An Approach for Traffic Load Detection using Image Segmentation

Saja S. Azeez, Loay E. George, Faisel G. Mohammed

Abstract— The segmentation is one of the most computer vision processes importance, it aims to understand the image contents by partitioning it into segments that are more meaningful and easier to analyze. In the current research work change detection and region growing method is used in order to extract the vehicles areas from its complex background, and then, calculate the traffic load (density) on roads which is important information for solving traffic congestions, also It's worthy to mention that image registration to compensate the alignment changes of the camera is used. Traffic load detection as a computer task is not an easy task as it seems since computers don't have cognitive abilities like human brains. The obtained results from applying the proposed approach were encouraging when implemented on different samples of congestion cases.

Index Terms— Segmentation, region growing, and image registration.

1 Introduction

IN the recent years the vehicles number has increased rapidly thus traffic congestions have increased in return. Thus nowadays researchers focus on this problem to find the best solutions.

There are many published works concerned with vehicles detection, there are researches that use edge detection techniques [1,2,3], there is a research that uses gray level pattern matching [4] and there are other methods.

In this research vehicles are detected without the need for image enhancement, edge detection techniques, or matching methods. The detection is implemented by using thresholding and region growing. The image registration is also used in this research which involves the spatial alignment of a pair of views of a scene.

Section 2 general flowchart for the detection approach, in section 3 Preparation phase, in section 4 the proposed approach description, section 5 experimental results, and section 6 concludes.

2 Proposed System Description

The proposed system utilizes computer vision techniques that are modified to meet the needs of such a system. This chapter is dedicated to demonstrate the system requirements, the system installation, the system general structure, and each system processes implementation. Figure 1 show the main component of the traffic load detection system.

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3 Preparation Phase

In this phase road samples (frames) are collected by taking snapshots of different congestion cases from videos.

Some videos don't contain an empty road snapshot; in this case an empty road sample must be created in order to be used as a reference image. A mask is also prepared in this stage depending on the road shape. Reference image and the mask are created manually by using applications such as Photoshop.

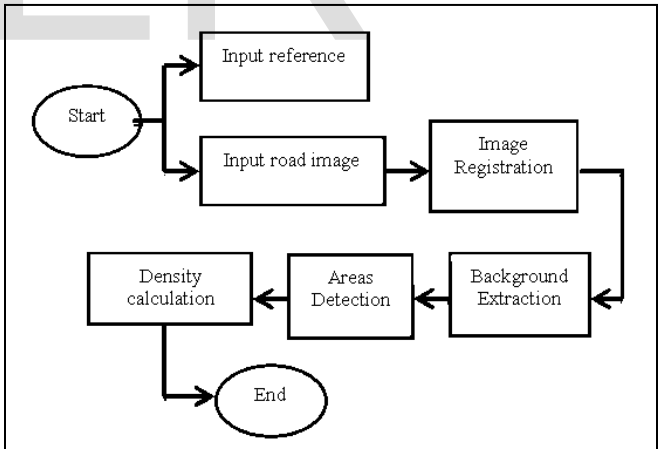


Fig. 1. Main flowchart for the detection approach.

4 The Proposed Approach Description

The proposed approach for traffic load detection is summarized in the following phases:

1. Image registration phase: image registration is required to compensate the alignment changes caused by the camera vibrations.
2. Traffic load detection phase : it is implemented to extract only the objects that we are interested in it by following

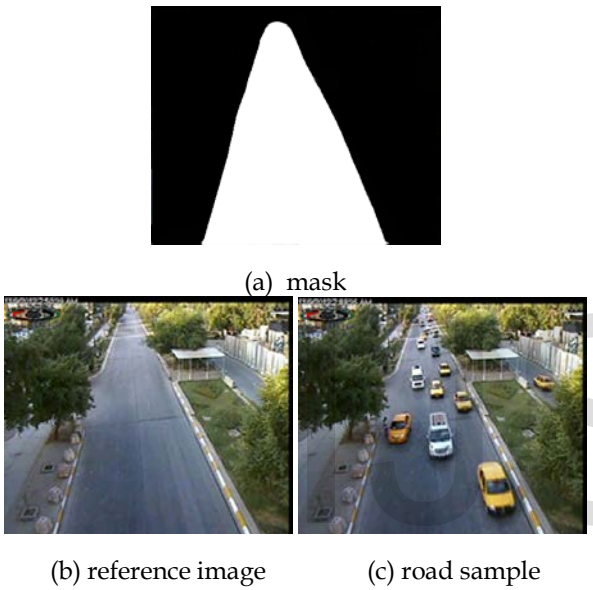
these operations:

- Anding
- Subtraction
- RGB to binary conversion
- Region growing

3. Density calculation phase: in this phase, the density is calculated from the information of the second phase

4.1 Image registration phase

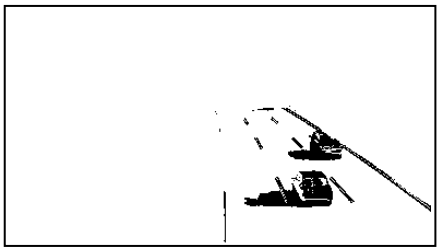
Pixel by pixel processing between two images is required in the detection approach of this research. To avoid the problem that result from misalignment see fig (2- a) which contain objects of interests and noise, image registration is used. Its involves the spatial alignment of a pair of views of a scene [5].



