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Traffic Red Light Violation Detection using Image Processing

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ABSTRACT: As the problem of urban traffic congestion spreads, there is a pressing need for the control. Traffic problems nowadays are increasing because of the growing number of vehicles and the limited resources provided by current infrastructures. The simplest way for controlling a traffic light uses timer for each phase. Another way is to use electronic sensors in order to detect vehicles, and produce signal that cycles. We propose a system for controlling the traffic light by image processing.

KEYWORDS: Traffic, Red light violation, Image processing,Signal spot, Distance, Vehicle.

I. INTRODUCTION

Red light violation is one of the major causes of fatal accidents in urban areas. Various sensors are used in practice to detect the vehicles which violate the red light rule. Microwave and optical sensors may cause false triggering of the camera due to non-vehicle objects which may pass on the pedestrian crossing. Magnetic loop and fibre-optic sensors are more reliable in detecting vehicles; however, they are also avoided because of destruction caused on the asphalt and interruption of traffic during their installation. In order to eliminate the adverse effects of vehicle sensors, image processing techniques are used in new system.

There are two methods in image processing, to detect vehicles and also take the pictures of vehicles violating the red light rule using only a single camera.

- Background removal method: Here empty road is used as reference. This method is susceptible to daylight change and climate which may cause false detection.
- Inter-frame difference method: Here each current frame is subtracted from the previous frame to determine the changed regions (i.e. moving objects).This technique helps us to avoid false detection due to changes in daylight and climate conditions by updating the reference frame at each refresh cycle.

Inter frame differencing method is used to detect the red light violation ,the performance of this system is compared with reference to a magnetic-loop detector based red light violation detection system, the rate of false triggering was below 1%, However still these methods give false results. In order avoid all these effects, in this project we are installing camera in the vehicle itself, we are measuring distance between vehicle and signal spot when red light signal is on. As vehicle moves towards signal spot distance decreases, when this distance is less than certain threshold it is treated as red light violation.

II. METHODOLOGY

The methodology involves the following steps.

1. Start.
2. Set the properties of video objects such as frames per trigger and returned colour space.
3. Since we are using two cameras we use two red light detected flags, initially these flags are set to zero.
4. Get the frames from each camera, extract red coloured objects. Now compute the metric of each object, this metric is nearly 1 for round objects and this metric is compared with threshold1, if metric is greater than the threshold then it is treated as a red light is detected because red light signals are round shaped.

$(4*pi*area/ (perimeter)^2)$

5. Now compute the distance between signal spot and vehicle. As the vehicle moves towards signal spot the distance between signal spot and vehicle decreases, this distance is compared with certain threshold if it is less than threshold2 then it is treated as a red light violation.
6. Now send the data to serial port saying red light violation happens.

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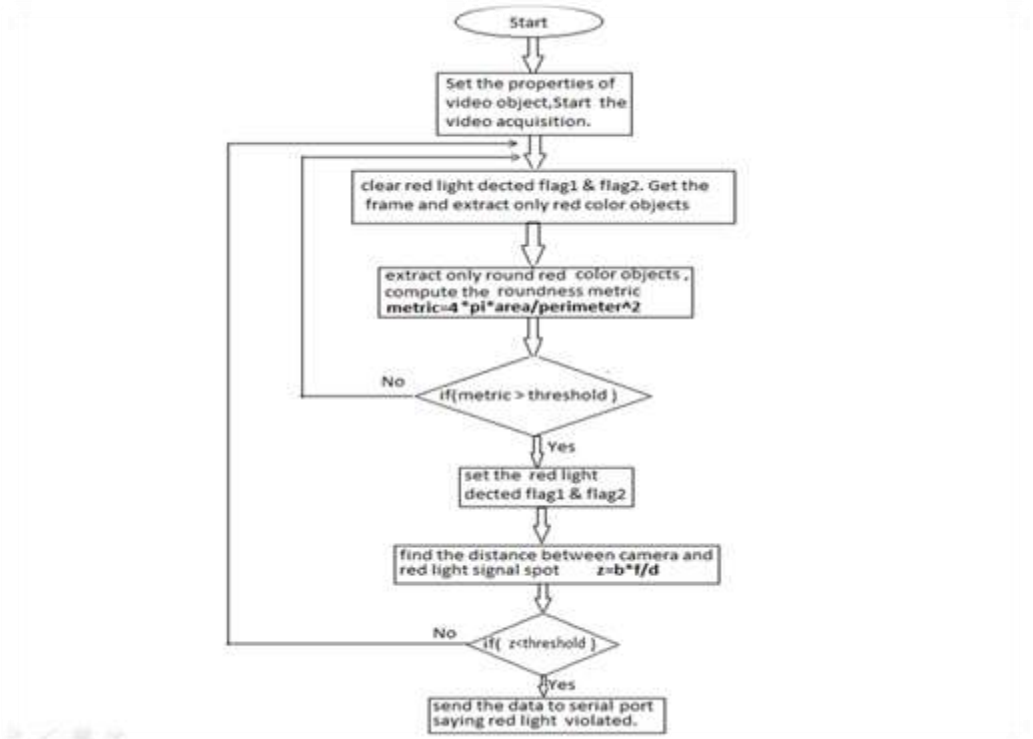

