclusive) and maxConvexity (exclusive).

REFERENCES

[1] Roxanne Hawi, George Okeyo,Michael Kimwele, 'Smart traffic light control using fuzzy logic and wireless sensor network' ,Computing Conference, 2017, 11 January 2018

[2] Manjunath Managuli, Abhaya Deshpande, Sudha H Ayatti,'Emergent vehicle tracking system using IR sensor', Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT), 2017 International Conference, 15-16 Dec. 2017

[3] S Ankitha, K B Nayana, S R Shravya, Lovee Jain,'Smart city initiative: Traffic and waste management',Recent Trends in Electronics, Information Communication Technology (RTEICT), 2017 2nd IEEE International Conference, 19-20 May 2017

[4] Song Ling,E Chi,'A traffic adaptive asynchronous media access control protocol of wireless sensor networks',Systems and Informatics (ICSAI), 2016 3rd International Conference, 09 January 2017

[5] Ravi Patel, Dr. Tejas Shah,'Traffic Routing Control at Cross Road Using Image Processing Techniques',IJSETR, Vol. 6, 2017, 694-697

[6] Mohhamad Shahab Uddin, Ayon Kumar Das, Md. Abu Taleb,'Real - time Area Based Traffic Density Estimation by Image Processing for Traffic Signal Control System: Bangladesh Perspective',IEEE 2nd International Conference on Electrical Engineering and Information Communication Technology, May 2015.

[7] Ayoub Fikri,El Mehdi Zrihni,Yassine Salih Alj,'A smartphone-based system for traffic congestion control using RFID tags',Electrical and Information Technologies (ICEIT), 2015 International Conference, 25-27 March 2015