

**Intelligent Traffic Signal Scheduling using Real Time Image Processing**Adhokshith Datta¹, Abhay Hemanth²¹Student, Computer Science Engineering, RNSIT, Bangalore,²Student, Computer Science Engineering, RNSIT, Bangalore,

Abstract: Traffic in the current urban demographic is growing at an immense rate. With such a large influx of vehicles into metropolitan areas, the problem of traffic congestion is ever growing. Therefore, managing traffic in a traffic junction using an efficient traffic signal is of utmost importance to maintain a streamlined flow of vehicles. Traffic lights currently operate under two inefficient methodologies. Our proposed system will require a camera to be adjusted next to the traffic light. Using real time digital image processing, images will be constantly processed to detect vehicles and control traffic accordingly.

Keywords: Computer Vision, Image Processing, Gamma Correction, Intelligent Systems

I. INTRODUCTION

In this rapidly developing world, traffic congestion is a constant problem that seems to increase by the day, especially in the metropolitan cities. Traffic congestion leads to longer trip times and the vehicular queuing due to poor infrastructure. Due to urbanization and traffic congestion, we turn to image processing and related technology to reduce the traffic delay and travel time especially in developing countries as the current automatic time based control is not solving the problem at hand and traffic signals using magnetometers and loop detector's aren't quite reliable in developing countries. This idea of controlling the traffic light efficiently in real time has attracted many researchers to work in this field with the goal of creating an automatic tool that can estimate the traffic congestion and hence control the traffic in an optimal manner. 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

II. MOTIVATION

The traffic lights that are in widespread use today do not do much efficient reasoning when deciding when to change the lights for the various road users waiting in different lanes and thus cannot solve the problem of traffic congestion. 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. Even though today's methods are robust and work well when the traffic load is distributed evenly across the lanes in the intersection, the systems are very inefficient because they are unable to handle various simple situations that arise throughout the day. Hence, to optimize traffic control it becomes necessary to design a tool that is better equipped to handle different traffic scenarios.

III. EXISTING METHODS

There are currently two methods to detect traffic at a particular point. The first method involves manual labor. A designated traffic policeman is situated at a traffic junction to manage the traffic light efficiently by analysing the oncoming traffic. While this method has proved to be constructive and somewhat efficient, it requires man power. Allocating traffic police to each junction will be highly unproductive and require an enormous amount of man power.

The second, more modern method is to use electronic circuits to detect vehicles at a signal. These circuits are built into the road at a traffic junction and uses induction loop. The induction loop causes a magnetic field which affects the electrons inside the car when it arrives. These electrons cause an eddy current which induces it's own magnetic field. When this field induced by the current affects the underground current, a vehicle is detected by the traffic light and it produces the signal accordingly. However, this procedure is expensive and hard to implement. Also, it is not entirely reliable since an eddy current can be induced by any metal object.



Figure 1. Electronic Circuits built into the road

IV. PROPOSED METHOD

The approach specified in this paper uses image processing and computer vision to identify the density of traffic. There are three phases which constitute the necessary steps involved in processing the image. A camera is placed adjacent to the traffic light to analyse the oncoming traffic. This camera first takes an image of an empty road and processes it for calibration. Subsequently, it continually processes image sequences and compares it with the reference image to find the image density.

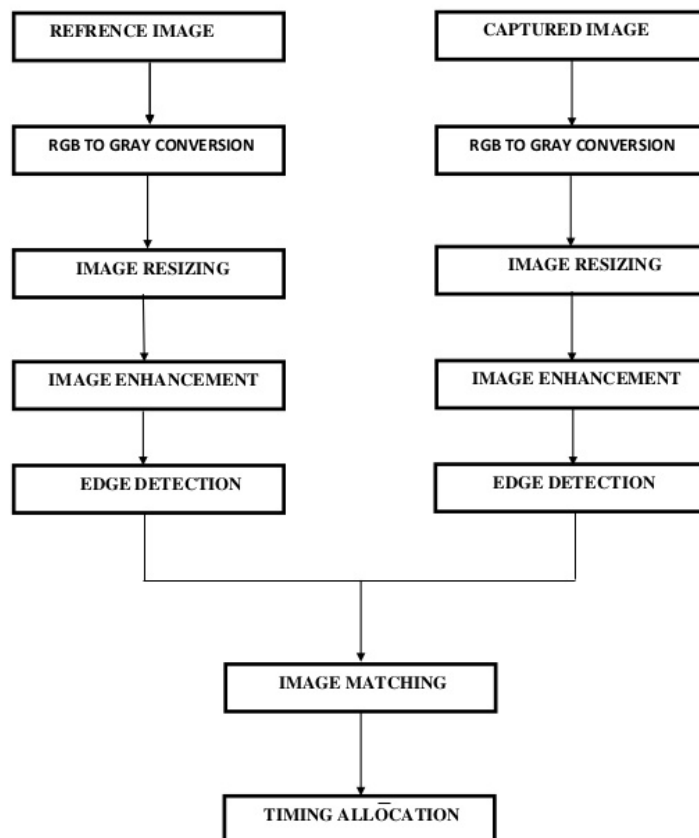


Figure 2. Flowchart of procedure

Phase 1

- An image of the empty road is taken
- The RGB image is converted to grayscale
- The grayscale image is enhanced by using gamma correction
- The edges of the image are detected using Prewitt edge detection

