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An Intelligent Traffic Control System using Morphological Operation

Navya Sree[1], D. Likhitha[2], E. Sheswika[2], K. Nikhila[2], G. Hrushitha[2]

[1]Assistant Professor, [2]UG Student, [1,2]Department of Electronics and Communication Engineering
[1,2]Malla Reddy Engineering College for Women, Maisammaguda, Hyderabad, Telangana, India

Abstract: In India, with the growing number of vehicles, traffic congestion at junctions has become a serious issue. The density of vehicles is increasing day by day and there is an urgent need of adaptive traffic signals which can do real time monitoring of traffic density. This paper describes a system which uses image processing for regulating the traffic in an effective manner by taking images of traffic at a junction. A step by step approach of image acquisition, image processing and implementation of algorithm to change the traffic light duration as per the density of vehicles on different roads at a traffic signal is followed. The number of objects in a given image is counted and priority is given to the densest road.

Keywords: Traffic congestion, Image processing, RGB to Gray conversion, image resizing, image enhancement, edge detection, image matching, timing allocation.

1.Introduction :Traffic congestion leads to a progressive reduction in traffic speeds, resulting in an increase in journey times, fuel consumption, other operating costs, and environmental pollution contributing to global warming. Traffic congestion has become a serious problem in recent days due to the increased number of vehicles and the need for people to travel more for work and vacation. It may bring stress to people, and makes them get stuck in traffic. It also makes people take longer to reach their destination. These problems of congestion are suffered not only by the motorists but also by the users of public transport, generally lower-income persons who have to pay higher fares on account of congestion. Another major consequence of traffic congestion is that an ambulance or a fire truck is unable to respond in an awaited time. People may encounter trouble with their important work due to traffic jams. This may lead to personal as well as professional drawbacks. Traffic congestion can also cause an impact on the mind of a person because of the constant blowing of horns and frustration. Various measures have has been proposed by the government to overcome the traffic jam problem by imposing parking restrictions and adopting traffic signal rules. The existing traffic light control approaches are time-dependent instead of the vehicle density on the road. It postulates manual handling

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which causes congestion and longer waiting time. This hesitation in waiting time produces traffic jams and creates more smoke emission. Thus, a traffic light control system based on image processing is the optimal solution for traffic congestion. 2. Traffic Light Control Traffic lights are signals that are used to control the movement of vehicles on the road. This traffic signal when effectively monitored can control the traffic on the road and avoid congestion. The traffic light on the road comprises of 3 signals- red, yellow and green. People are made to hold back for the green signal to further proceed. Delay in the red signal cause longer waiting time because of congestion. CCTV cameras are installed at almost all junctions on the urban cities and accident-prone and traffic-prone areas. This would enhance traffic maintenance and help police book violators. With the help of these CCTV cameras, we can calculate the density of vehicles on the road. Image processing is the use of computer algorithms to perform image processing on digital images. This technique controls the traffic light signals on the road in order to avoid unnecessary traffic congestion

2.Existing Method: The traffic lights used in India are basically pre-timed wherein the time of each lane to have a green signal is fixed. In a four lane traffic signal one lane is given a green signal at a time. Thus, the traffic light allows the vehicles of all lanes to pass in a sequence. So, the traffic can advance in either straight direction or turn by 90 degrees as shown in Fig.1. So even if the traffic density in a particular lane is the least, it has to wait unnecessarily for a long time and when it gets the green signal it unnecessarily makes other lanes wait for even longer durations.