Figure 1: The methodology of the proposed work

Algorithm:

The algorithm involves the following steps

1. Installing Camera in each vehicle.
2. Camera must be on at all time when the engine gets started.
3. Camera is elevated at certain angle depending on the height of traffic lights.
4. Camera keeps tracking the red light signal. Once the red light is detected, the distance between signal spot and vehicle is calculated.
5. As the vehicle moves towards signal spot the distance between signal spot and vehicle decreases, this distance is compared with certain threshold if it is less than threshold then it is treated as a red light violation.
6. Each camera is given special identification number, this identity is send to Control room, and then person is fined as the rules.

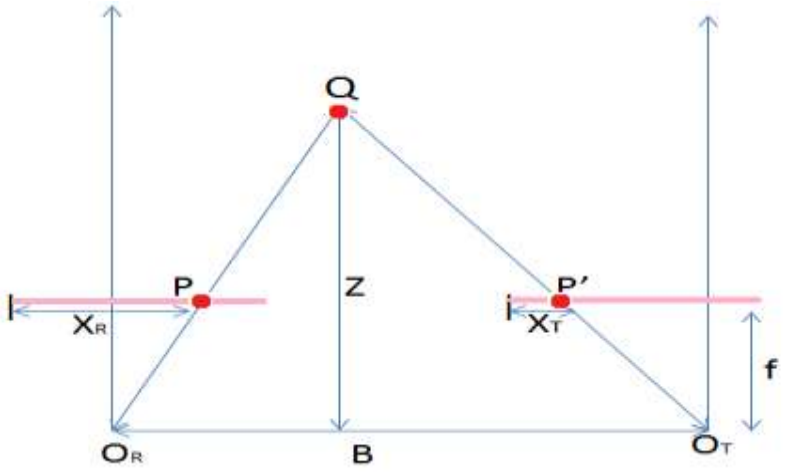

Figure 2: Mathematical modelling of the proposed method

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Description of the methodology are as follows
Q is Signal Spot.
P is the position of red light signal formed on the right camera image.
P' is the position of red light signal formed on the left camera image.
OR is the position of right Camera.
OT is the position of left camera.
B is the Distance Between two cameras.
Z is the distance between signal spot and camera.
XR and XT is the value of x with respect to y-axis.
The experiments are conducted in a simulation environment using MATLAB tool and the different cases are presented.

f is the focal length of lens.

$$(B/Z) = ((B + XT) - XR)/(Z - f) \rightarrow$$
$$Z = (B * f)/(XR - XT)$$

From this mathematical model and from Expression for "Z" we come to know that the distance get decreases as the vehicle moves towards signal spot.

III. IMPLEMENTATION DETAILS

Case 1:To show that green colour objects are not detected

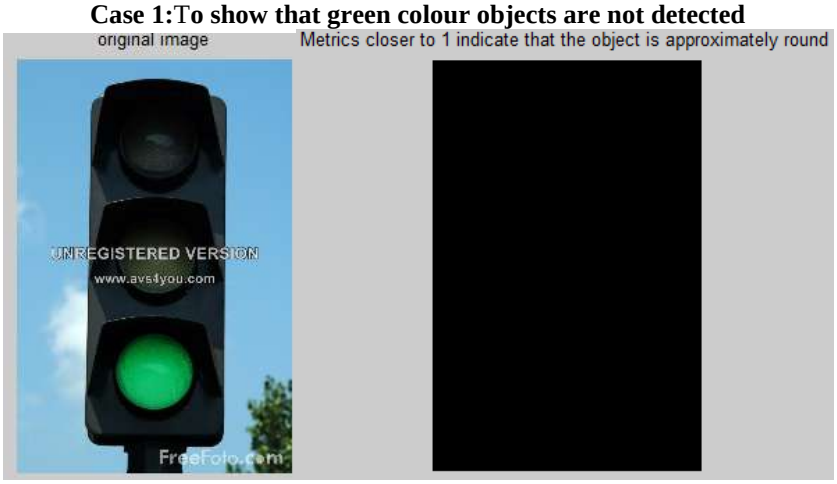

Figure 3: To show that green colour objects are not detected

Case 2: To show that only red colour objects are detected(Only round red colour objects are detected)

