Adaptive Traffic Control System with Ambulance Detection

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Abstract- Now-a-days road accidents are the major problem in this modern world. It can be found that narrow roads and rapid increase of means of transport are the main reasons behind increasing number of vehicles. The major cause leading to traffic jam is the high number of vehicle which was caused by the population and the development of economy. The scanty infrastructure and the irrational distribution of the development are also main reasons for augmented traffic jam. The inadequate infrastructure cannot handle the issue of traffic is also a decisive reason. In general, traffic rules and signs are used to control this problem. Normally traffic lights are controlled manually as well as automatically. Timers for each phase are the simplest way to control the traffic light automatically. Another way is to use electronic sensors in order to detect vehicles, and produce signal. These Traffic Jams indeed are the reasons for the Ambulances to not to reach hospitals in time.

Here a system that uses image processing algorithm in real time traffic to control the traffic light efficiently and also helps the high priority vehicles like ambulances to avoid traffic congestion. A web camera is placed in each phases of traffic light that will capture the still images of the road where the traffic should be controlled. 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. The ambulance is detected by continuously monitoring the 4 junctions and detection the ambulance siren using Template Matching algorithm. This system can be implemented as an embedded system module.

Keywords – Traffic control, Ambulance detection, Image processing algorithm, embedded system module

I. INTRODUCTION

The number of vehicles on the road increases day by day therefore for the best utilization of existing road capacity, it is important to manage the traffic flow efficiently. Traffic congestion has become a serious issue especially in the cities. The main reason is the increase in the population of the large cities that subsequently raise vehicular travel, which creates congestion problem. Due to traffic congestions there is also an increasing cost of transportation because of wastage of time and extra fuel consumption. Traffic jams also create many other critical issues and problems which directly affect the human routine lives and sometime reason for life loss. For example if there is an emergency vehicle like ambulance on the road with the critical patient on board. In that situation if an ambulance gets stuck in a heavy traffic jam then there are high chances that the patient cannot reach the hospital on time. So it is very important to design an intelligent traffic system which control traffic intelligently to avoid accidents, collisions and traffic jams. The most common reason of traffic congestion in third world countries is an inefficient traffic signal controlling which affects the traffic flow. For example if one lane has less traffic and the other lane with huge traffic but the duration of green light for both lanes is same then this is the waste of available resources and is inefficient. By considering the above example if the lane with higher traffic density should switch on the green signal light for a longer period than the lane with lesser density.

1.1 Existing Systems:

1.1 Various Existing Systems For Traffic Light Control Are:

1.1.1.Microcontroller:

The microcontroller controls the traffic lights at the zebra crossing or can say traffic junction which is not flexible method, rather, there is fixed on and off timings for yellow , green and red lights.

1.1.2. Vehicle Actuated Control:

It continuously attempt to adjust green light times. One of the major drawback is that it does not take into account the vehicles waiting at the red. A detector is located at a distance ahead of stop line and it sends the controller sensitive to signals. The system will work only if the assumed flow matches the actual traffic flow.

1.1.3. Manual Controlling:
Manual controlling the name instance it require man power to control the traffic. Depending on the countries and states the traffic polices are allotted for a required area or city to control traffic. The traffic polices area or city to control traffic. The traffic polices will carry sign board, sign light and whistle to control the traffic. They will be instructed to wear specific uniforms in order to control the traffic.

1.1.4. Automatic Controlling:
Automatic traffic light is controlled by timers and electrical sensors. In traffic light each phase a constant numerical value loaded in the timer. The lights are automatically getting ON and OFF depending on the timer value changes. While using electrical sensors it will capture the availability of the vehicle and signals on each phase, depending on the signal the lights automatically switch ON

1.2 Drawbacks:
In manual controlling more man power is needed. As the strength of traffic police is poor, it is not possible to control traffic manually in all area of a city or town. So better solution is needed to control the traffic. On the other side, automatic traffic controlling a traffic light uses timer for every phase. Using electronic sensors is another way in order to detect vehicles, and produce signal that to this method the time is being wasted by a green light on an empty road. Traffic congestion also occurred while using the electronic sensors for controlling the traffic.
The rest of the paper is organized as follows. Proposed solution is explained in section II. Experimental results are presented in section III. Concluding remarks are given in section IV.

