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Design and Implementation of Smart "Traffic Signalling System"

(Under the Guidance of Dr. S. Ravishankar Prof. ECE Dept.)

G. RAM SRIVATSAV ECE13054
G.V.V.S.S. KIRAN ECE13055
G.A. SAI CHARAN ECE13060

Abstract

- Traffic congestion was recognized as major problems in modern urban areas for easy movement of vehicles.
- The Traffic Density in cities like Bangalore is highly random in nature and is very difficult to predict. There is a need to deploy a smart signalling system to regulate and monitor the traffic.
- This project aims to implement a smart traffic signalling system for seamless movement of vehicles on road in an optimal way.

Literature Survey(Md. Munir Hasan 2014)[1]

- In this paper[1], author proposed a method for determining traffic congestion on roads using image processing techniques and a model for controlling traffic signals based on information received from images of roads taken by video camera.
- Author extracted traffic density which corresponds to total area occupied by vehicles on the road in terms of total amount of pixels in a video frame instead of calculating number of vehicles.

Literature Survey(Md. Munir Hasan 2014)[1]

- Author set two parameters as output , traffic cycle and weighted time for each road based on traffic density.
- Traffic Cycle is the total time required for one complete rotation of the signal lights at any traffic point.

Literature Survey(Md. Munir Hasan 2014)[1]

- The denser the traffic, longer is the traffic cycle. This method is applied for longer cycle duration when there is more traffic so that more vehicles can pass at a time.

Literature Survey(Anurag Kanungo 2014)[2]

- This paper[2] presents the method to use live video feed from the cameras at traffic junctions for real time traffic density calculation using video and image processing.
- It also focuses on the algorithm for switching the traffic lights according to vehicle density on road, there by aiming at reducing the traffic congestion on roads which will help lower the number of accidents.

Literature Survey(Anurag Kanungo 2014)[2]

- This system consists of video cameras on the traffic junctions for each side as if it is a four way junction. Therefore four video cameras will be installed over the red lights facing the road.
- Cameras would be capturing video and broadcasting it to the servers where using video and image processing techniques the vehicle density on every side of the road is calculated and an algorithm is employed to switch the traffic lights accordingly.

Literature Survey(Anurag Kanungo 2014)[2]

- Hardware also includes connection of these cameras to the server to receive live feed and a server capable enough for handling the processing requirements.
- Software used in the system includes MATLAB and image processing toolbox and C++ compiler to generate algorithmic results.

LITERATURE SURVEY(Bilal Ghazal 2016)[3]

- This paper[3] proposes a system based on PIC microcontroller that evaluates the traffic density using IR sensors and accomplishes dynamic timing slots with different levels.
- Moreover, a portable controller device is designed to solve the problem of emergency vehicles stuck in the overcrowded roads.

LITERATURE SURVEY(Bilal Ghazal 2016)[3]

- The IR transmitter and the IR receiver are mounted on either sides of a road. When an automobile passes on the road between the IR sensors, the system is activated and the car counter is incremented.

LITERATURE SURVEY(Bilal Ghazal 2016)[3]

- The collected information about the traffic density of the different roads of a junction is analysed in order to modify dynamically the delays of green light at the lane having the significant traffic volume. The whole system could be controlled by PIC microcontroller or even by PLC.

LITERATURE SURVEY(Vivek Tyagi 2012)[4]

- This paper[4] considers the problem of vehicular traffic density estimation, utilizing the information cues present in the cumulative acoustic signal acquired from a roadside-installed single microphone.
- This cumulative signal comprises several noise signals such as tire noise, engine noise, engine-idling noise, occasional honks, and air turbulence noise of multiple vehicles.

LITERATURE SURVEY(Vivek Tyagi 2012)[4]

- The occurrence and mixture weightings of these noise signals are determined by the prevalent traffic density conditions on the road segment.
- For instance, under a free-flowing traffic condition, the vehicles typically move with medium to high speeds and there by produce mainly tire noise and air turbulence noise and less engine-idling noise and honks.

LITERATURE SURVEY(Vivek Tyagi 2012)[4]

- For slow-moving congested traffic, the cumulative signal will largely be dominated by engine-idling noise and honks; air turbulence and tire noises will be inconspicuous.
- Further more, these various noise signals have spectral content that are very different from each other and, hence, can be used to discriminate between the different traffic density states that lead to them.

