# SMART VEHICLE DETECTION METHODOLOGY USING SATELLITE IMAGING

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**ABSTRACT**

*There is an increasing demand for traffic monitoring of densely populated areas. The traffic flow on main roads can partially be measured by fixed installed sensors like induction loops, bridge sensors and stationary cameras. Traffic on smaller roads – which represent the main part of urban road networks – is scarcely monitored and information about on-road parked vehicles is not collected. Hence new applications like traffic monitoring and vehicle detection from these images have achieved considerable attention on international conferences. The presented approach focuses on the detection of single vehicles by extracting of vehicle queues from satellite imagery.*

**Keyword: -** *Image Enhancement, Morphological Image Processing, Segmentation, Otsu Threshold, Edge Detection*

## 1. INTRODUCTION

There is an increasing demand for traffic monitoring of densely populated areas. The traffic flow on main roads can partially be measured by fixed installed sensors like induction loops, bridge sensors and stationary cameras. Traffic on smaller roads – which represent the main part of urban road networks – is scarcely monitored and information about on-road parked vehicles is not collected. Wide-area images of the entire road network can complement these selectively acquired data. New optical sensor systems on satellites, which provide images of 1-meter resolution or better, e.g. Ikonos and QuickBird, make this kind of imagery available. Hence new applications like traffic monitoring and vehicle detection from these images have achieved considerable attention on international conferences, e.g. (Bamler and Chiu, 2005; Heipke et al., 2005; Stilla et al., 2005). The presented approach focuses on the detection of single vehicles by extracting of vehicle queues from satellite imagery.

### 1.1 Related work

Depending on the used sensors and the resolution of the imagery different approaches (Stilla et al., 2004) have been developed in the past. The extraction of vehicles from images with a resolution of about 0.15 m has already been comprehensively tested and delivers good results in many situations. Available approaches either use implicit or explicit vehicle models (Hinz, 2003). The appearance-based, implicit model uses example images of vehicles to derive gray-value or texture features and their statistics, which are assembled in vectors. These vectors are used as reference to test computed feature vectors from image regions. Since the implicit model classification uses example images the extraction results depend strongly on the choice of representative images.

## 2. PROPOSED APPROACH

Approaches using an explicit model describe vehicles in 2 or 3 dimensions by filter or wire-frame representations. The model is then either matched "top-down" to the image or extracted image features are grouped "bottom-up" to create structures similar to the model. A vehicle will be declared as detected, whenever there is sufficient support of the model found in the image. These approaches deliver comparable or even better results than approaches using implicit models but are hardly applicable to satellite imagery since there vehicles only appear as blobs without any prominent sub-structures (see Fig. 1).

Three different methods for vehicle detection from simulated satellite imagery of highway scenes are tested in (Sharma, 2002). The gradient based method and the method using Bayesian Background Transformation (BBT) deliver the best number of vehicle counts compared to ground truth. Since the number of false detections is lower using BBT, this method is more reliable. The performance of the third method using Principal Component Analysis (PCA) varies significantly with the noise level of the image. Furthermore, the method gives the lowest vehicle count. A manually created background image is mandatory for the PCA and BBT method, which requires extensive interactive work. Consequently, the approaches can hardly be generalized and are limited to images of the same scene.

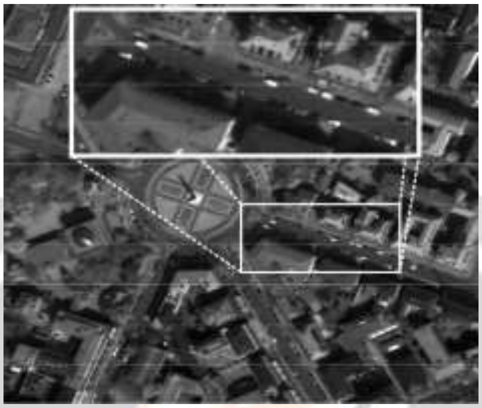

**Fig -1:** Vehicles in optical high-resolution

### 2.1 Image Enhancement

A brief distribution of enhancement technique will be as under:

- Spatial domain strategies, that is direct affected to the pixels.
- Frequency domain strategies, in image it works on the Fourier rework

### 2.2 Morphological Image Processing

In image process, Morphology could be a tool that is employed to extract the elements of image so that illustration and description of the region shape form a sort of a skeleton and boundaries are provided [8]**.** Thus, the morphological operations and their operators also can be used for filtering, dilution and pruning.