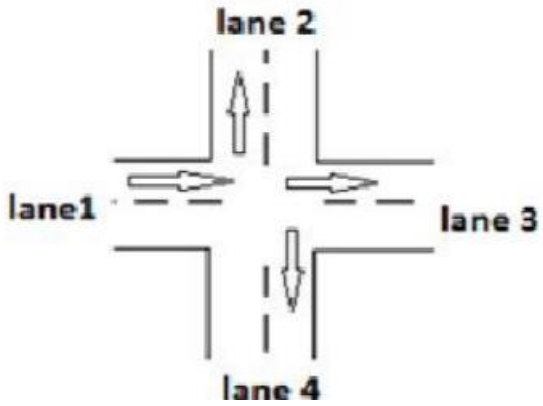

Fig1: Lane Diagram

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Issues in Existing Methods: A time-based traffic control system is one of the common methodologies or techniques to control traffic. But this methodology is contingent on time rather than on density. On account of this, the vehicles have to encounter an erratic delay in waiting time. The vehicles are made to wait even on the empty road in a time-based traffic control system which can again contribute congestion or traffic jam. Sensors can be used to detect vehicles and control traffic accordingly, A traffic light control system based on the image processing technique can handle the problem of traffic congestion more effectively.

3.Proposed system : There is technique which is used for the traffic light control based on image processing which measure the traffic density on the road and according to the traffic density measurements, it decides the cyclic time of the traffic light signals. This also overcome the problem of expensive sensors because in this technique a high quality camera has been used for intelligent traffic light control.

Following are the steps involved:

- Image acquisition, in which empty road and image with traffic on road is captured; empty road image is saved as a reference image.
- RGB to gray conversion of both the images
- Image enhancement
- Image matching using Morphological edge detection, which matches the edges of the reference image and the image with traffic on road.

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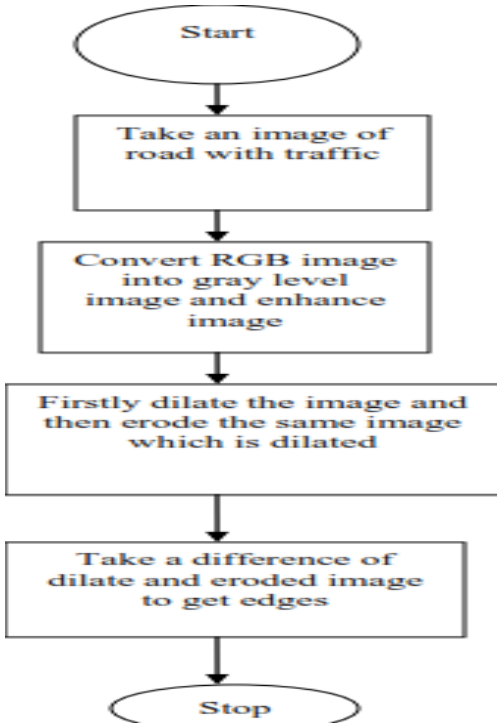

Fig2. Flow Chart Of Proposed System

4.1METHODOLOGY

A. Image acquisition: The image is captured by a webcam. It is then transferred to the computer via a USB cable. The image acquisition and further processing is done by using MATLAB.

Fig3: Image Acquisition Flow Diagram

B. Image processing: The image is captured by using a webcam placed at the road junction. It has the capability of taking images of all the roads meeting at the junction. The webcam is mounted on the DC motor. The motor is responsible for capturing images from all directions in

steps of fixed time interval. The speed of rotation of the camera is designed to be such that it is greater than the click-to-capture time of the camera. The acquired image is converted to grey scale image for further processing. The grey scale image is then converted to a binary image that contains only two colours, black and white. This image is known as the threshold image. The main purpose of thresholding the image is a radical reduction of information in order to simplify further processing. The threshold image is then complemented for further image processing.

C. Image Enhancement : In this process the images are adjusted in such a way that the results are more suitable for further processing. In this, the obtained image is converted into a greyscale image.

D. Edge detection : Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensities which characterize the boundaries of objects in an image.It filters out useless information, while keeping the important structural properties of an image. In this proposed system, edge detection technique is used. The boundaries of each image are found and the number of objects is calculated.

E.Image matching: Edge based matching is the process in which two representatives (edge) of the same objects are pared together. Any edge or its representation on one image is compared and evaluated against all the edges on the other image.

Result 1: Matching between 10 to 50% - green light on for 60 seconds

Result 2: Matching between 50 to 70% - green light on for 30 seconds

Result 3: Matching between 70 to 90% - green light on for 20 seconds

Result 4: Matching between 90 to 100% - red light on for 60 seconds

5.SIMULATION RESULTS

This section describes the simulation results that have been tested with various traffic images. All the experiments have been done in MATLAB 2009a version.

