TRAFFIC MANAGEMENT USING IMAGE PROCESSING AND ARM PROCESSOR

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Abstract - *In this paper, we aim to establish a smart and efficient traffic surveillance system which monitors the enormous movement of vehicles that cause traffic congestion. Here, we hope to develop a vision-based vehicle detection module that identifies the presence of vehicles and counts them. We achieve it with the help of Mali-C52, which is an ARM based video processor which captures the real time video of the area of interest (AOI). This video is processed in various stages and is later interfaced with an ARM microcontroller which controls the traffic.*

Key Words*: *Traffic congestion, Vehicle detection, MALI C52, Area of Interest (AOI)

I: INTRODUCTION

The rapid growth in the number of vehicles is a key feature of good economic development. However, this increased growth causes a number of problems, which includes traffic congestion, increase in the number of road accidents, no mechanism for emergency vehicle movements and traffic delay.

These problems could not be solved by traditional methods of traffic management. This is due to the usage of outdated microcontrollers such as AT89C51, which had very less internal memory and no in-built ADC. These systems also used pre-defined programs, which lacked flexibility of modification on real time applications. Hence, there is a need for an updated and more reliable traffic management system.

The advancement in technology and innovation of smart devices has been able to create a smart environment for the user to travel with more comfort. Therefore, we use an advanced image processing technique in which the MALI C52 ARM-based video processor can be used to capture the real time video of the area of interest. This video is segmented to produce images which is given will be given as an input to a MATLAB algorithm. The processed image is interfaced with the LPC2148 ARM microcontroller, which can produce density. By comparing the densities of different roads, the microcontroller generates an output that controls the traffic signal.

This vision-based system involving advanced techniques, has the following advantages:

1. This system provides connectivity through the internet for surveying the real time traffic flow

2. With the advancement in computer technology, this system has an advantage of instantaneity, reliability and security.

3. It has easy maintenance.

The rest of the paper is organized as follows:

Section II: System overview

Section III: System design and prototype

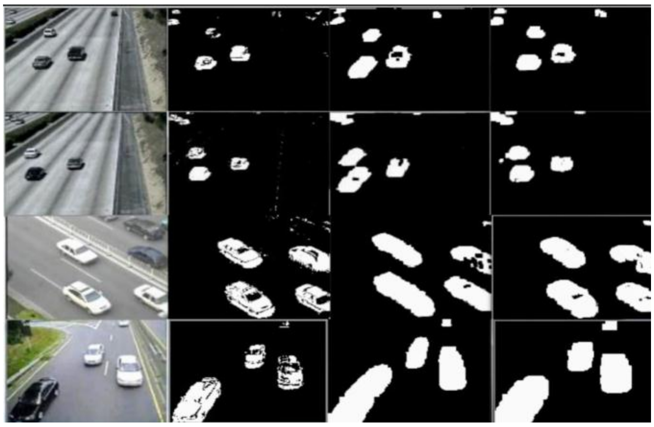
Section IV: Conclusion

II: SYSTEM OVERVIEW

In the very first step, we obtain the real time video which is read and converted into images and then frames. This frame can be processed in a series of steps which are listed below:

A. VEHICLE DETECTION BY BACKGROUND SUBTRACTION

In the frame obtained, we are focused only on the area of interest which is actually the moving vehicles. This region is called the foreground and the remaining view is called the background. The main difference between the foreground and the background is that the foreground is a small, spatial region in the frame which changes in a short period of time. On the other hand, the background is the region in the frame that does not change and if it does, it changes very slightly over a very large interval of time. With respect to our idea, the video is captured from above the road. In such cases, we observe that there arises an advantage of a static background. We can utilize the algorithm used in [2] compared to those used in [3],[4] and [5] due to its high detection performance even if it means that we have to compensate with higher computational requirements. This can be clearly understood by taking an example as shown in *fig 1*. (A) represents the image of 4 different roads. Further in (B) we observe that Background Subtraction has been successfully performed. In (C) we observe that all the unwanted architecture of the vehicles and noise has been removed to obtain a better Foreground. Ultimately in (D) we observe that the 'Canny' operation is performed, which gives the best image possible for further processing.