- The final result is considered to be the reference image

Phase 2

- Real time image of a road is captured
- The RGB image sequence is converted to grayscale
- The grayscale image sequence is enhanced by using gamma correction
- The edges of the images are detected using Prewitt edge detection
- The final result serves as the real time image sequence

Phase 3

- Subsequently, the reference image and the real time image sequence are matched against each other.
- According to the percentage of match between the two images, traffic light allocation is configured accordingly.
 1. If the match is between 0-15%, the green light of the respective lane will be allocated for 90 seconds
 2. If the match is between 15-50%, the green light will be on for 60 seconds.
 3. If the match is between 50-80%, the green light will be on for 30 seconds.
 4. Finally, if the match is between 80-100%, red light will be allocated for 60 seconds.

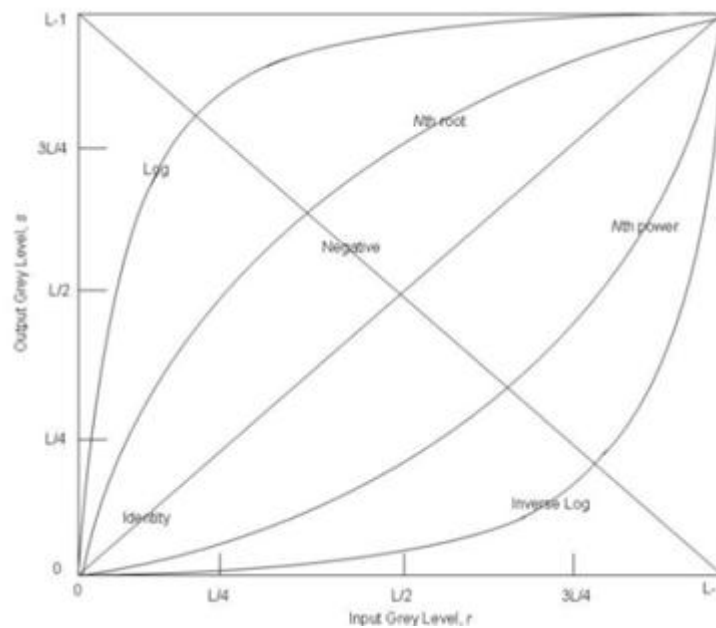


Figure 3. Gamma Factor

4.1 Image Enhancement using Gamma Correction

Image enhancement is the process of adjusting images in order to make the result sharper and reduce the noise. One of the most prominent methods of image enhancement to use gamma correction of an image. Gamma correction is also known as power law transform is a suitable method to iron out the smudged parts of the image. It follows the simple equation shown below.

$$S=RC^y$$

where S is the output gray level, C is the input gray level, R and y are positive constants. For various values of gamma applied on the image, the equation yields the images shown below. As we can see from the images below, it is an absolute necessity to use a gamma correction factor that's greater than one. Only then will the contrast be more distinguishable in the image.



Figure 4. Example under different gamma factor

4.2 Edge Detection using Prewitt Edge Detection

Edge detection is extremely important in image processing. It detects the border of the road and provides the internal area of the image to be processed. Edges in an image are detected by the amount of change from one pixel to the subsequent signal. These changes are measured by derivatives. The second derivative is directly proportional to the magnitude of change in the intensity of the pixel. If the derivative of the image gradient is not equal to zero, that pixel is considered to be a pixel on the edge. The first derivative identifies if the pixel is part of an edge. The second derivative of the pixel determines whether the pixel lies on the dark side of the image or the light side of the image. The gradient of the pixels of a 2D image has 2 attributes in accordance to the two axes, X and Y. The below equations demonstrate the image gradient factor of a pixel.