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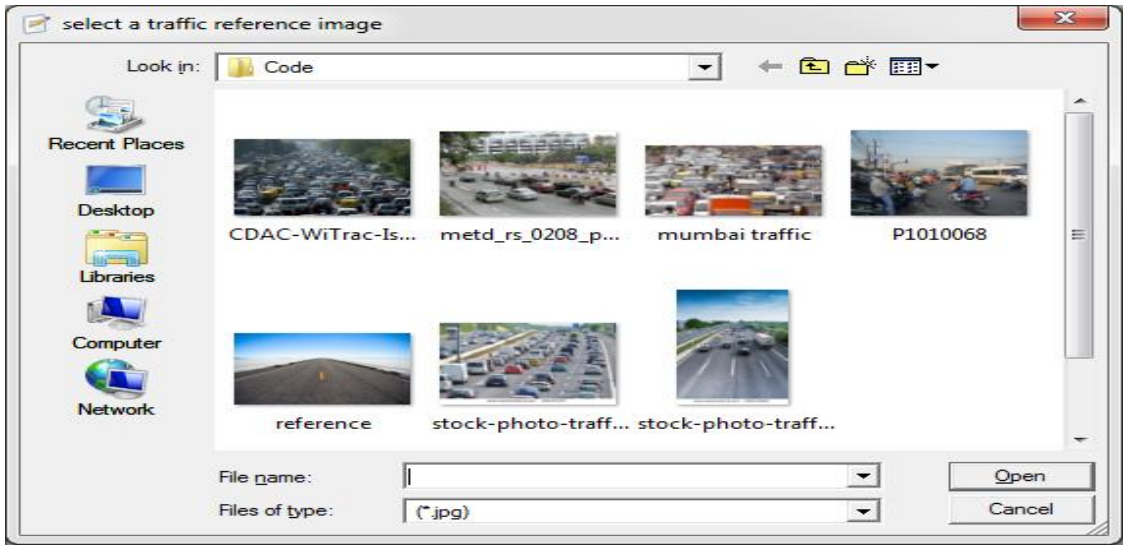