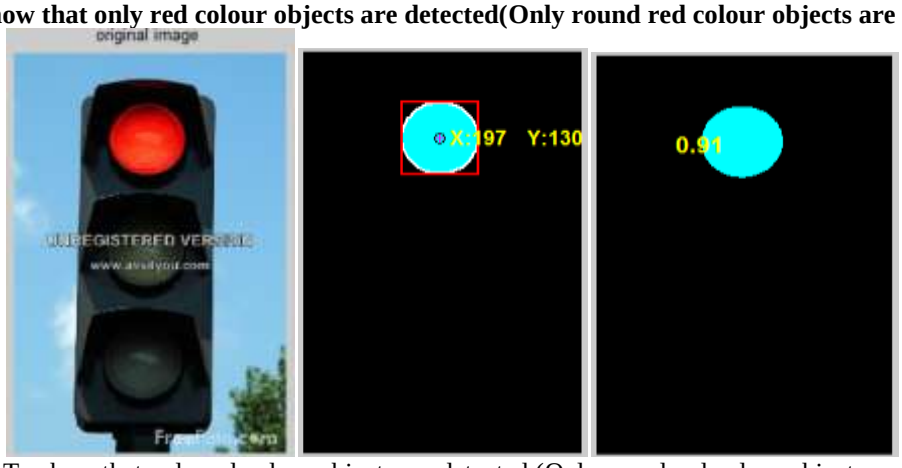

Figure 4: To show that only red colour objects are detected (Only round red colour objects are detected)

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Case 3: To show that only red objects are detected other colour objects are not detected

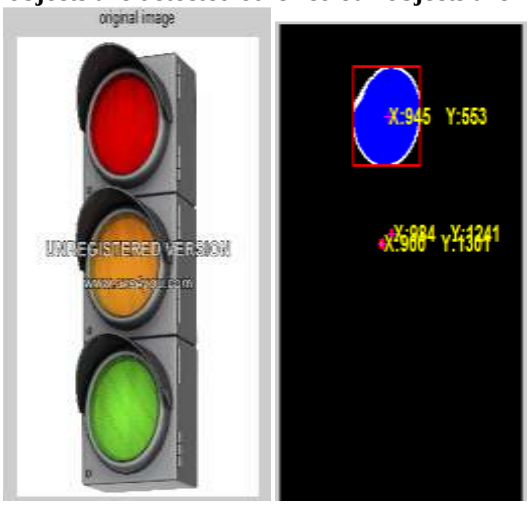

Figure 5: To show that only red objects are detected other colour objects are not detected

IV. RESULTS AND DISCUSSIONS

The sample results are presented in this section for further discussion and analysis

Considering the threshold distance between vehicle and signal spot is T=0.005 units.

Result 1:

Distance between vehicle andsignal spot is Z=0.0079units. From figure 6, it can be concluded that Z > T distance between vehicle and signal spot is greater than threshold which means the vehicle is has not crossed violation line hence **no Violation**.