LITERATURE SURVEY(Ms.Pallavi Choudekar 2011)[5]

- In this paper[5] they propose a system for controlling the traffic light by image processing. The system will detect vehicles through images instead of using electronic sensors embedded in the pavement.
- A camera will be installed alongside the traffic light. It will capture image sequences. Setting image of an empty road as reference image, the captured images are sequentially matched using image matching.

LITERATURE SURVEY (Ms.Pallavi Choudekar 2011)[5]

- For this purpose edge detection has been carried out using **Prewitt edge detection** operator and according to percentage of matching traffic light durations can be controlled.

LITERATURE SURVEY(Ms.Pallavi Choudekar 2011)[5]

Following are the steps involved

- Image acquisition
- RGB to gray conversion
- Image enhancement
- Image matching using edge detection

Literature Survey

Author(year)	Title	Features	Method used to Determine the Features
Md. Munir Hasan	Smart Traffic Control System with Application of Image Processing Techniques	1. traffic density 2. green light on time calculation	For Traffic Density they used Image Processing. (sobey edge detection **) we planned to use this method to detect the traffic density because this is more efficient when compared others.**
Anurag Kanungo	Smart Traffic Lights Switching and Traffic Density Calculation using Video Processing	Traffic Density.	For traffic density they used video processing .

Literature Survey

Author(year)	Title	Features	Method used to Determine the Features
Bilal Ghazal	Smart Traffic Light Control System	1.Traffic density	They uses IR sensors and PIC controller
Vivek Tyagi	Vehicular Traffic Density State Estimation Based on Cumulative Road Acoustics	1.Traffic density	This paper uses microphone on road sides ad records acoustics
Ms.Pallavi Choudekar	Implementation of Image Processing in Real Time Traffic Light Control	1. Traffic Density	For Traffic Density they used Image Processing.(Prewitt edge detection)

Parameters That are Considered in Calculation of Green Light Time

- Traffic Density
- Driver Reaction Time

Traffic Density

Traffic Density

- Traffic Density is one of the major factor that effects the seamless flow of ambulances, In metropolitan cities, traffic density plays an important role in navigation of emergency vehicles.

Literature Survey

Methods	Image Acquisit	Preprocess	Density Calculation
Background Subtraction technique	Uses cameras	Grayscale conversion, Binary conversion, Erosion, Dilation	Motion detection using Consecutive frame comparison based on histogram key region and Vehicle detection using background
Canny Edge Detection Technique	Uses cameras	Grayscale conversion, Background subtraction	Canny edge detection for vehicle edge detection, Moore neighborhood algorithm for object count

Methods	Image Acquisit	Preprocess	Density Calculation
Dual method technique	Uses cameras	Grayscale conversion	using a combination of gradient magnitude and direct subtraction techniques to detect vehicles. **We use this way of detection.**
Gradient Method	Uses cameras	Grayscale conversion	using canny edge detector and gradient based edge detection

Literature Survey

- We can also use proximity sensors ,RFID sensors and IR sensors to estimate Traffic density, but all these methods are inaccurate when compared with Image Processing.

Methodology

- To estimate traffic density we combine 2 methods

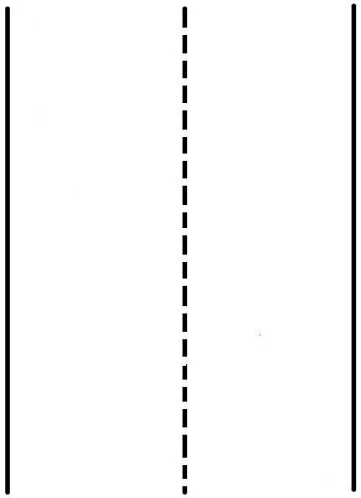
  1-Gradient method and

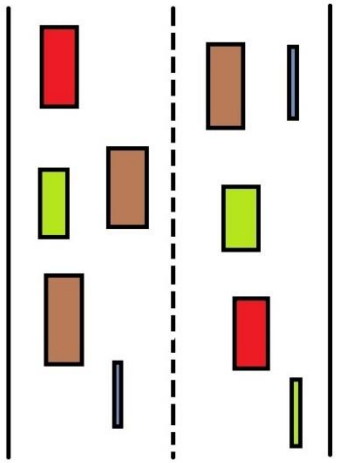
  2-Direct subtraction method

- Then we combine both of the results for better detection of vehicles.