II. PROPOSED SOLUTION

In order to face these complex situations in traffic congestion, we proposed a solution to control the traffic lights by image processing. A 360 degrees camera will be placed alongside the traffic light. It will capture images on all four sides of the junction. These images are processed using image processing techniques and Traffic density on each side is detected by calculating the total area occupied by these vehicles. These calculated traffic density values on each junction are given to the Arduino processor. Depending on the different density values different time durations are allocated along a particular junction. The emergency vehicles are detected by using siren detection system. In case of the presence of emergency vehicles in a particular junction, that particular junction will be given highest priority and green signal will be allocated to that junction.

2.1 Block Diagram Of Proposed Solution

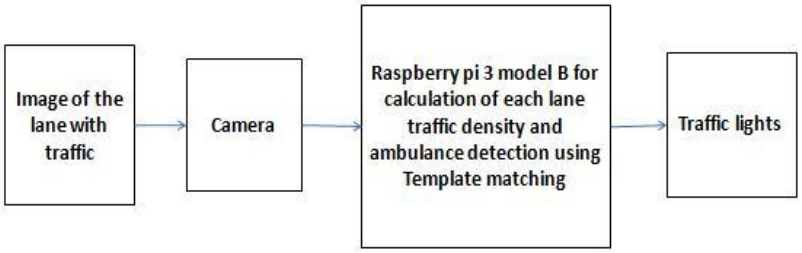

Fig 1 : Block diagram of proposed solution

2.2 Traffic Density And Ambulance Detection Using Opencv
2.2.1 Procedure Used For Detecting Traffic Density
Traffic density of lanes is calculated using image processing which is done by taking images of lanes that are captured using digital camera.
The pictures taken are then processed to determine the density of vehicles on each road at that instant. A list of priority is assigned to each road in one cycle and the waiting time for that road is made to vary according to its density.
A denser road is given more time to pass all its vehicles and reduce the traffic at the junction.
The density of each lane is determined and the microcontroller changes the duration of green light given for each lane as per the output after image processing

2.3 Traffic Density Detection Algorithm

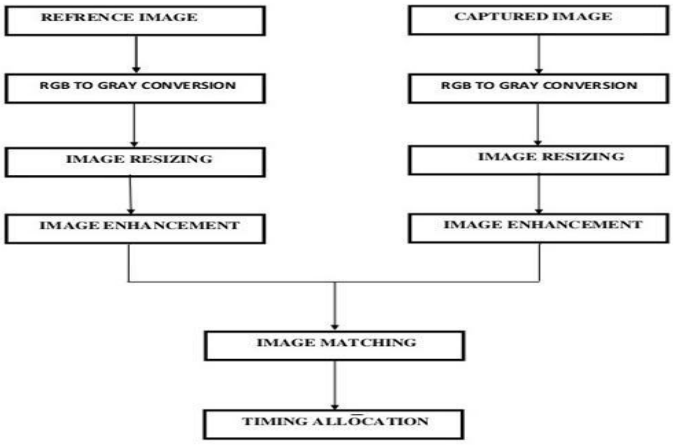

Fig 2 : Block Diagram of Traffic Control using Image Processing

2.4 Ambulance Detection Using Template Matching

Template Matching is a method for searching and finding the location of a template image in a larger image. Open CV comes with a function cv2.matchTemplate () for this purpose. It simply slides the template image over the input image (as in 2D convolution) and compares the template and patch of input image under the template image. Several comparison methods are implemented in Open CV. It returns a gray scale image, where each pixel denotes how much does the neighborhood of that pixel match with template.

2.5 Hardware Module

In this paper, the hardware used is:
MCU: Raspberry pi 3 for image processing and signal prioritizing.
USB camera: To capture images.
Toy cars for the prototype of a road junction and traffic model.