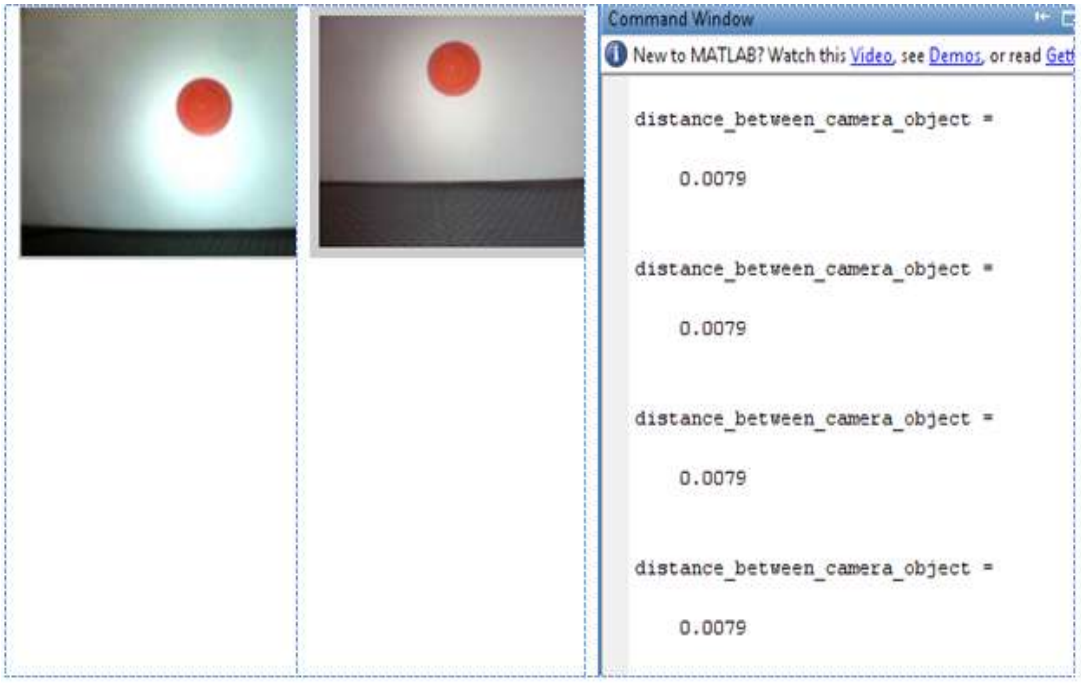

Figure 6: Captured Image from left cameraCaptured Image from right camera and distance computation

Result 2:

As the vehicle moves towards signals spot the distance between vehicle and signal spot decreases.

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Distance between vehicle and signal spot is Z=0.0060 units. From figure 7, it can be concluded that Z > T distance between vehicle and signal spot is greater than threshold which means the vehicle is has not crossed violation line hence **no Violation**.

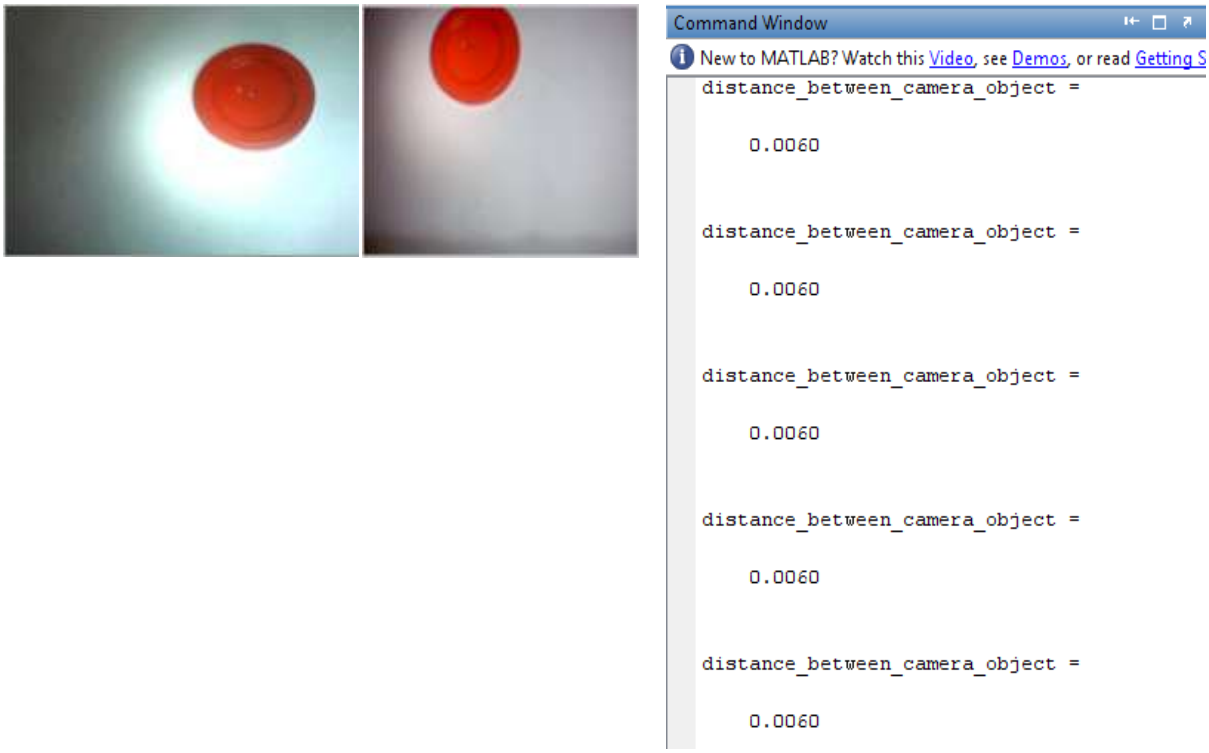

Figure 7: Captured Image from left camera Captured Image from right camera and distance computation

