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Adaptive traffic signal

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ABSTRACT

The current traffic control systems in India are inefficient due to randomness in the traffic pattern throughout the day. The traffic signal timers have a fixed time period to switch traffic between different directions. Due to this, the vehicles have to wait for a long-time span even if the traffic on the road is relatively less. If the traffic signal timer can be programmed to be manipulated with the continuously varying traffic density i.e. the count of vehicles on the road, the problem of traffic congestion can be reduced to significantly lower levels. Thus, the objective is to design an adaptive traffic control system algorithm with the use of an image processing system.

Keywords— *Traffic control system, Image Processing, Count of vehicles, Traffic Signal Timer*

1. INTRODUCTION

Objective of proposed system is to improve efficiency of existing automatic traffic signaling system. The system will be image processing based adaptive signal controlling, developed using MATLAB programming for simulation and development purposes. System will have a GUI through which we can select the desired input images to the system for density computation. Density computation is based on the number of vehicles present on the lane. After selecting the input images for all the four lanes, counting will begin and then based on the number of cars detected, the timer will be set accordingly. In order to compare the traditional and proposed system, input images will be the same for both the cases. This will help in highlighting the amount of time saved in proposed system thereby proving it to be more efficient than the traditional system. Moreover, simulated traffic lights are set corresponding to each input image to demonstrate the order in which traffic lights will be displayed along with the duration of the traffic lights.

2. PROPOSED SYSTEM

Fast transportation systems and rapid transit systems are nerves of economic developments for any nation. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control system for national development. One way to improve traffic flow and safety of the current transportation system is to apply automation and intelligent control methods. Traffic congestion may result due to heavy traffic at a junction. To avoid congestion there are so many traffic Management techniques available. But no technique is perfect by itself as the real time situations are generally continuously changing and the system must adapt itself to change in the continuously changing circumstances. We have tried to provide some traffic management strategy which is self-changing in nature, to fit into continuously changing real time traffic scenarios. In this system time is assigned to traffic light of lane according to the vehicle count on the road.

2.1 Flowchart

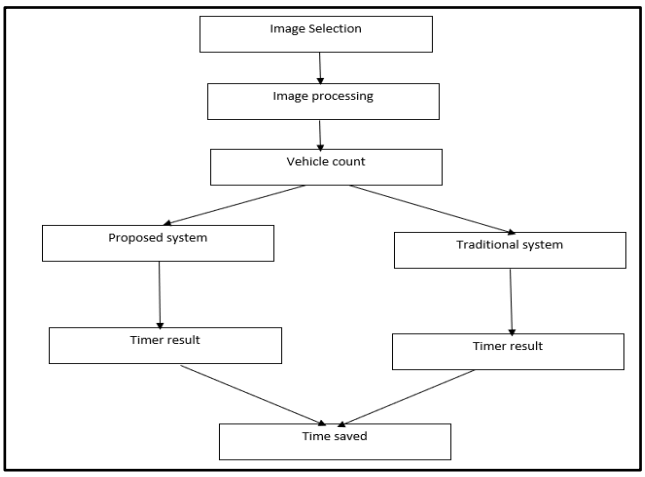

Fig. 1: Flowchart

2.2 Flowchart description

- Images are selected from the database by the user.
- Various image processing techniques involving image enhancement, noise removal, edge detection, etc. are applied in order to obtain the vehicle count.
- The number of vehicles detected will be same for both proposed and traditional system.
- The timer result for traditional system will be the same for all the images. Whereas, the timer result will vary for each image in the proposed system depending on the number of vehicles detected.
- The time saved will be calculated and displayed.

3. IMPLEMENTATION

3.1 Logic behind the timer

3.1.1 In traditional system: Here the timer set for each road will have duration of 60 seconds. Therefore, the total time required for each iteration would be equal to 240 seconds.

3.1.2 In Proposed system: Here the timer logic is as follows:

Table 1: Timer logic

Number of cars	Time allotted
0-10	20
10-20	40
20-30	60

Based on the above logic, adaptive time is calculated. The final output shows the difference between the proposed system and the traditional system thereby depicting that time is saved.

3.2 Image Processing steps involved for vehicle count and traffic estimation.

3.2.1 Image acquisition: A database of different instances of traffic on the road was collected.

3.2.2 Image processing filters applied to the chosen images:

Fig. 2: Image before applying the filters

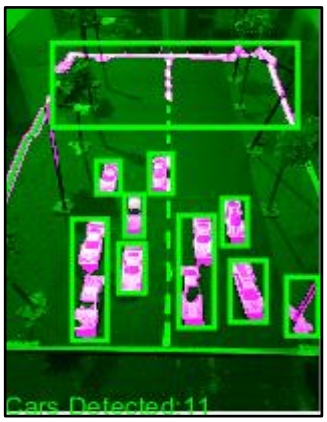

Fig. 3: Image after applying the filters and count generated

- Resizing of the selected image.
- Convert the given image into grayscale.
- Applying median filter for noise removal.
- Dilation: to gradually enlarge the boundaries of region of foreground pixels.
- Erosion: To erode away the boundaries of regions of foreground pixels
- Subtraction operation is used to find the difference in the pixels of two images.
- Now the resultant matrix obtained in the above step is converted to a grayscale.
- Now the two images are convoluted.
- Next the area opening operation is performed on the resultant image.
- Returning the measurement for the set of properties specified by properties for each labelled region of the image.
- Finally, the count for the number of vehicles in that particular image is obtained.
- Now allocation of time according to the previously mentioned timer logic is obtained.