Gradient Method

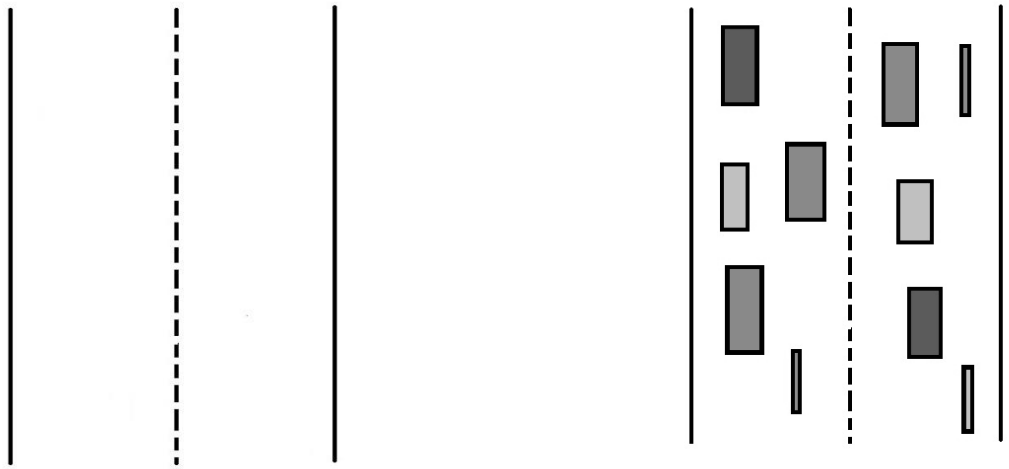
- At first the RGB foreground image from camera video frame and the background images from the reference data base are converted into grey scale image.





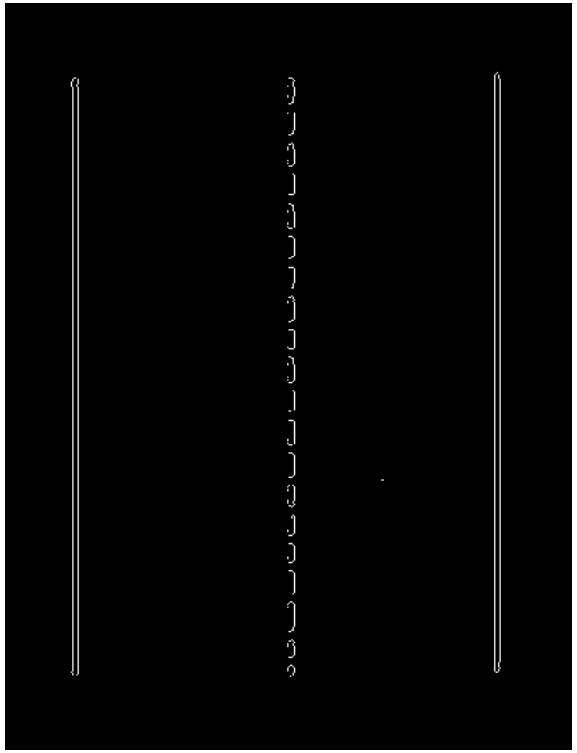
Gradient Method

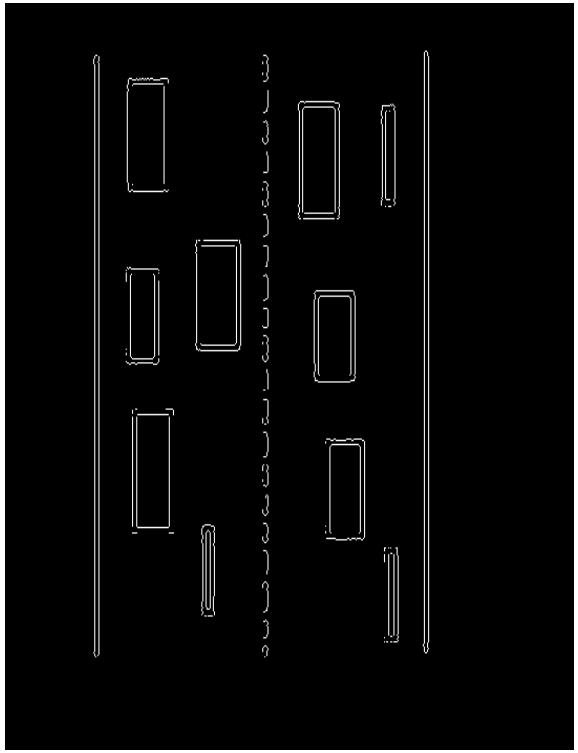
Grey Scale images:



