# MULTIPLE VEHICLE DETECTION AND SEGMENTATION

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# MULTIPLE VEHICLE DETECTION AND SEGMENTATION

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*In loving memories of my both late parents, Hasan bin Aziz and Sofiah Bt Hj Kasim, who don't have the opportunity to witness and share the joy of my success, Al Fatihah..*

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# ABSTRACT

Vision based system are widely used in the field of Intelligent Transportation System (ITS) to extract a large amount of information to analyze traffic scenes. Previously, this burdensome task was performed by human operator in traffic monitoring centre. Nevertheless, the increasing number of vehicles on the road as well as significant increase on cameras dictated the need for traffic surveillance systems. The research undertaken in this thesis is mainly concentrated on developing a multiple vehicle detection and segmentation focusing on monitoring through Closed Circuit Television (CCTV) video. The proposed system is able to automatically segment vehicle extracted from heavy traffic scene. In this work, optical flow estimation alongside with blob analysis technique is proposed in order to detect the moving vehicle. Since there is no reference background on the image, optical flow technique is used to distinguish between background from video scene with moving vehicle. Prior to segmentation, blob analysis technique will compute the area of interest region corresponding to moving vehicle which will be used to create bounding box on that particular vehicle. Experimental validation on the proposed system was performed and the algorithm is demonstrated on various set of traffic scene.

# ABSTRAK

Sistem berasaskan penglihaatan digunakan secara meluas di dalam Sistem Pengangkutan Pintar *(ITS)* untuk mengekstrak maklumat untuk menganalisa keadaan sesuatu trafik . Sebelum ini, tenaga kerja manusia digunakan untuk mengestrak semua maklumat ini  Walaubagaimanapun disebabkan penambahan bilangan kenderaan di jalan raya serta wujudnya kamera video yang canggih menyebabkan *ITS* menjadi suatu keperluan pada masa kini. Oleh yang demikian kajian tesis ini adalah untuk meghasilkan satu sistem yang dapat mengesan serta melakukan proses segmentasi terhadap sesuatu kenderaan ketika bergerak di jalan raya yang di ambil melalui isyarat Kamera Litar Tertutup *(CCTV)*. Sistem yang di perkenalkan mampu melakukan proses segmentasi ke atas kenderaan secara automatik yang di analisis melalui *CCTV* tersebut. Dalam kajian ini, teknik anggaran optik bergerak bersama-sama dengan analisis tompokan diperkenalkan untuk mengesan dan segmentasi kenderaan tersebut.  Disebabkan tiada rujukan latar belakang  terhadap video yang hendak di analisis, teknik anggaran optik bergerak sesuai di gunakan untuk membezakan antara latar belakang video dengan kenderaan yang bergerak kerana teknik ini sangat peka terhadap sesuatu pergerakan. Sebelum analisis segmentasi dilaksanakan, analisis tompokan akan mengira kawasan yang di kehendaki merujuk kepada kenderaan bergerak itu yang akhirnya akan menghasilkan kotak di sekeliling kenderaan itu. Algoritma yang dibangunkan diuji dengan pelbagai senario lalu lintas untuk pengesahan.

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| | | |
|---|---|---|
| ITS | - | Intelligent Transportation Systems |
| CCTV | - | Closed Circuit Television |
| IMS | - | Incident Management Systems |
| GPS | - | Global Positioning System |
| ATMS | - | Advance Traffic Management Systems |
| ATIS | - | Advance Traveler Information Systems |
| APTS | - | Advance Public Transport Systems |
| CVO | - | Commercial Vehicle Operation |
| AVCSS | - | Advance Vehicle Control and Safety Systems |

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# CHAPTER 1

## INTRODUCTION

In recent years, Intelligent Transportation Systems (ITS) have received a lot of attention. ITS refers to a variety of tools, such as traffic engineering concepts, software, hardware, and communications technologies, that can be applied in an integrated fashion to the transportation system to improve services in transportation systems operations, such as traffic management, commercial vehicle operations, transit management, and information to travelers [1]. Rapid development of technologies and the emergence of a new information age offer a new dimension in the operation and management of transport systems and facilities. ITS involved the application and integration of advance communication, microprocessor and information technologies into transport systems to achieve efficient utilization of infrastructure and energy resources, to improve safety and reduce the environmental impact of traffic.