With the assistance of erosion morphology technique boundaries or edges of an area and shape can be extracted by applying on A by B and then subtracting the eroded A from A.

$$\beta(A) = A - (A \ominus B)$$

### 2.3 Segmentation

To remove noise and artifacts if a picture has been preprocessed, than in deciphering the image typically segmentation is the main step. The features or region with the Image segmentation, are having similar characteristics, they are than known and later classified together [2]. Statistical classification could also be utilized in it, edge detection, threshold, region detection or any of the mix of those techniques. A collection of classified elements is segmentation step output, segmentation techniques are relied on region or edge.

- Edge-based techniques admit the discontinuities in a picture values between the distinct regions, and therefore the objective of the segmentation algorithmic program is to precisely demarcate the boundary separating of those regions.

- Region-based techniques admit the common patterns within the intensity values in a cluster of the neighboring pixels. The cluster of the neighboring pixels is known as the region, and therefore target of the segmentation algorithm is to cluster the regions according to the functional or anatomical roles.

**2.4 Edge Detection**

With the robust intensity distinct edges are placed within the image. As edges mainly take place at the image locations that replicate object boundaries, in image segmentation edge detection is generally used when there is a demand to separate the image into the areas with reference to the various objects. For the steps that are corrupted by white noise it is optimal for them. With reference to these areas optimality to the three criteria they are:

- Detection criterion ... vital edges should be there, fake responses should be avoided.
- Localization criterion ... minimum distance should be prevailing between the particular and the located position of the edge.
- One response criterion ... multiple responses into a one edge are reduced (moreover it is somewhat coated by initial criterion as when there in single edge there are two responses one in every of them should be treated as wrong).

**2.5 Otsu Threshold**

To find a best threshold value k* the Otsu threshold employ the class reparability and magnifies the middle-class variance [10]. With this threshold use of objects from their background is extracted. In Otsu threshold k* technique MATLAB includes built-in function that access it. By directly relating to the Otsu threshold to the testing image it will observe the bright vehicles, however there is chance of lane markers and road dividers to be available on the highways. To cut back the issue of road dividers and lane markers a pre-process step is applied. During this pre-process step the sliding neighborhood operation is registered to the testing image. The sliding neighbor operation could be assigned to every pixel of testing image with the highest level of intensity to its neighborhood (it is a final rectangular space of 3-by-3 pixels, because it is center pixel it is allotted by operation).

## 3. METHODOLOGY

Morphological recognition algorithms are used to develop an automated system in MATLAB R2013a. In which satellite images are taken as input and converted into gray scale image for pre-processing. After conversion these images are converted into binary images after image complement. After conversion canny edge detection method has done and passed this detection to the dilation process. The area is selected after filtration and dilation where number of vehicles is maximum and vehicles are recognized from the image in the form of bounding box. The number of vehicles is counted by blob analysis. Here we are using reference image New 5.

The steps are elaborated below:

1) Satellite Image Acquisition
2) Necessary Operations
3) Image segmentation process
4) Image Enhancement

**3.1 Satellite Image Acquisition**

Initially stage of any vision system is the image acquisition stage. Once the input image has been obtained, a number of methods of processing can be applied to the image to perform the different vision tasks required today. Figure 1 shows the image that we acquired as a reference.

**Fig -2:** Acquired image

**3.2 RGB to Gray Scale Conversion**

A binary image is stored as a logical array where each pixel of the image assumes only one of the two discrete values: either 1 or 0. An image consists of numeric values between 0 - 255. Thus the numerical value of the picture is reduced from 0 – 255 to only to two values with binary level. Thus, an image is converted into 2 - bit format from 8 – bit format. The threshold value must be determined for this conversion. If the pixel value in the image is greater than threshold value, then the pixel value is shown as "0"; and if the image pixel' value is less than threshold value, the pixel value is shown as "1". Thus in this way the image is converted into binary image. Image is converted into binary image from gray scale. Intensity change value is calculated easily as compared to gray scale and color image.