Result 3:

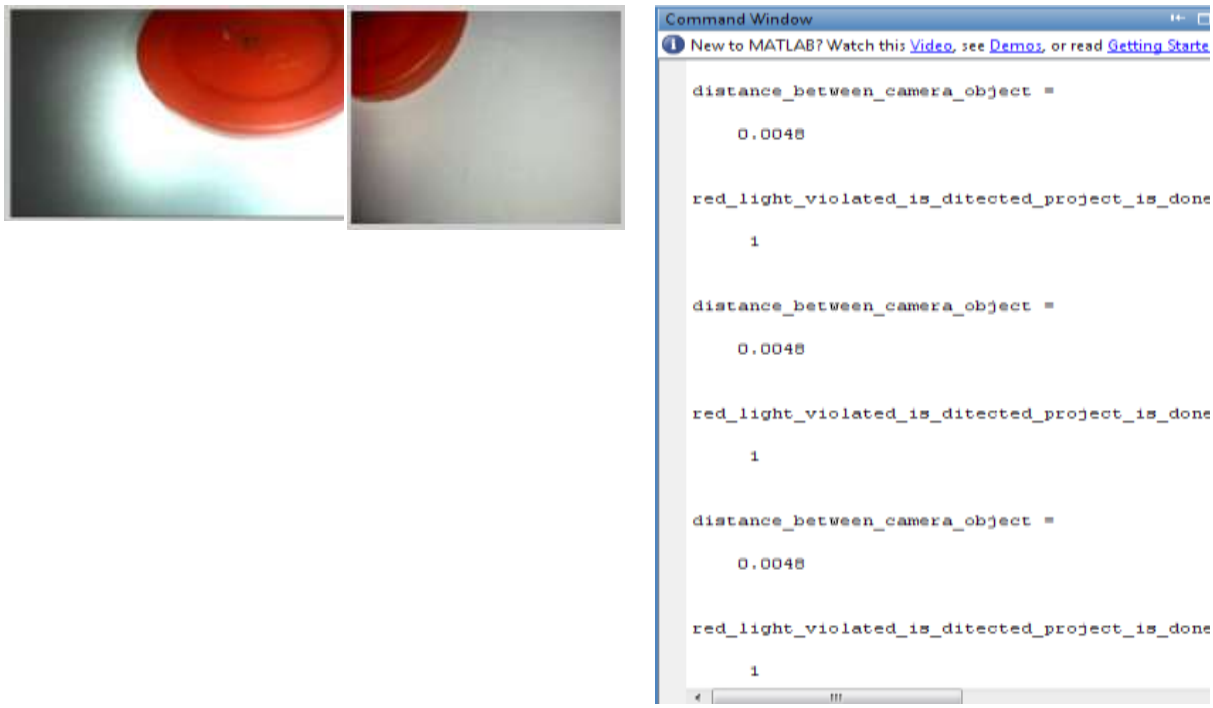

Figure 8: Captured Image from left camera Captured Image from right camera and distance computation

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Still, if the vehicle is moving towards signal spot obviously the distance between vehicle and signal spot(z) decreases.

From Figure 8, Distance between vehicle and signal spot is Z=0.0048units.

Z < T distance between vehicle and signal spot is **lesser** than threshold which means the vehicle is has not crossed violation line hence **Violation.**

Threshold is (T)0.005 units

Table 1: Result tabulation

Result no.	Distance between vehicle and signal spot(Z) units	comparison	Violated/ Not violated
1	0.0079	Z > T	Not violated
2	0.0060	Z > T	Not violated
3	0.0048	Z < T	Violated

V. CONCLUSION

Looking back on this proposed work, the overall outcome of results to be observed. This is clear that image processing techniques can be used for red light violation detection which will help the traffic police for monitoring the traffic management

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