(A) (B) (C) (D)

fig.1

B. SEGMENTATION

There never exists an ideal situation where all frames that are extracted are noiseless. Sometimes this noise can be mistaken as edges by the system. Hence, it becomes important to eliminate it. One of the simplest method for segmenting images is thresholding , which is used to create binary images from gray-scale images .A basic idea of this operation is shown in *fig.2*. In our concept, we use the method of automatic thresholding in which we extract required information from pixels while reducing the noise. It is achieved by using a feedback loop to optimize the threshold value before conversion. This involves the following steps:

- Select the initial threshold value which is the mean 8-bit value of the original image.
- Divide the image into 2 parts:

  (a) Pixel values that are less than or equal to the threshold value-the background

  (b) Pixel values that are greater than the threshold value-the foreground
- Find the mean value for both images
- Calculate the new threshold by averaging the 2 means

If the difference between the calculated and original threshold value are below a set limit, it means that our process has finished, else the feedback loop takes this calculated value and the process continues until the desired value is achieved.

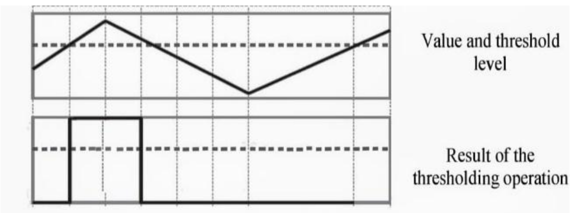


fig.2

C. CANNY

This method is used to identify edges based on an algorithm [6]. To identify each vehicle, we have to consider that region only as shown in the fig.1 (D). This image further contains false detections due to the variable vehicle architecture, which causes contours. This can be removed by converting all pixels in the main edge to white.

D. BLOB RATIO ANALYSIS

During the movement of vehicles on the road, we observe that in some situations, two vehicles may be very close to each other. Another major observation to be made is that there are different types of vehicles as well. For example: Cars, bikes, trucks, etc. To solve this problem, there exists a co-efficient called Blob ratio. It is given as follows:

Blob ratio= Height/Width

This ratio must lie within a specified range for each vehicle. If this value shifts, it indicates the presence of more than one vehicle in the area of interest. An idea of how the Blob Ratio varies is shown in the following table.

Number of vehicles	Object image	Height	Width	Blob ratio
1		54	56	0.96
2		75	43	1.75
1		28	32	0.87
2		34	55	0.62

III: SYSTEM DESIGN PROTOTYPE

Once the main process is developed, it becomes important to establish a good core organization which is more reliable and applicable on a real time basis. It is essential to use an advanced image capturing device such as Mali-C52 video and image processor to capture fast movement of vehicles. This device delivers high dynamic range (HDR) image quality and image signal processing (ISP) in real time. It can be tuned to a wide range of targets even under low light. It also has automatic calibration and tuning tools, which deliver high resolution still images and a downscaled video stream concurrently. This high-quality image should be given as an input to the MATLAB software.

MATLAB performs the function of image processing. Image processing is the technique used to convert an image into digital format which provides detailed information about pixel values, grey scale images, navigating within images, measuring distances and other such similar operations. At first, the reference image of the area of interest is sent to the MATLAB software. This is compared with the real time image that is obtained from the Mali-C52. These images are converted into their respective matrices. The difference in these matrices represents the change in pixel values. This basically depicts the presence of a vehicle. If no such difference is observed, it depicts the absence of vehicles. This value gives us the density of the road we are trying to monitor. Similar analysis can be performed on 4 different roads to calculate their densities. The values obtained are sent to LPC-2148 microcontroller. It can analyze the 4 values and identifies the road with the highest density and that corresponding road's signal will be made green. The entire idea of this process is shown in *fig.3 and fig.4.*

