Abstract: In present century the traffic problem in metro cities is a very serious issue since the number of vehicles on road is increasing day by day. This project is about implementing image processing algorithm in real time traffic light control which will control the traffic lights efficiently. A web camera is placed in each phases of traffic light that will capture the still images of the road where we want to control the traffic. Then those captured Images are sequentially matched using image matching with a reference image which is an empty road image. The traffic is controlled according to percentage of matching. This system can be implemented as an embedded based module. It depicts the problem of controlling traffic lights under fixed or adaptive routing algorithms for urban vehicular networks can increase the efficiency, fuel consumption and safety measures.

Keywords: Image Acquisition, Traffic Signaling, Image Matching.

I. INTRODUCTION

As the population of the modern cities is increasing day by day due to which vehicular travel is increasing which leads to congestion problem. Traffic congestion has been causing many critical problems and challenges in the major and most populated cities. Due to this traffic congestion there is more wastage of time. The steady increase in the number of automobiles on the road has amplified the importance of managing traffic flow efficiently to optimize utilization of existing road capacity. High fuel cost and environmental concerns also provide important incentives for minimizing traffic delays. Road accident is another main problem in modern world. If we observe seriously the causes of road accidents, we found that narrow roads and rapid increase of means of transport are the main reasons behind increasing number of road accidents. Due to the massive growth in urbanization and traffic congestion, intelligent vision based traffic light controller is needed to reduce the traffic delay and travel time especially in developing countries as the current automatic time based control is not realistic while sensor based traffic light controller is not reliable in developing countries. Traffic Rules & Laws, Road Signs and Traffic Control Systems are used to solve the previously mentioned traffic problems.

Traffic laws are the laws which regulate the traffic rules, while rules of the road are both the laws and the informal rules that may have developed over time to facilitate the orderly and timely flow of traffic.

II. TRAFFIC LIGHT SYSTEM

A traffic light system is an electronic device that assigns right of way at an intersection or street crossing by means of displaying the standard red, yellow and green coloured indications. An addition, it works in conjunction with pedestrian displays to assign pedestrian crossing right of way. A traffic light, also known as traffic signal, stop light, stop-and-go lights, is a signalling device positioned at a road intersection, pedestrian crossing, or other location in order to indicate when it is safe to drive, ride, or walk using a universal colour code (and a precise sequence, for that are colours blind). Nowadays, a red light meant traffic in all directions had to stop. A yellow light meant cross-town traffic would have to slow and a green light would to go or proceed. The difficulty in understanding this confusing colour sequence was compounded by neighbouring towns using another system. The development of an intelligent control structure ensures an optimal solution for all participants in the transportation and road traffic system. There are different ways controlling road intersections. In the simplest cases the right-hand rule or, if the traffic is higher, a roundabout or the signal of a policeman can help steer the traffic. However, especially in big cities, in the complicated cases when the roads in the intersection have several lanes, the use of traffic lights cannot be avoided. An additional issue arises when in the intersection not only roads but also railroad tracks take part, what often occurs in suburban traffic situations. The most common way to handle this type of intersection is the conventional cyclic lights control [2].

III. MOTIVATION

The traffic lights that are in widespread use today do not do much intricate reasoning when deciding when to change the lights for the various road users waiting in different lanes. How long the signal stays green in one lane and red in another is most often determined by simple timing that is calculated when the crossing is designed. The systems are very inefficient because they are unable to handle various
simple situations that arise throughout the day. Unnecessary waiting time in the signal can be avoided by determining in which side the green signal should be large during the traffic. In Case the structure of the traffic [3].

IV. PROBLEM DESCRIPTION
In Ethiopia, all of the traffic light system used is the traditional system. These systems encounter many limitations i.e. timing is not based on number of vehicles due to this we have the following draw backs:

A. Heavy Traffic Jam
With increasing number of vehicles on road, heavy traffic congestion occurs substantially in major cities. This happened usually at the main junctions commonly in the morning before office hour and in the evening after office hours. This causes an increased time wasting of the people on the road.

B. Green Light For An Empty Road
There are these times where there are no vehicles on a junction but the green light is on for that junction. Whereas, on the other junction there exists a queue of waiting vehicles but the red light is on for that junction.

C. No Traffic, But The Pedestrians Still Need To Wait
At certain junctions, sometimes even if there is no traffic, pedestrians have to wait. Because the traffic light remains green for the preset time period, the road users should wait until the light turn to red.

LIMITATION: Changes in lightening conditions and weather conditions have been tackled in many of the previous approaches and they are going to be considered also in our proposed approach, but the problem that has never been addressed before and has a significant effect on the traffic pace is the stationary vehicles, specially the unattended ones. The problem with the traffic density measurement is that the traffic density of a road with stationary or unattended vehicles is the same as the traffic density of a road with no stationary vehicles. Traffic flow counts the number of vehicles that passes through the frame during a certain time interval. However, it may give an empty road a higher priority than a congested road, because fewer vehicles are passing through the given point in that empty road. Therefore, we will concentrate on the detection of the delayed and unattended vehicles in the proposed approach for computing more informative metric about the traffic congestion in order to have more effective way of traffic.

V. ARCHITECTURE FOR THE CONTROL SYSTEM
In this architecture camera is placed on top of the signal to get the clear view of the traffic on the particular side of the signal so that it will capture the Image and analyze the traffic in that particular side and get the count of the number of vehicle [4]. With this count the density of that particular side will be determined and corresponding signal will be provided Fig.1.

Fig.1. System architecture.