$$G_x = \partial f / \partial x$$
$$G_y = \partial f / \partial y$$

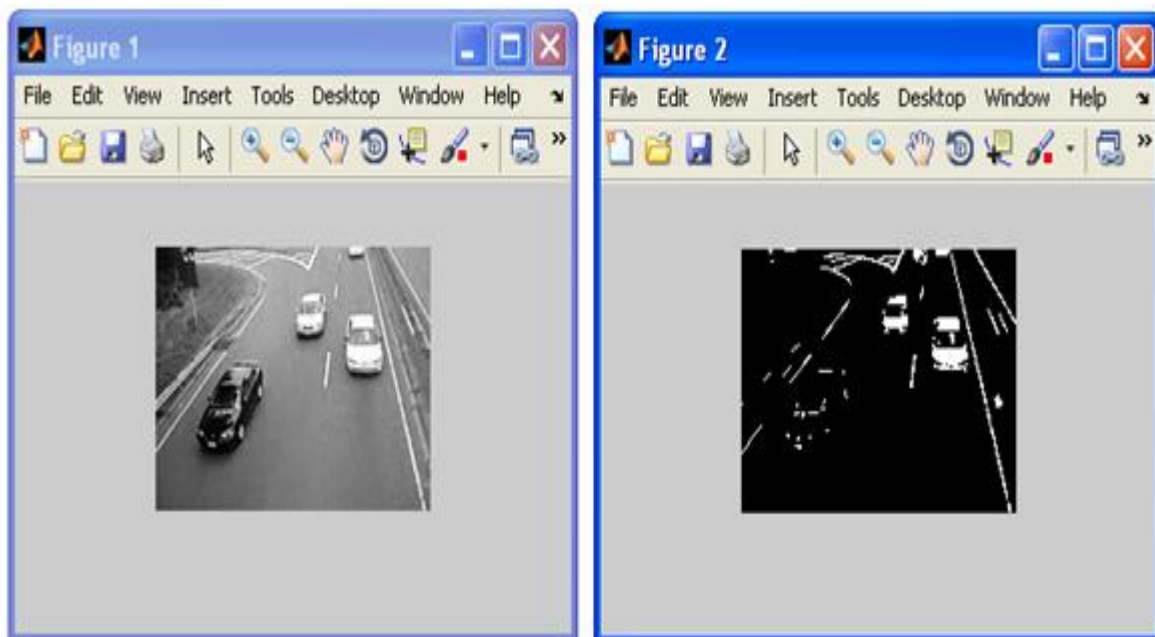


Figure 5. Edge detection using Prewitt method

4.3 Image Matching

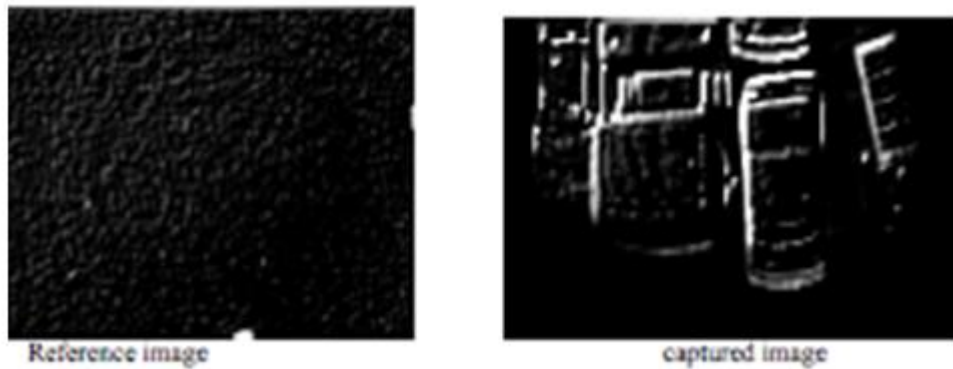


Figure 6. Image matching of reference and captured image

Once the edge detection process is completed on both the images, the images need to be matched. In order to match the two images, we use an edge based matching technique. Firstly, the edges on the reference image which match the real time image cancel each other out. Subsequently, according to the number of extra edges present in the real time image, the amount of traffic present at the junction can be approximated. Finally, depending of the percentage of difference between the reference image and the image sequence, signal time will be allocated accordingly.

V. IMPROVEMENTS

The approach presented above is appropriate for analysing and scheduling green light signals accordingly. However, there are many other further enhancements to make the entire process of traffic light scheduling smarter. One of these enhancements requires a hardware device which can identify sound. With the inclusion of a sound detector to the image processing apparatus, it is possible to give emergency aid services the right of way by appropriately scheduling the traffic lights. With the combined information from the sound detector and image processor, it is possible to identify ambulances or fire engines and assign a green light to the lane where they are present.

VI. CONCLUSION

The study shows that the use of image processing to schedule traffic lights is a more efficient way to control the flow of traffic when compared to traditional methods. Since it uses computer vision to gather information about traffic density, it is abundantly more reliable and leads to better traffic flow. This traffic light scheduling based on image processing doesn't work based on the metal near a signal like the electronic circuit method. Hence it is more robust and leads to fewer errors. This method also offers an option to smartly detect oncoming ambulances and schedule signal accordingly. This proposed method can be enhanced further by increasing the number of cameras to see the variation in the traffic density.

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