Gradient Method

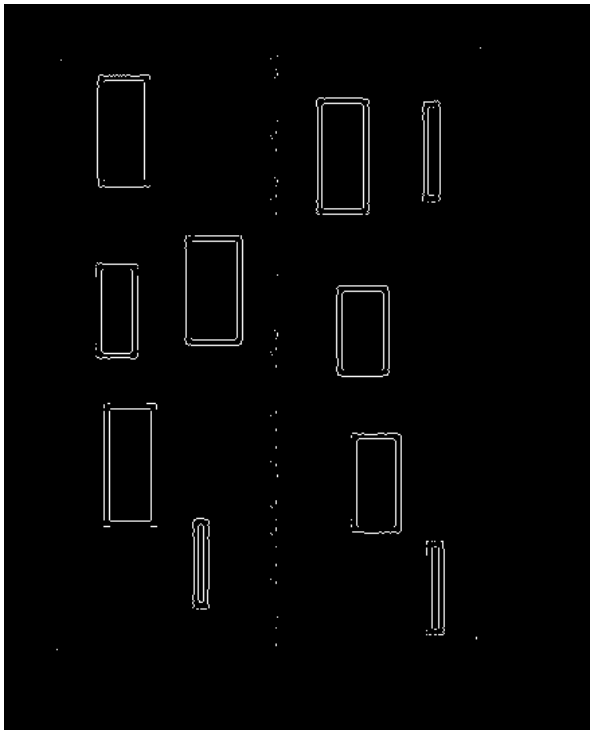
- Then we apply sobel edge detecting operation on the background and foreground image.





Gradient Method

- Foreground and Background images are subtracted to obtain foreground objects.



Gradient Method

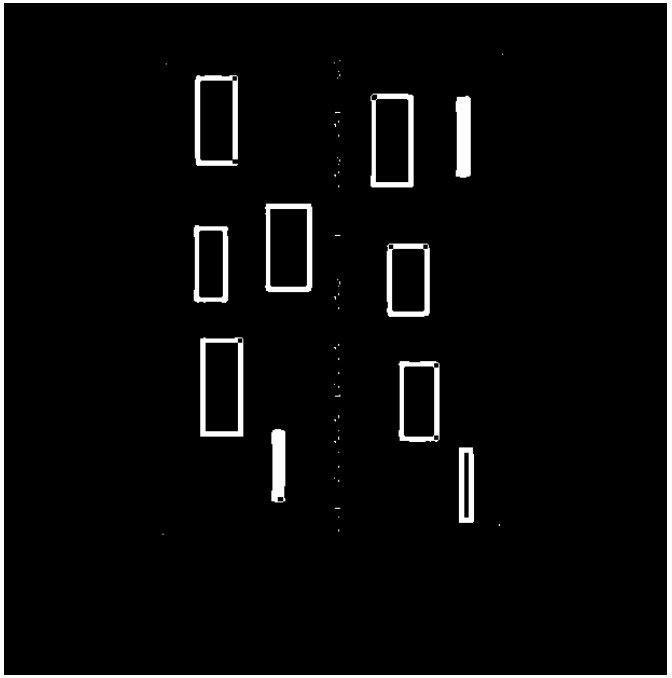
- Now we need to do some noise removal to remove the noise introduced by subtraction. We choose wiener filter because of it's ability remove the additive noise and invert the blurring simultaneously.

  Gtuned = Gobj −0.009

  $$G_{tuned} = \begin{cases} G_{tuned} & \text{If pixelvalue} \geq 0 \\ 0 & \text{else} \end{cases}$$