Fig. Select a reference image

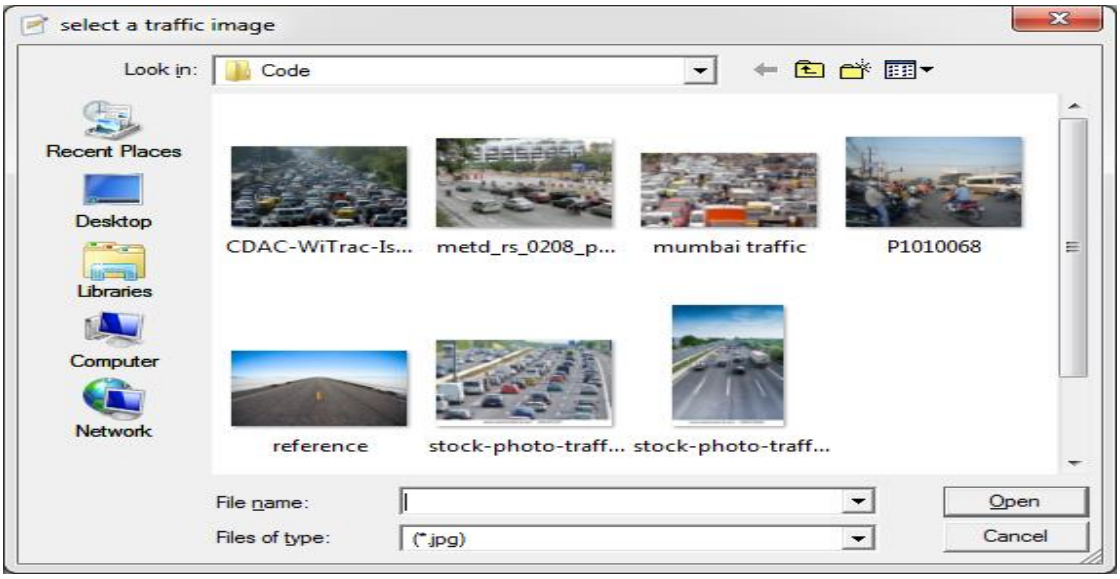

Fig. Select a traffic image

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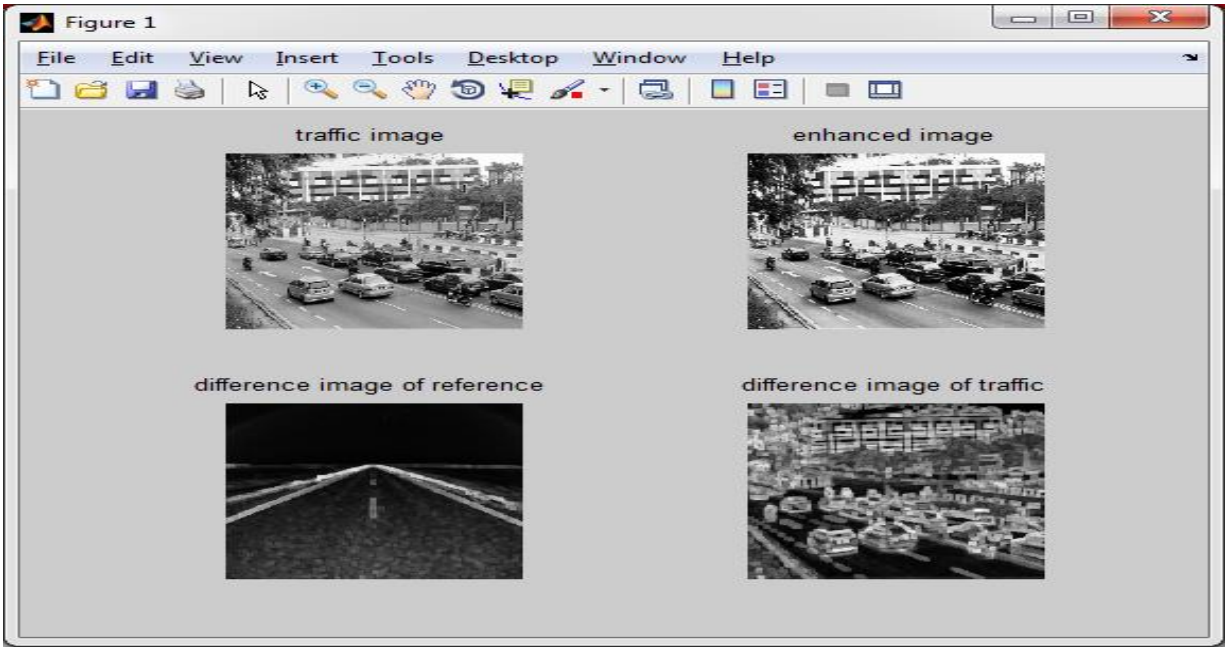