ITS can be considered as an integrated system of people, roads and vehicles utilizing advanced data processing and communications technology. In general, the application of ITS can be broadly grouped into five major areas [2]:

i. **Advance Traffic Management Systems (ATMS)**. ATMS are the foundation for many other ITS applications. They provide the traffic surveillance that gather

information needed by the other applications. In urban areas ATMS process that information to determine the congestion level based on the traffic flow, and then optimize traffic signal timings and control Variable Message Sign (VMS). On expressway, they can detect incident and provide information to drivers via VMS and other means.

ii. **Advance Traveler Information Systems (ATIS)**. ATIS disseminate information to the travelling public over a variety of distribution media. Among these are TV and radio, the internet, information kiosk, mobile telephones, in-vehicle displays and VMS. ATIS can assist in pre-trip planning as well as in providing guidance while the traveler in en route.

iii. **Advance Public Transport Systems (APTS)**. APTS applies ITS technologies to address the needs of public transport. Some applications directly assist the travelling public such as transport information systems and integrated ticketing while others are associated with transport management including vehicle monitoring and fleet scheduling and management.

iv. **Commercial Vehicle Operation (CVO)**. CVO improves transport vehicle safety and productivity by employing technologies such as electronic transaction, weigh-in-motion and automatic vehicle identification and tracking.

v. **Advance Vehicle Control and Safety Systems (AVCSS)**. AVCSS comprise two major application areas, Advance Collision Avoidance Systems (ACSA) and Automated Highway Systems (AHS). ACAS adds to traditional safety systems such as seat belts and air bags by enhancing driver performance with the provision of warning of hazardous situations around the vehicle or even correcting driving efforts. AHS takes this a step further provide ‘hands off’ driving while maintaining driver safety and optimizing road capacity.

Among the components mentioned above, APTS becomes one of the important research efforts all over the world. This research work will contribute for the development of traffic monitoring system. Most of the ITS application are designed using readily available technology (sensors, communication etc.) which makes them reliable and useful.

Modern technology offers variety of sensors which can be incorporated in ITS applications such as Magnetic loop detector, Microwave (Radar), Laser, Infrared, Magnetometer, and camera. Each of these sensors has their own advantages and disadvantages. Among those options, magnetic loop detector is most popular. Magnetic loops are cheap and provide traffic parameters such as average speed, vehicle flow and vehicle density which is useful in traffic monitoring application. But, they have some limitations. First, they are very inflexible, modification and addition require digging groves in the road, thus producing traffic disturbance. Second, they cannot be used for more sophisticated tasks such as queue length measurement, road occupancy and tracking. [3]

Vision based system is a promising alternative since it requires no pavement adjustments and has more potential advantages such as larger detection areas, more flexibility and affordable. At the same time the system performs better and provides good quality results. Besides, image based traffic monitoring system are much less disruptive to install, thus they do not produce serious traffic disturbance. Vision based systems allow the visualization of vehicles on the road by using a single camera (monocular vision) mounted in perspective view of the road segment that is being monitored, thus enabling traffic-scene analysis such as traffic-conditions assessment and travel-speed estimation, as well as queue-length measurement, in which traditional non-visual surveillance systems could not do.

However traffic flow raises interesting but difficult problems for image processing. The various light conditions and different weather circumstance places a strong need on the robust algorithms, which require a great amount of computational power to meet the real-time operations of the traffic monitoring system. This work focused on developing multiple vehicle detection and segmentation to automatically

detect moving vehicle based on automated vision system. This is initial step before it can be advance to another system such as travel speed estimation, vehicle tracking and classification and so on so forth.

## 1.1 Problem Statement

a) Analyzing scenes from congested traffic especially on the traffic light area is difficult because there are many vehicles occluding each other at the same time.

b) It is even more difficult when the video is compressed or when weather conditions are bad.

c) In practice, traffic monitoring videos are usually highly compressed and are in low resolution, and matching models with vehicles in such a scene is difficult.

## 1.2 Objective

The goals of this project are:

a) To develop multiple vehicle detection and segmentation algorithm that can work robustly with a low resolution highway monitoring video that is highly compressed.

b) To apply the develop method and implement in real time automated vehicle surveillance monitoring systems.

## 1.3 Scope of Work

Following are the scope of this project:

i. The video taken will be based on input from closed circuit television (CCTV) with a resolution of 384 x 288 pixels.

ii. Video capturing will be performed during daytime with good weather condition.

iii. Video camera will be static during video capturing from an uncalibrated camera

iv. Only video taken at the traffic light will be considered as the worst case scenario to monitor moving and stationary vehicles.

## 1.4 Thesis Overview

This thesis is organized as follows;

Chapter 2 gives an insight to the research and development vehicle segmentation and detection done by various researchers and the background study of this project.

Chapter 3 presents theories and methodology of the proposed vehicle segmentation method. In this section, detailed explanation given for each stage involve in the vehicle segmentation process. Chapter 4 mainly devoted for demonstrating the experimental results of the project, performance and discussion.

Chapter 5 deals with the summary and conclusions of the project. Some recommendation and suggestions for the future development of the project are also discussed.

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