Detection of Vehicles in Highway Traffic Images Using Differential Morphological Profile and Blob Detection

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***Abstract*—Vehicle detection has been a crucial part in traffic surveillance system. Many methods are being developed till date for efficient detection of vehicles. Differential morphological profile followed by Blob detection would be an efficient method for detecting vehicles. Firstly, vehicles in the image are detected using opening and closing profiles. Blob detection is then applied to the resultant image. The proposed method gives efficient results compared to the image processing methods developed until now.**

***Keywords*— Blob detection, Closing profile, Differential morphological profile, Opening profile, Vehicle detection.**

I. INTRODUCTION

Vehicle detection has been a challenging scenario in traffic surveliance system. It helps in solving traffic problems. It has many applications such as traffic control, construction of roads and military applications. With the help of vehicle detection we can observe parameters such as vehicle speed, vehicle density, traffic flow rate and congestion level.

Up to now many algorithms were developed for detecting vehicles. One of the algorithm is based on neural networks. Problem with neural networks is that it need training samples and it also does not have any universal model. Other approach is fuzzy measures. In fuzzy approach vehicles are detected based on the light intensity value of different pixels of the image. Depending on the intensity values, fuzzy approach will decide if it is a vehicle or not. Area and circumference are also considered to decide the type of vehicle depending upon the size. Finally defuzzification is done. Other well known algorithm is segmentation. Segmentation needs background image. This background changes with weather conditions. So this algorithm will be complex.

Another approach is time differencing. Here we subtract one frame from another frame. But this method could not be efficient in all type of weather conditions. In this method small blobs are also produced which are difficult to separate. Simple thresholding techniques are also used for detecting vehicles but noise would be more in this techniques.

II. PROPOSED METHOD

The proposed method efficiently detects vehicles moving on the road. Differential morphological profile followed by blob detection are the two main steps in this method. Steps followed in this method are-

1) Input an image
2) Converting the image into gray scale image
3) Differential morphological operations
4) Thresholding
5) Blob detection
6) Counting number of vehicles

After giving the image as input differential morphological operations are applied on the image. Next step is blob detection which gives only vehicles and hides the unwanted objects completely.

Fig 1 shows the input image and Fig 2 shows the steps followed in proposed method.

Fig 1: Input image

A Input an image:

The algorithm is applied on images taken in traffic. Algorithm can be applied on any type of image. Input image is shown in Fig 1.

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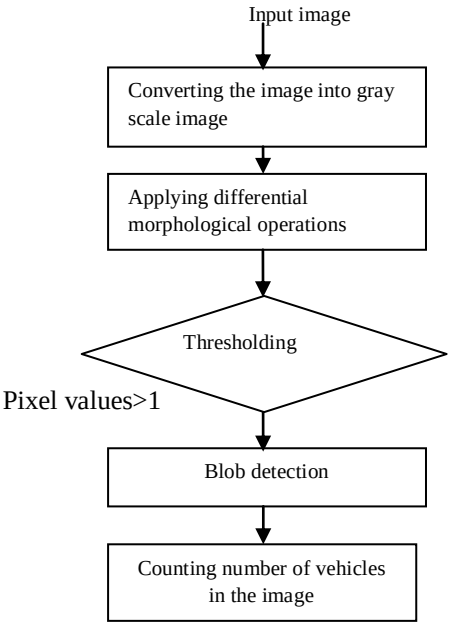

Fig 2: Proposed method

B Converting the image into gray scale image:

The first step in our algorithm is to convert the rgb image into gray level image. It is done using luminance converter shown in Equation 1,

$$I_S = 0.2986 \times I_R + 0.5870 \times I_G + 0.1140 \times I_B \quad (1)$$

I_G is the grey level image. I_R, I_G, I_B are the red, green and blue intensities of the image respectively.

C Differential morphological operations:

Mathematical morphology can be used in many types of applications such as segmenting an image, recognition of patterns and noise removal in an image. Mathematical morphology deals with set and set operations thereby making it different from other approaches. Vehicle features are effectively detected using differential morphology. Differential morphology is the combination of opening and closing profile. Opening and closing profiles i.e., opening and closing by reconstruction means the opening and closing operations done repetetively using different sizes of structuring elements. Closing by reconstruction means dilation of image followed by erosion of the image. Opening means erosion of the image followed by dilation of the image. Initially closing by reconstruction is done followed by opening by reconstruction.

Closing profile is shown in Equation (2),

$$\prod_{\phi RC}(I_S) = \{\prod_{\phi RC\lambda} : \prod_{\phi RC\lambda} = \phi_{RC}{}^{\lambda}(I_S) \forall \lambda \in [o,n]\} \quad (2)$$

L.H.S shows the image after performing closing profile.

Similarly opening profile can also be calculated. Next derivatives of opening and closing profile are calculated. It is given by,

$$\Delta_{\gamma RC}(I_S) = \{\Delta_{\gamma RC\lambda} : \Delta_{\gamma RC\lambda} = \prod_{\gamma RC(\lambda-1)} - \prod_{\gamma RC\lambda} {}^{\forall \lambda \in [1,n]}\} \quad (3)$$

In Equation (3), L.H.S shows the derivative of opening profile. R.H.S shows the subtraction of consecutive opening operations.

$$\Delta_{\phi RC\lambda}(I_S) = \{\Delta_{\phi RC\lambda} : \Delta_{\phi RC\lambda} = \prod_{\phi RC\lambda} - \prod_{\phi RC(\lambda-1)} {}^{\forall \lambda \in [1,n]}\} \quad (4)$$

In Equation (4), L.H.S shows the derivative of closing profile. R.H.S shows the subtraction of consecutive closing operations.