Fig. Enhanced and difference images after morphing

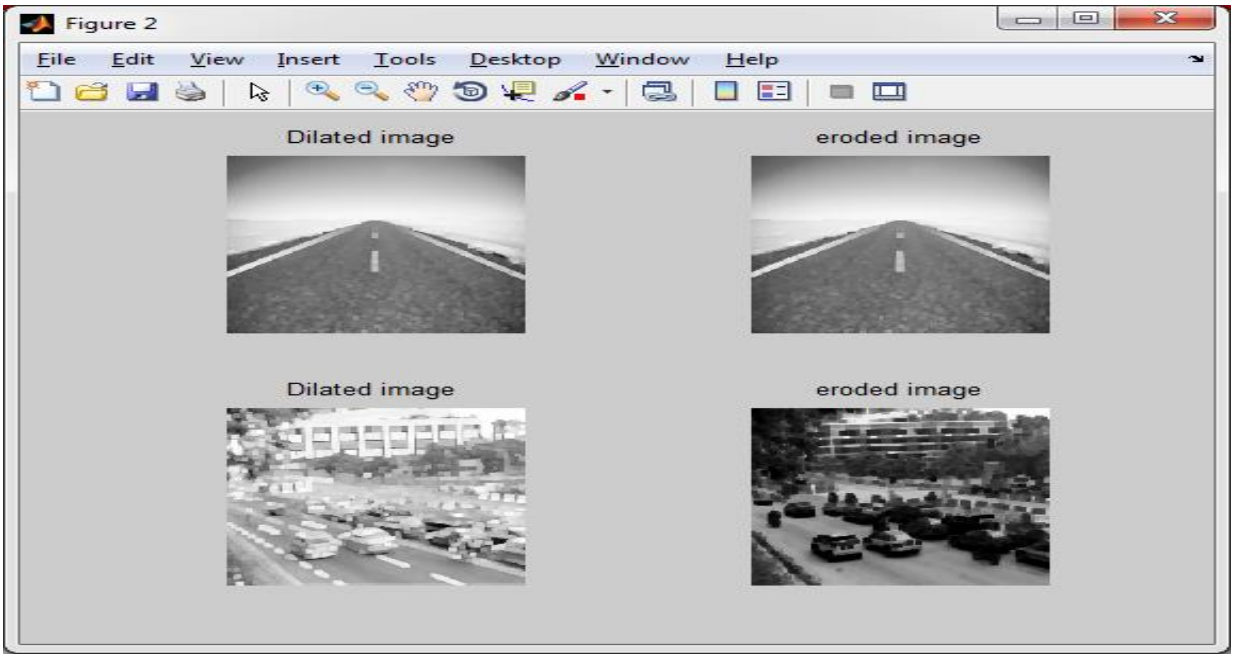

Fig. Morphological processed images

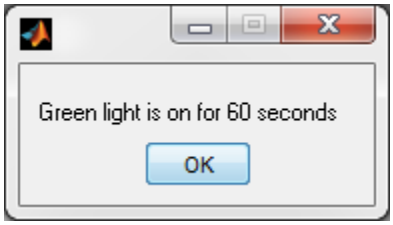

Fig. message box to display number of seconds

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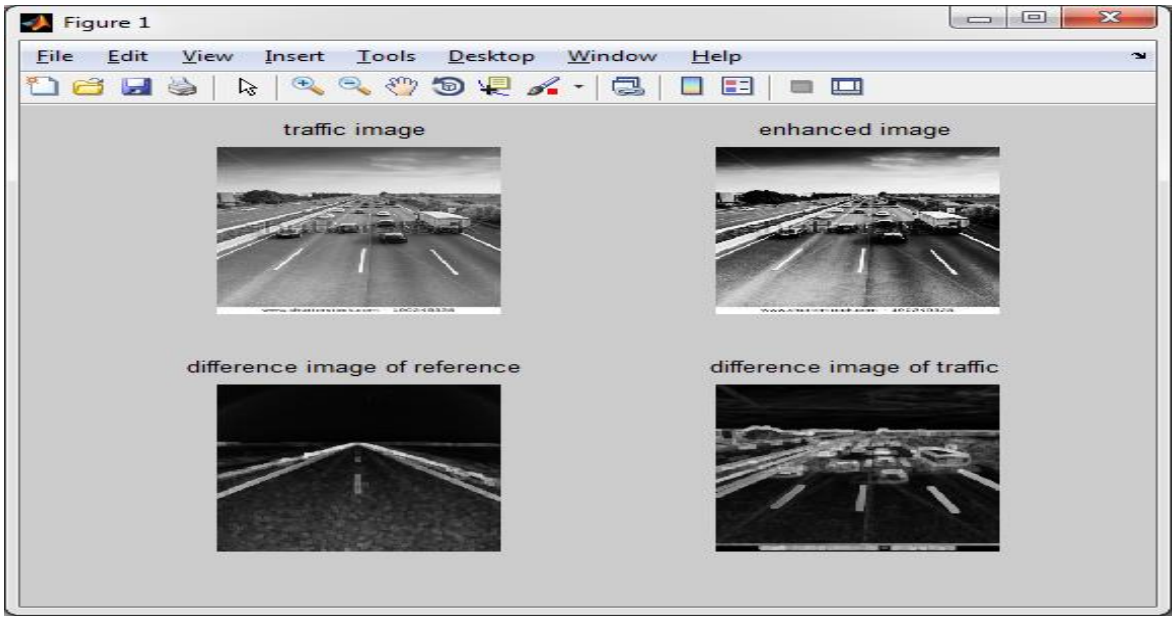

