

A Semantic Extraction and Analysis for Traffic Density Using Traffic Images: A Critical Review

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Abstract—Population growth in large cities has contributed to the increase in vehicles' number, leading to the traffic congestion problem. Incompetent traffic supervision could squander an inconsiderable number of man-hours and might lead to fatal consequences. Therefore, intelligent traffic surveillance systems have to carry more significant roles in highway monitoring and traffic management system throughout the years. Although vehicle detection and classification methods have evolved rapidly throughout the years, they still lack high-level reasoning. Accurate and precise vehicle recognition and classification are still insufficient to develop an intelligent and reliable traffic system. There is a demand to increase the confidence in image understanding and effectively extract the images conformed to human perception and without human interference. This paper attempts to summarize a review on several methods that semantically extract and analyze traffic density with image processing techniques. Three (3) methods that have been selected to be discussed in this paper are semantic analysis of traffic video using image understanding, mining semantic context details of traffic scene, and integrating vision and language in semantic description of traffic events from image sequences. Each method is discussed thoroughly, and their outstanding issue is deliberated in this paper.

Keywords— Intelligent traffic surveillance; semantical analysis; traffic images; traffic density.

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I. INTRODUCTION

The rapid development in the social economy today has resulted in the improvement of lifestyle and living levels. Most of the population could afford various means of transportation. Therefore, traffic congestion has been increasing lately in many development areas due to the rise in vehicles. Although other research has been done over the years to develop the most intelligent traffic surveillance system, the combination of some approaches such as content-based image and video retrieval technology is still unable to express exact and complete high-level semantic results. In other words, they still lack high-level reasoning that is required to understand the significance of the traffic objects or scenes and the meaning its conveyed.

Nonetheless, several research types have been carried out, which attempted to analyze or describe traffic images semantically. Some approaches intended to employ the image understanding method and mining the semantic context information to analyze traffic video semantically. Meanwhile, other procedures discuss the implementation of vision and language integration to provide traffic image descriptions

semantically. The use of ontologies to cover traffic occurrences using vocabularies to annotate traffic video resources is also included in some studies. These approaches will be reviewed and compared throughout this paper to come up with the most practical approach.

The traffic surveillance system has evolved over the years. This evolution can be categorized into three simple stages. The first stage is the employment of several approaches that do not implement image processing techniques, such as Magnetic Loop Detector (MLD) and infra-red sensor. Magnetic Loop Detector (MLD), with the help of its magnetic traits, is buried under the road to calculate the vehicle's quantity, whereas the infra-red sensor is installed at the side of the road to monitor traffic flow [1]. However, Magnetic Loop Detector (MLD) provides limited traffic information and requires a discrete vehicle counting and traffic surveillance system [1]. On the other hand, the infra-red sensor is subjected to a high failure rate in the situation where fogs and mists are present [2]. Other than that, the traffic surveillance system also employed an inductive loop detector that seems to be a costlier solution but unable to deliver accurate and consistent results when installed in a deprived