**Fig -3:** RGB to gray scale

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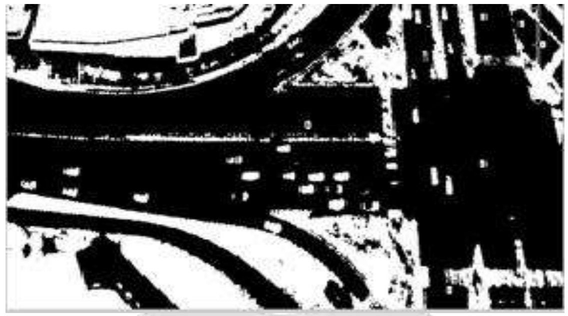

**Fig -4:** Gray to binary image

**3.4 Canny Edge Detection**

Edge detection is an important technique to fetch useful structural data from different vision objects and reduce the volume of data to be processed. Thus, a development of edge detection solution to address these requirements can be implemented in a wide range of situations. The figure 4 shows the demonstration of canny edge detection:

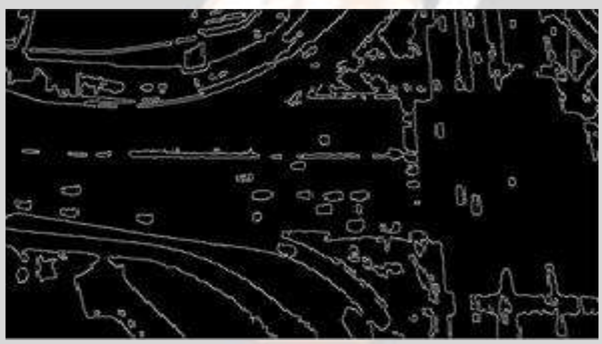

**Fig -5:** Canny edge detection

**3.5 Filling Holes**

Here we will fill the holes which were created on the canny edge detection to extract the text. This is the major step of text extraction. This is the main part of the Morphological operations. Figure of this step is given below:

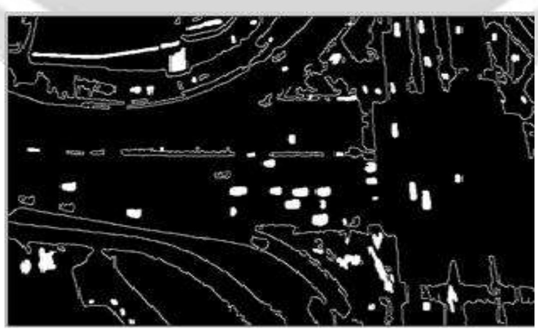

**Fig -6:** Filling holes

**3.6 Filtration using High Pass Filter**

A high pass filter is the basis for most sharpening methods. An image is sharpened when contrast is enhanced between adjoining areas with little variation in brightness or darkness. Here we got those pixels which are greater than the value of 25. Those pixels whose values are lesser than the 25 pixels are suppressed.

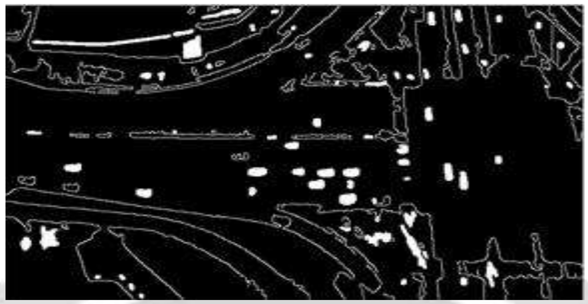

**Fig -7:** High pass filter

**3.7 Cropping the area**

Here we will crop that area where numbers of vehicles are maximum using imcrop command

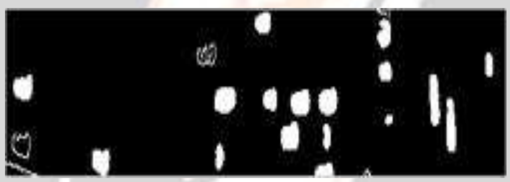

**Fig -8:** High pass filter

**3.8 Detected Vehicles using Blob Analysis**

Blob Analysis is a fundamental technique of machine vision based on analysis of consistent image regions. As such it is a tool of choice for applications in which the objects being inspected are clearly discernible from the background. Diverse set of Blob Analysis methods allows creating tailored solutions for a wide range of visual inspection problems.

**Fig -9:** Detected vehicles

## 4. CONCLUSIONS

In the past 3 decades satellite imaging has been used with success for geographical, weather, and geological applications. With the advancement of technology, additional refined sensors offer higher resolutions, and with quicker computer systems, the employment of satellite imaging has opened the fields of application and exploration. Segmentation techniques supported thresholding are used to extract highways and vehicles from pictures containing roadways scenes. Color properties are accustomed to extract vegetation areas from cities and fields scenes. Results of this work might be used to assist transportation agencies within the study of traffic density and trends across huge geographic areas.

## 5. REFERENCES

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