

# Vehicle Classification and Counting for Vehicle Census

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**Abstract**—Vehicle classification has been significantly important to vehicle census as it provides traffic count information to reflect the traffic density of a particular roadway. However, it has been a time consuming and sophisticated task to classify different vehicles into the desired category. Besides, the hardware-based technique used for classification leads to high cost of implementation and maintenance. Thus, we proposed an image processing based solution to extract the features of each vehicle in the traffic scene. The proposed framework incorporates a combination of detection, tracking and classification of vehicle to ensure high accuracy and performance for vehicle census. Experimental results show that our proposed framework can be applicable in real world applications.

**Index Terms**—Vehicle Census; Vehicle Classification; Image Processing

## I. INTRODUCTION

Recently, traffic vehicle census has shown great significance as the information produced can be useful in different real life applications especially for reducing traffic congestion as well as road planning [1]. In this case, vehicle classification plays a vital role in classifying different types of vehicle and produces a unique counter for each type. Nevertheless, vehicle classification has been a time consuming and sophisticated task in order to generate the traffic statistic for vehicle census. Thus, this study is being carried out to identify the necessary requirements as well as to develop an efficient algorithm for vehicle classification. There are several ways to acquire the information of vehicle type such as hardware-based sensors and software-based approach using image processing technique. However, the hardware-based technique usually is not being considered due to higher implementation and maintenance cost [2]. Therefore, the motivation of the study is clear as automated vehicle classification with the use of computer vision has become more demanding to assist in these problems. The software-based method provides ease of maintenance and visualization capabilities which enables the extraction of richer information with wider view of traffic scenes [3].

The rest of the paper is organized as follows. In Section II, the related works of vehicle classification is highlighted to compare and analyze the existing technique being used. Besides, the proposed methodology is presented in Section III while experiment and result will be covered in Section IV. Section V concludes the paper with some future works to be discussed.

## II. RELATED WORKS

There are numerous approaches that have been studied by researchers whereby each technique use different features and procedures in order to detect and classify vehicles. One of the methods that has been referred by most of the research works is the length-based vehicle classification proposed by [4] as it provides the most basic and fundamental concept in vehicle classification. The proposed method makes use of the registration line to detect the presence of vehicles in the scene. A longitudinal line is placed along each line of travel to measure the length of each vehicle while the result is stored in an array to compute mean, standard deviation and range for classification purpose. In this case, the particular array is considered to contain trucks if the range is greater than 75% of the mean vehicle length. The vehicle is classified as truck provided that its length is greater than one standard deviation above the mean. However, this method only focuses on classifying trucks while the result is mainly dependent on the statistic of real data in which the mean and standard deviation obtained can be varied in different scenes.

[5] presented a vehicle classification algorithm using size and shape of vehicle. Grayscale conversion and binary thresholding are being performed on the vehicle image as pre-processing task in this approach. Then, erosion process is carried out on the pre-processed image while the boundary of vehicle is extracted through subtraction of eroded image from the input image. Features vector is derived from the vehicle boundary image and Euclidean distance is used to measure the similarity between the input vectors and template vectors of each vehicle class. Nevertheless, this proposed technique uses image instead of video as an input for classification.

A new technique suggested by [6] categorizes the vehicles based on estimation of direction angle (DA). Vehicle detection is performed on the captured frame sequences based on the widely used background subtraction approach. The operation basically computes the absolute difference between current frame and a reference frame, which is also known as background image [7]. A minimal up-right rectangle is formed around each detected vehicle whereby most of the car objects are square bounded while motorcycles are typically rectangular bounded. Then, the DA to the first primary axis (FPA) within the bound is evaluated as a specific feature to classify vehicles because motorcycles tend to have lower DA values compare to car category. However, the proposed strategy is sensitive to illumination change due to static background image and it only focuses on classifying motorcycles out from the traffic flow.

The usage of bounding box has been one of the most popular techniques in vehicle classification due to its