3.3. Time saved

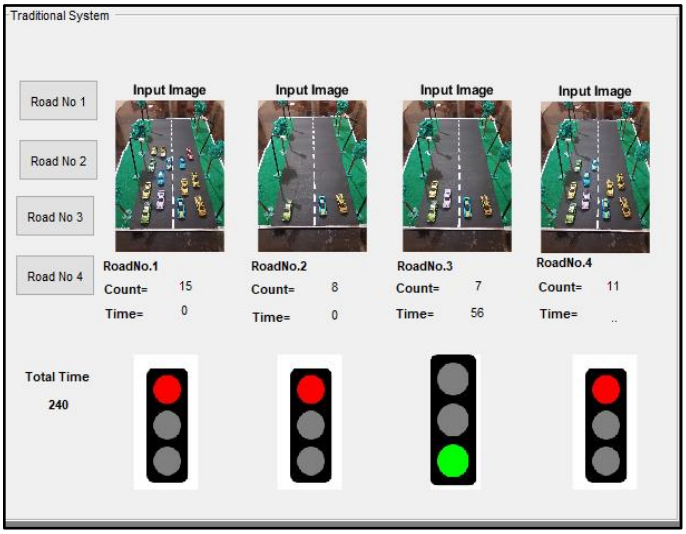

Fig. 4: Traditional System

In the above picture of traditional system, the total time obtained after one iteration is 240 seconds.

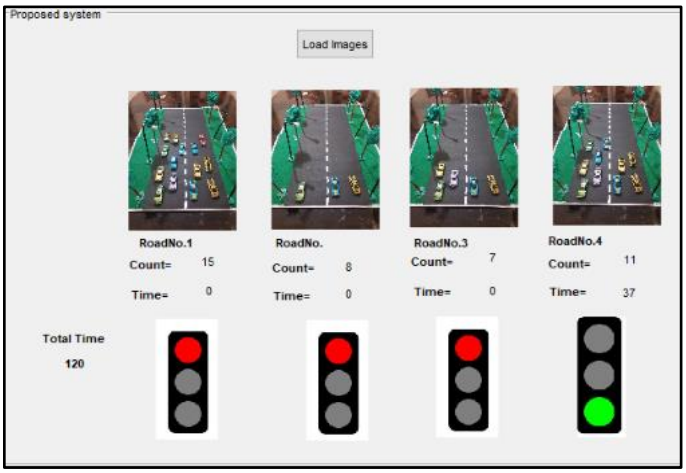

Fig. 5: Proposed System

In the above picture of proposed system, the total time obtained is 120 seconds. Hence there is saving of 120 seconds.

Table 2: Logic for Traditional System

Road Number	Number of vehicles (Count)	Time for which the green signal is ON (in seconds) (Time)
Road no.1	15	60
Road no.2	8	60
Road no.3	7	60
Road no.4	11	60

From the above table, the total time obtained after completion of 1 iteration that is time obtained after processing of all the 4 roads is 240 seconds (60*4).

Table 3: Logic for Proposed System

Road Number	Number of vehicles (Count)	Time for which the green signal is ON (in seconds) (Time)
Road no.1	15	40
Road no.2	8	20
Road no.3	7	20
Road no.4	11	40

From the above table, the total time obtained after completion of 1 iteration i.e. time obtained after processing of all the 4 roads is 120 seconds (40+20+20+40). In this way, comparing the total time obtained in both the traditional and the proposed system, clearly 120 seconds are saved.

4. CONCLUSION

The major advantage of an Adaptive Traffic System is its robustness and ease of installation. Use of image processing techniques will prove to be more accurate than the conventional inductive loop detectors and Infrared sensors. This system would also help in reduction of noise and air pollution levels, and also result in low fuel consumption. It thus demonstrates that with least resources and maintenance, it is capable of stabilizing traffic in 4-way intersection squares in much less cycles then in traditional fixed timers.

5. FUTURE SCOPE

There exists a huge scope of advancements in the present form of image processing based adaptive traffic control system. This system is easily scalable and could be implemented at various road junctions. This model could be integrated with number plate detection system wherein cameras would be placed at the bottom on the streets so that vehicles that break signals can be detected. Thereafter their number plates would be detected using this system and the proper action could be then taken.

The accuracy of this work can be improvised further by doing thermal image processing. Thermal image processing is effective even during extreme weather conditions such as, mist or fog. With integration of techniques such as display boards at intersections, solar power sources, synchronization of all traffic squares in the city and high-resolution night vision imaging devices, the accuracy and efficiency of the system can be greatly increased.

6. REFERENCES

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