2.6 Raspberry Pi 3:

Fig 3: Raspberry pi 3 model B board

III. EXPERIMENT AND RESULT

3.1 Implementation of Algorithm

1. Reference image and the image to be matched is continuously captured using a camera that is installed at the junction.
2. The output images of previous step are matched using pixel to pixel matching technique.
3. After matching the timing allocation is done depending on

The percentage of matching as
If the matching is between 0 to 10%- green light is on for 50 seconds.
If the matching is between 10 to 20% - green light is on for 45 seconds.
If the matching is between 20 to 30% - green light is on for 40 seconds.
If the matching is between 30 to 40% - green light is on for 35 seconds.

If the matching is between 40 to 50% - green light is on for 30 seconds.
If the matching is between 50 to 60% - green light is on for 25 seconds.
If input image is of size (WxH) and template image is of size (wxh), output image will have a size of (W-w+1, H-h+1). Once you got the result, you can use cv2.minMaxLoc() function to find where is the maximum/minimum value. Take it as the top-left corner of rectangle and take (w,h) as width and height of the rectangle. That rectangle is your region of template.
If the matching is between 60 to 70% - green light is on for 20 seconds.
If the matching is between 70 to 80% - green light is on for 15 seconds.
If the matching is between 80 to 90% - green light is on for 10 seconds.

Fig 4: Image of reference road

Fig 5: Image of traffic junction 1

Fig 6: Image of traffic junction 2

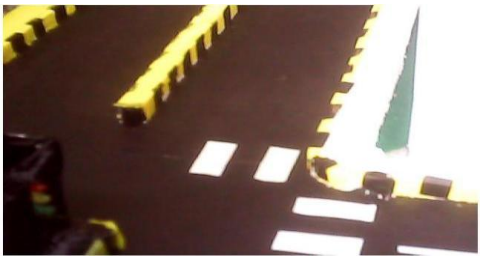

Fig 7: Image of traffic junction 3

Fig 8: Image of traffic junction 4

3.2 Simulation Results

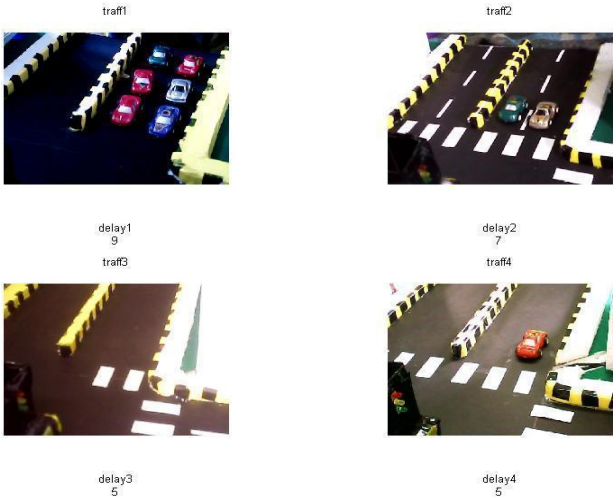

Fig 9: Detected ambulance template

Fig 10 : Ambulance in traffic

Fig 11: Ambulance template

Fig 12: Final output

IV.CONCLUSION

In this paper, a method for estimating the traffic using image processing is presented. “Traffic control using image processing” technique that overcomes all the limitations of the earlier techniques used for controlling the traffic, earlier. The use of the algorithm removes the need for extra hardware such as sound sensors. The increased response time for these vehicles is crucial for the prevention of loss of life. Major advantage is the variation in signal time which control appropriate traffic density using image matching. High priority vehicles can be detected with high accuracy which helps in preventing the loss of life by traffic congestion.

The advantages of this new method include such benefits as use of image processing over sensors, low cost, easy setup and relatively good accuracy and speed. Because this method has been implemented using image processing and PYTHON-OPENCV software, production costs are low while achieving high speed and accuracy and identify violations of the spiral movements of cars. The accuracy in calculation of time due to single moving camera depends on the registration position while facing road every time

This method diminishes the use of extra hardware devices like sensors, wireless routers, GSM modems, set up for monitoring station etc. Presence of vehicle detection is consistent as the images of traffic are taken here. Reality is visualized and hence, functionality is more effective and efficient than all techniques.

V. REFERENCE

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