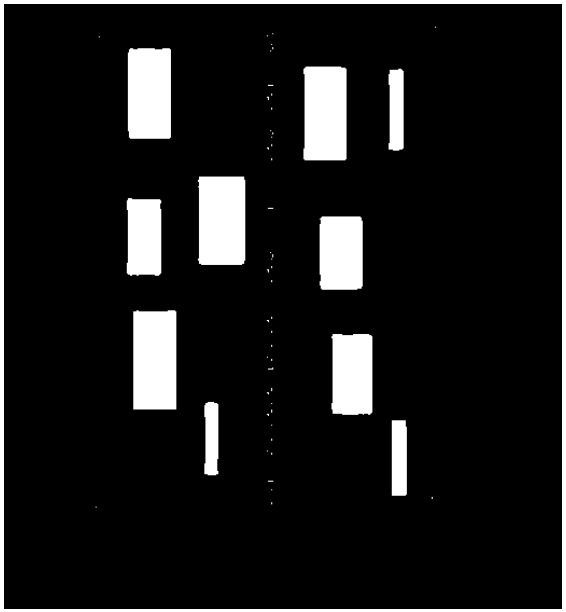
Gradient Method

- Then we perform morphological image closing



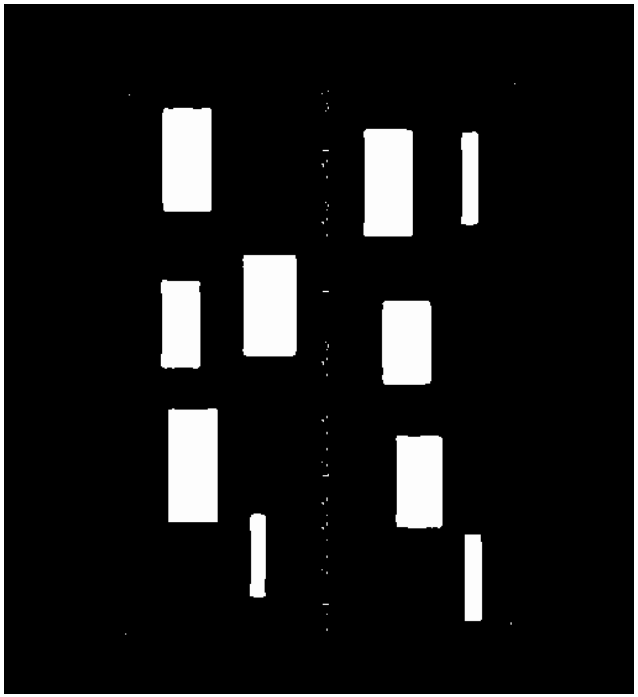
Gradient Method

- After that we perform flood fill operation to fill the holes in the objects with closed contours so that we get image with solid foreground objects.

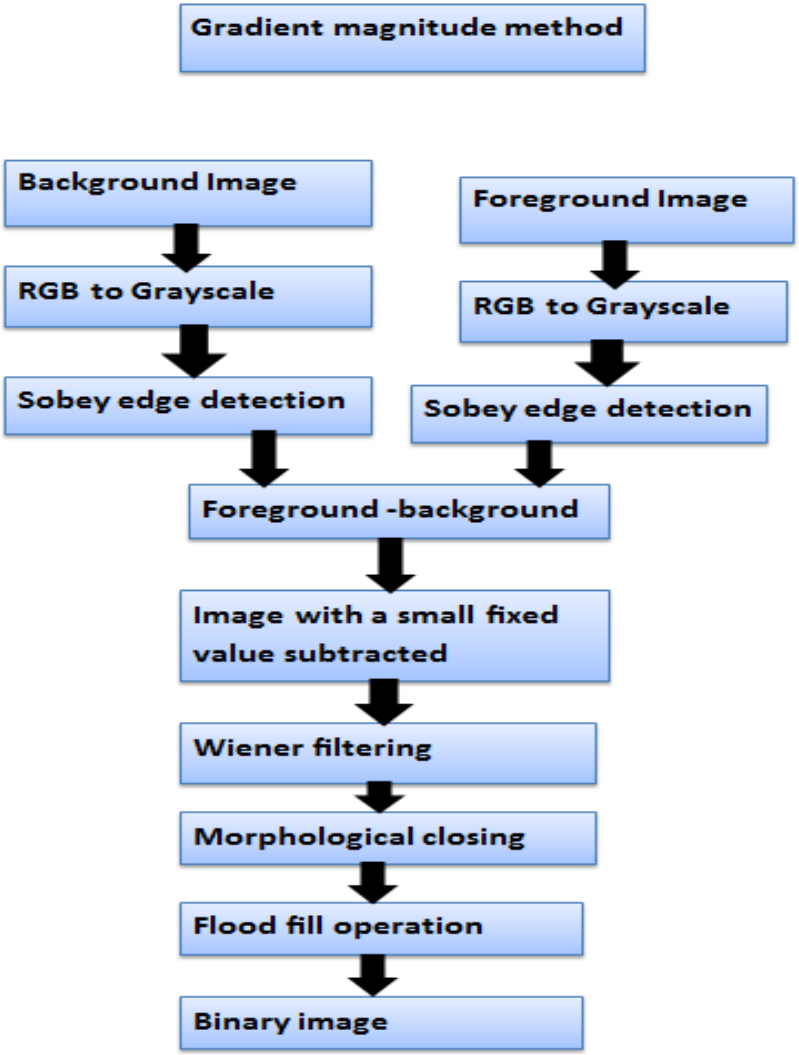


Gradient Method

- Now we convert the filled image into a binary image to easily count the number of white pixels.