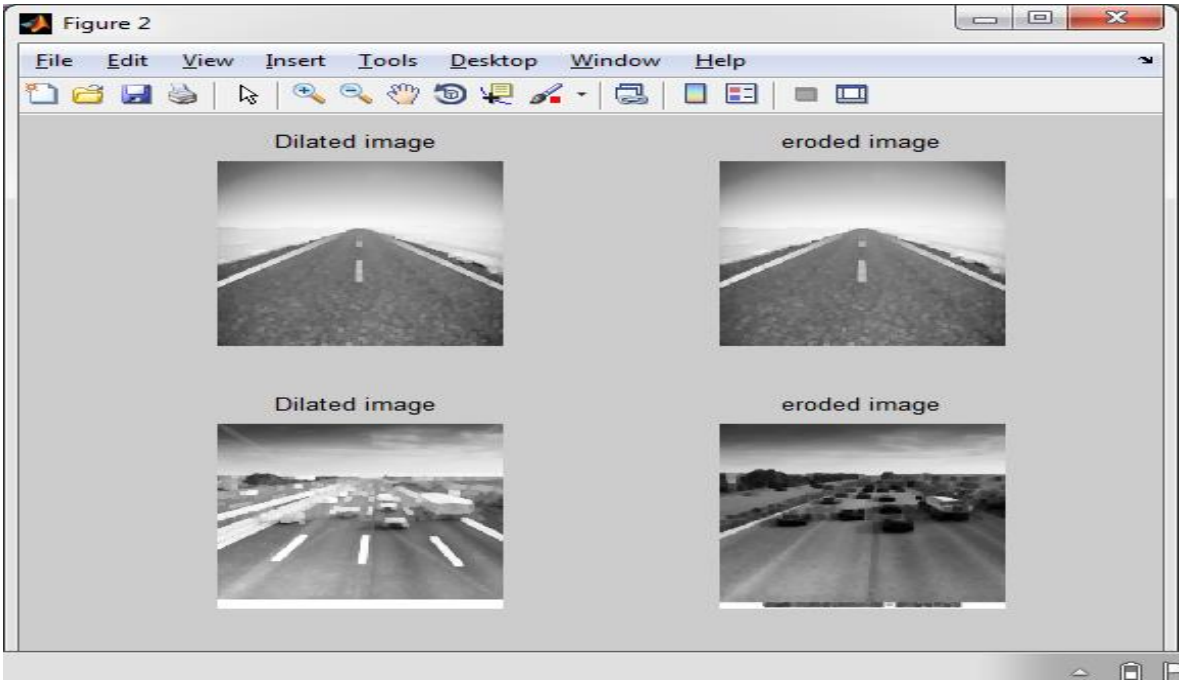

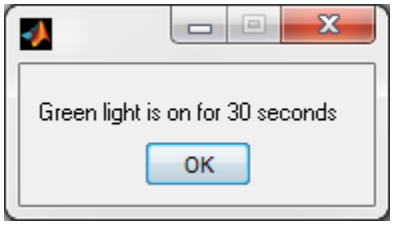

6.Conclusion: The study showed that image processing is a better technique to control the state change of the traffic light. It shows that it can reduce the traffic congestion and avoids the time being wasted by a green light on an empty road. It is also more consistent in detecting

vehicle presence because it uses actual traffic images. It visualizes the reality so it functions much better than those systems that rely on the detection of the vehicles' metal content. Overall, the system is good but it still needs improvement to achieve a 92% percent accuracy.

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