D. Thresholding:

Next step is thresholding. Here valid pixels i.e., pixels greater than certain value are only considered. This thresholding helps in removing unwanted data thereby detecting vehicles. Equation (5) shows the thresholding,

$$I_{result}(x,y) = 1 \quad \text{for pixel value} > T$$
$$= 0 \quad \text{for pixel value} < T \quad (5)$$

E. Blob Detection:

For the resultant image Blob detection is applied. Blob detection is mainly dependent on Laplacian of Gaussian(LoG). It has mainly two main steps-

i: Convolution of image with Gaussian. Gaussian kernel is given by,

$$g(x,y,t) = \frac{1}{2\prod t^2} \ell^{-x^2+y^2 / 2t^2} \quad (6)$$

Equation (6) shows the Guassian kernel.

$$f(x,y) = g(x,y,t) * I_{result}(x,y) \quad (7)$$

Equation (7) gives the output after convolving the resultant image with the Gaussian kernel.

ii: Applying Laplacian operator to the result.

Laplacian is nothing but the second derivative. It is given by Equation (8). This is applied on the image obtained from Equation (7).

$$\nabla^2 L = L_{xx} + L_{yy} \quad (8)$$

F. Counting number of vehicles:

After detecting the blobs number of vehicles are counted using bwlabel that counts the connected components.

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III. SIMULATION & ANALYSIS

Step by step output is shown in this section. Output after converting into grey level image is shown in Fig 3.

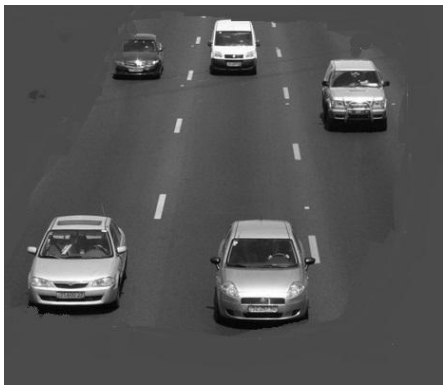

Fig 3: Grey level image

Output after performing differential morphological profile is shown in Fig 4.

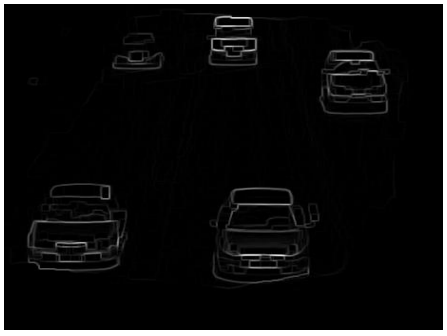

Fig 4: Output after Differential Morphological Profile

Next step is Thresholding. Output after Thresholding is shown in Fig 5.

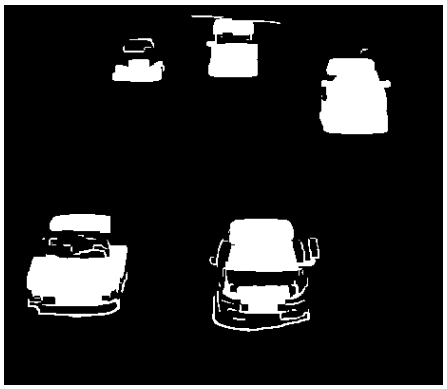

Fig 5: Output after Thresholding

Next step is Blob detection. After performing blob detection we can have featured image i.e., image in which vehicles are clearly detected. The output is as shown below in Fig 6.

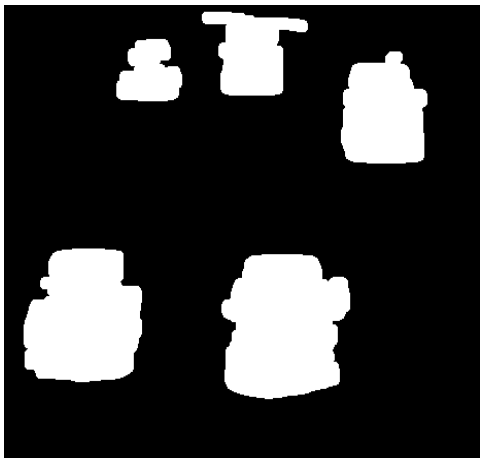

Fig 6: Output image after Blob detection

Differential morphology followed by blob detection would give us the above output. Finally the count obtained is 5.
Comparing efficiency of detection of vehicles with the reference methods is shown in Table 1.

Table 1: Comparision of proposed method with existing methods

Method	Efficiency
[1] Ghani, K.A. et al.,	60%
[2] Wu, J.P., et al.,	45%
[3] Ozkurt, C. et al.,	70%
[4] Vanaja, A., et al.,	56%
[6] Mantri, S. et al.,	40%
Proposed method	95%

IV. CONCLUSION

The proposed method have automatic vehicle detection algorithm for traffic images that take into account the differential morphological profile and blob detection for detection process. Further extensions are needed to reduce the misclassification and improve the detection accuracy.

V.REFERENCES

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Author's profiles

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