(a) mask

(b) reference image (c) road sample

Fig. 2. input image.



(a) Thresholding without image registration

(b) Thresholding with image registration

Fig. 3. Image registration tests

Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). First, use the In this research a reference block (RB) is selected from the reference image then we open a search window in the road sample to seek the reference block match. Mean absolute difference (MAD) is used as a similarity measure as follows:

$$MAD=abs(r1-r2)+abs(g1-g2)+abs(b1-b2) \quad (1)$$

Where r1, g1, b1 belongs to the reference image, and r2,g2,b2 belongs to the road sample. When the block with the least MAD is found and let it be located block (LB), the whole road image is shifted according to the difference in x-axis and y-axis between RB and LB in order to match the reference image geometry.

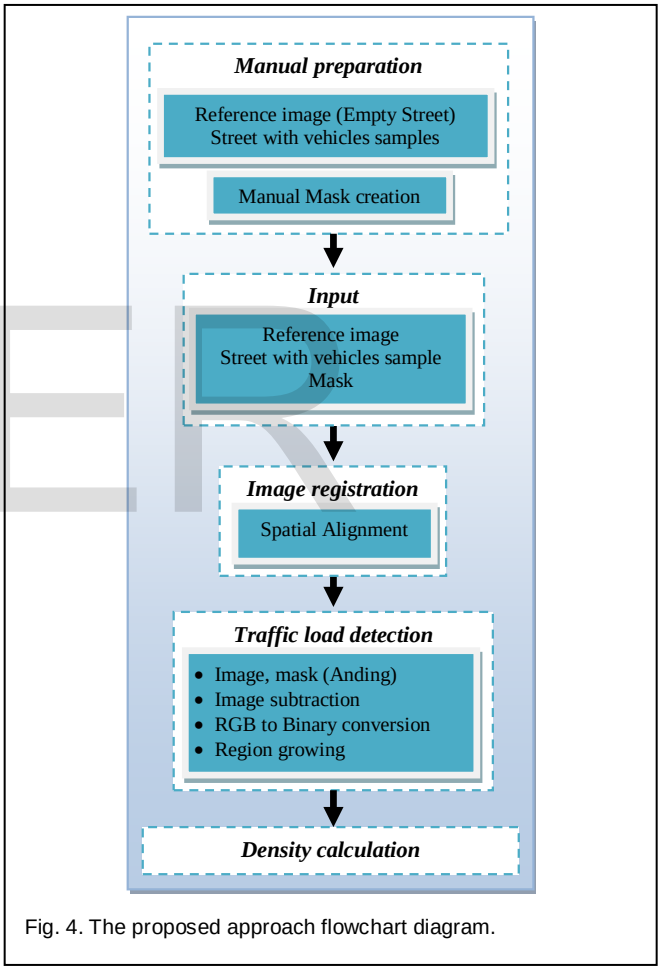


Fig. 4. The proposed approach flowchart diagram.

4.2 Traffic load detection phase

This phase includes the following operations:

4.2.1 Anding

It is possible to use a binary image as a mask to modify a grey scale image. This is most often done to blank out some portion of the grey scale image, either to create a display in which only the regions of interest are visible or to select regions whose brightness, density, and so forth are to be measured. It is possible to produce the same result by multiplying

the grey scale image by the binary image, with the convention that the binary image values are 0 (OFF) or 1 (ON) at each pixel [6].

The mask that was created earlier is a binary image depends on the concept mentioned above, see figure 5.

In this research the logical operator (AND) is applied on the mask and on the RGB, as a result the region of interest (the roads with vesicles) is obtained as follows:

G(x,y)=mask(x,y) and road(x,y) (2)

Fig. 5. Anding results.

4.2.2 Subtraction

The image subtraction operator takes the difference of two input images, see figure 6. It usually uses the absolute difference between pixel values. Image subtraction can be used to detect changes in a series of images of the same scene or recognize a moving object [7].

In this research image subtraction is used to remove the background which is considered constant and detect the changes as follows:

G(x,y)= reference(x,y)-road(x,y) (3)

Fig. 6. Subtraction results.