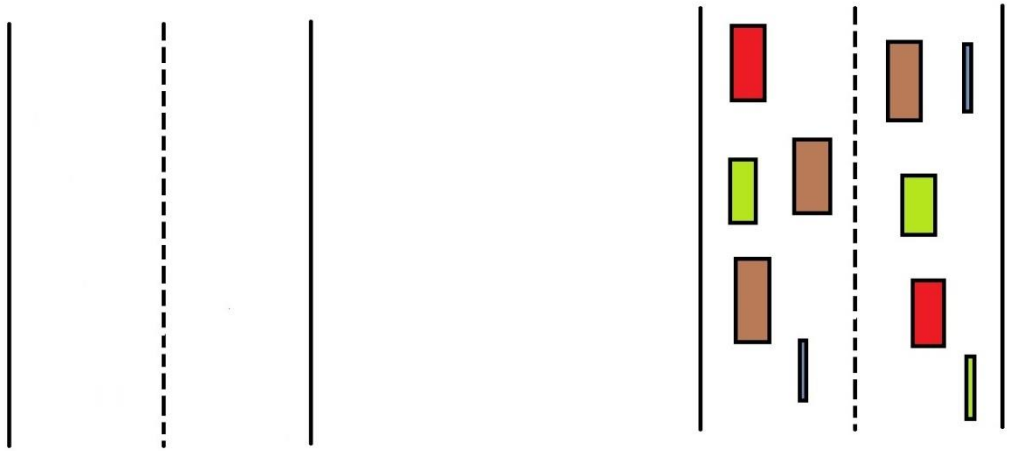


Flow chart(for finding traffic density)

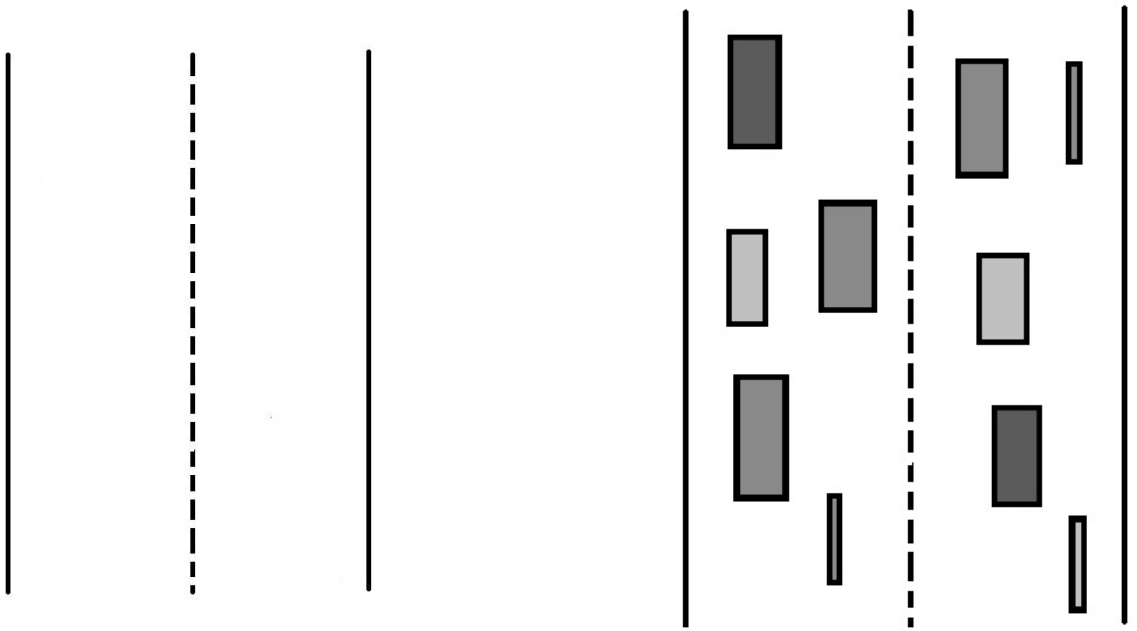


Direct Subtraction Method

- At first the RGB foreground image from camera video frame and the background images are converted into grey scale image.