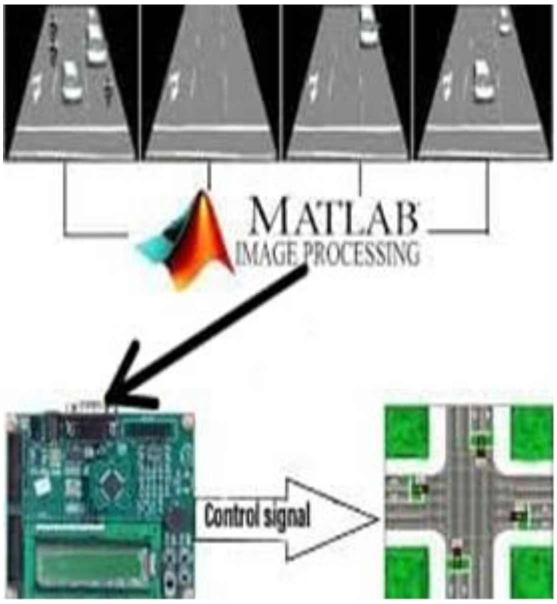


fig.3

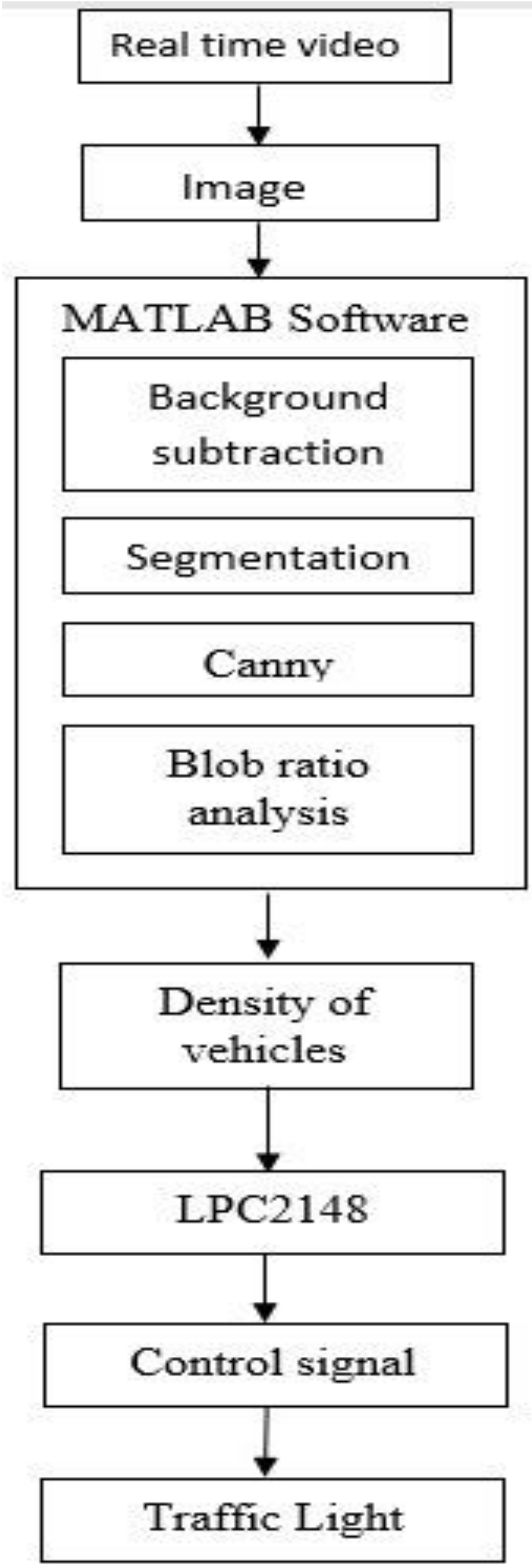


fig.4

IV: CONCLUSION

In this paper, we aim to successfully develop a smart traffic management system which uses MATLAB software for processing and generates an output which is interfaced with ARM processor LPC-2148 to generate the desired output. This method enables us to have real time monitoring of the traffic flow and considerably reduce the problems of traffic congestion and delay.

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