4.2.3 RGB to Binary conversion

The result of the previous step is converted to binary for fast processing by using threshold value. The pixels that are below the threshold will be set to zero and considered pavement while any pixel that pass the threshold will be set to 255 and detected as a change (vehicle).

The threshold used is 40; this threshold is suitable for different road samples, in fact less than 40 increases the noise as well as some of the road pavement detected as a change, while the use of a higher threshold weakens the detection specially the dark vehicles.

Fig. 7. Subtraction results.

4.2.4 Region growing

Region Growing, as implied by its name, is an algorithm that groups pixel sub regions into bigger areas. It starts with a set of known seeds into grow regions by merging to each seed point those neighborhood pixels that have similar statistical features [8]. The number of points for each region and the regions coordinates now are obtained.

The noise in fig (6) can't be removed by using median filter or by using morphological operation because it comes as small blocks therefore region growing is used to remove it.

Region growing removes the regions that have a number of points less than threshold (sizethr). Using sizethr as a high global threshold removed the small vehicles at the end of the road along with the noise therefore a dynamic smoother threshold is used which is increased with the increasing in y-axis by an n value as follows:

sizethr=sizethr + n (4)

The initial sizethr=20 while n=1.5, increasing and decreasing these values been tested each has its own problem such as (no change in the result, removing larger vehicles parts, and leaving some noise) respectively.

Fig. 8. region growing result.

4.3 Density calculation phase

The previous phase will provide us with the number of points for each object and the points coordinates, these results is used to calculate the traffic load (density) as follows:

Density= (blocks points/ road points) * 100 (5)

5. Experimental Results

In order to investigate the effectiveness of the proposed method, experiments were carried out on different samples of congestions cases as shown in figure 8.

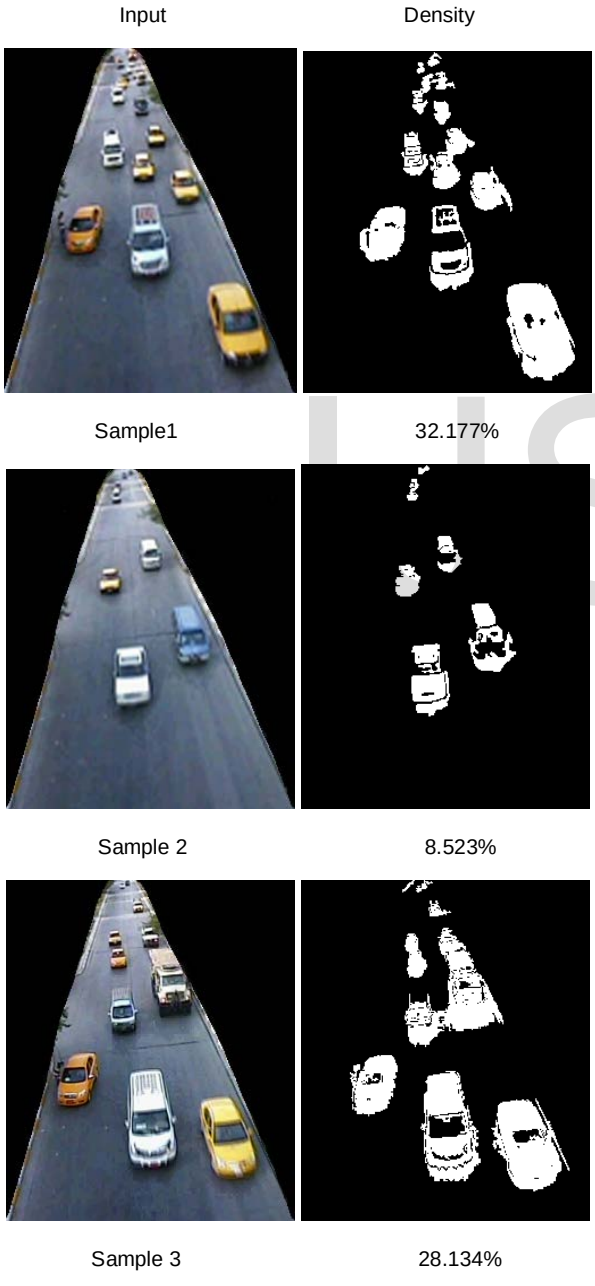


Fig. 9. Tested Samples.

6. Conclusion

The detection approach showed encouraging results approach in the detection of light color vehicles as compared to the dark vehicles, part of the dark vehicles disappear because it have the same color as the pavement. This approach works on other images size but requires threshold tuning. The density calculation should be improved because the vehicles position is not considered during the calculation and this factor can change the density results appreciably.

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