Grey Scale images:



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  $D_{tuned} = D_{obj} - 0.009$

  $D_{tuned} = D_{tuned}$ If pixelvalue ≥ 0

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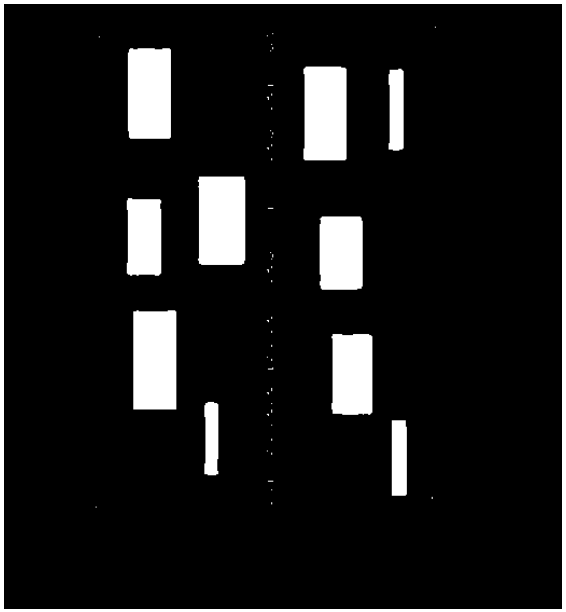

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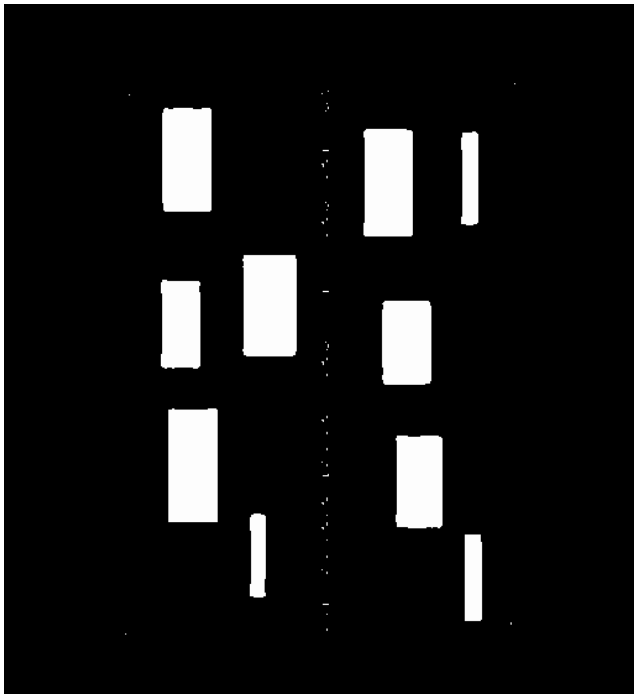
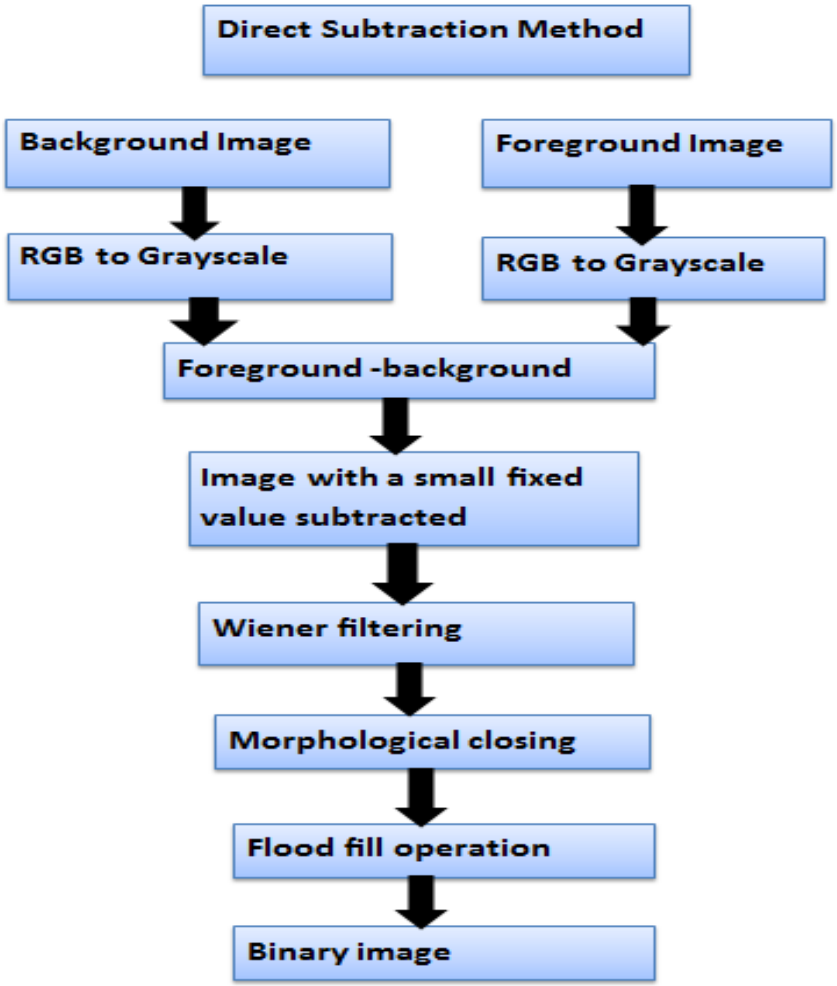
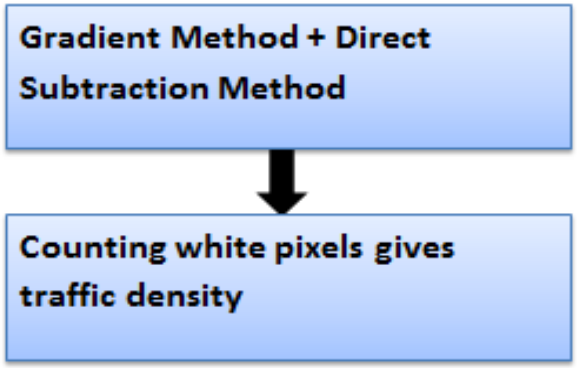