VI. BLOCK DIAGRAM

A. RGB To Gray Scale Image
Humans perceive colour through wavelength-sensitive sensory cells called cones as shown in Fig.2. There are three different varieties of cones, each has a different sensitivity to electromagnetic radiation (light) of different wavelength. One cone is mainly sensitive to green light, one to red light, and one to blue light. By emitting a restricted combination of these three colours (red, green and blue), and hence stimulate the three types of cones at will, we are able to generate almost any detectable colour. This is the reason behind why colour images are often stored as three separate image matrices; one storing the amount of red (R) in each pixel, one the amount of green (G) and one the amount of blue (B). We call such colour images as stored in an RGB format. In grayscale images, however, we do not differentiate how much we emit of different colours, we emit the same amount in every channel. We will be able to differentiate the total amount of emitted light for each pixel; little light gives dark pixels and much light is perceived as bright pixels. When converting an RGB image to grayscale, we have to consider the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One of the
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B. Image Resizing

Image scaling occurs in all digital photos at some stage whether this be in Bayer demosaicing or in photo enlargement. It happens anytime you resize your image from one pixel grid to another. Image resizing is necessary when you need to increase or decrease the total number of pixels. Even if the same image resize is performed, the result can vary significantly depending on the algorithm. Images are resized because of number of reasons but one of them is very important in our project. Every camera has its resolution, so when a system is designed for some camera specifications it will not run correctly for any other camera depending on specification similarities, so it is necessary to make the resolution constant for the application and hence perform image resizing.

C. Image Enhancement

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further analysis. For example, we can eliminate noise, which will make it is easier to identify the key characteristics.

VII. IMPLEMENTATION ALGORITHM

The algorithm behind the block diagram consists of following steps:

- We have a reference image and the image to be matched is continuously captured using a camera that is installed at the junction.
- The images are pre-processed in two steps as follows:
  - Images are rescaled to 300x300 pixels.
  - Then the above rescaled images are converted from RGB to gray.
- Edge detection of pre-processed images is carried out using canny edge detection technique.
- The output images of previous step are matched using pixel to pixel matching technique.
- After matching the timing allocation is done depending on the percentage of matching as
  - If the matching is between 0 to 50% - green light is on for 20 seconds at road1 and red light is on for 25 seconds at road2,3,4.
  - If the matching is between 50 to 90% - green light is on for 10 seconds at road1 and red light is on for 13 seconds at road2,3,4.
  - If the matching is above 90% - green light is on for 50 seconds at road1 and red light is on for 8 seconds at road2,3,4.

We have used an approach of comparing a reference image with the real time image pixel by pixel. Though there are some disadvantages related to pixel based matching but it is one of the best techniques for the algorithm which is used in the project for decision making. Real image is stored in matrix in memory and the real time image is also converted in the desired matrix. For images to be same their pixel values in matrix must be same. This is the simplest fact used in pixel matching. If there is any mismatch in pixel value it adds on to the counter used to calculate number of pixel mismatches. Finally percentage of matching is expressed as

\[ \% \text{match} = \frac{\text{No. of pixels matched successfully}}{\text{Total No. of pixels}} \] (1)

The program written using MATLAB to implement the above algorithm is given in appendix however the output of each step and final results of the program are given in next sections.

VIII. FLOW CHART

![Flow chart](image)

IX. DENSITY MEASUREMENT

A. Source Image

In this system the source image is the RGB image which can be given by the users for getting the contour image and the vehicle count in output screen. The following code can be used to auto size of the output screen Fig.4.

![Source image](image)
B. Gray Scale Image
The gray scale image can be used to display the objects in the format of black and white. In this system the output will be display the gray scale image after getting the source image only, because source image only converted into the gray scale image as shown in Fig.5.

Fig.5. Gray scale image.

D. Canny Image
Canny image is the image one of the edge detector that can be used to outline the edges of the objects. It can be help full for find out the objects. Here we have convet the threshold image to canny image as shown in Fig.6.

Fig.6. Canny image.

X. DIGITAL IMAGE PROCESSING
Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subfield of digital signal processing, digital image processing has many advantages over analog image processing; it allows a much wider range of algorithms to be applied to the input data, and can avoid problems such as the build-up of noise and signal distortion during processing [5]. The different levels at which one may want to interact with the system

- **User interface**: Running the GUI, Creation of batch jobs for applications using mat lab batch, Batch management, batch execution, including use of Matlab scripts to run batch jobs on multiple datasets with very little user interaction.
- **Application Development**: Requirements on code structure of application.
- **Introduction**: Internal representation of batch configurations, Introduction to writing batch configuration scripts, Integration of an application into configuration management and GUI.

XI. RESULTS
The output of MATLAB given below clearly indicates the implemented results of the algorithm designed.

A. Matching Between 90-100%

Fig.7.

In the above figure both the images are same and captured image is a perfect match of reference image thereby showing 100% match and GREEN light is displayed for 5 seconds at road1 and RED light is displayed for 8 seconds at road2,3,4.

B. Matching Between 50-90%

Fig.8.
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C. Matching Between 0-50%

Fig.9.

XII. CONCLUSION

“Traffic control using image processing” technique that we propose overcomes the limitations of the earlier (in use) techniques used for controlling the traffic. Earlier in automatic traffic control use of timer had a drawback that the time is being wasted by green light on the empty. The technique we proposed avoids this problem. Upon comparison of various edge detection algorithms, it was inferred that Canny Edge Detector technique is the most efficient one. The project demonstrates that image processing is a far more efficient method of traffic control as compared to traditional techniques. Also it is more effective than the density based system based on since it is cost effective and less prone to error. The major advantage is the variation in signal time which control appropriate traffic density using Image matching. The accuracy in calculation of time due to single moving camera depends on the registration position while facing road every time.

XIII. REFERENCES

[5] Traffic light control system simulation through vehicle detection using image processing by Mac Michael B. Reyes and Dr Eliezer A. Albacce.