Flow chart(for finding traffic density)



- After this we add direct subtraction method and gradient method images to get better detectable image for estimation.
- Then we find count number of white pixels in the combined image which when divided with the area of the road gives, the traffic density value.

Flow chart(for finding traffic density)



- Now we use fuzzy estimation, by mapping the traffic density value to a membership function(Fuzzification).

Weather

- Sudden changes in weather causes increase in traffic congestion.
- The main weather changes that effect the traffic congestion is Rainfall.

Rainfall

- Rainfall is one of the major factor that effect the traffic congestion.
- Rainfall causes slippery roads .So, the speed of the vehicles travelling on that road reduces, This in turn increases Traffic Congestion.
- Highest recorded rainfall in India is 6 mm/min.

DRT(Driver Reaction Time)

- DRT is the time that the driver takes in response to the change of traffic light to green.

Ton (Green Light On Time Calculation)

- Now we calculate the time for which the green light should be on by the formulae.

  Ton=Td*K+DRT

  -Td-Fuzzy membership function Value.

  -DRT-Driver Reaction Time.

  -K-Weather Constant(varying from 1-2).

Prioritizing Emergency Vehicles

Prioritizing Emergency Vehicles

- We had divided emergency vehicles into two categories.
- Emergency vehicles (E1)

  1-Ambulances.

  2-Fire Engines.
- Emergency vehicles (E2)

  1-police vehicles.

  2-government vehicles.

Emergency vehicles (E1)

- In this category we considered all the emergency vehicles that involve in life saving activities.

Emergency vehicles (E2)

- In this category we considered the remaining emergency vehicles including government transport vehicles.

Calculation of priority factor

- Based on the values of the count of E1 and count of E2 we calculate this priority factor for every road that converge at the junction.
- The road with maximum priority factor value will change first to green with the time calculated based on Traffic density, Weather factor and Driver reaction time.

Timeline	Work Plan
November 2016	Literature survey
January 2017	Literature survey and Simulating the base paper[1] identified during literature survey
February 2017	Literature survey and Simulating the base paper[1] identified during literature survey
March 2017	Design ,Implementation and Testing continued.
April 2017, May 2017	Preparing a research paper for publishing the work and submitting for publication.Draft copy of Project report documentation.

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