Automatic Traffic Signal Management System

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Abstract: Robust and reliable traffic surveillance system is an urgent need to improve traffic control and management. Vehicle flow detection appears to be an important part in surveillance system. The traffic flow shows the traffic state in fixed time interval and helps to manage and control especially when there’s a traffic jam. In this project, we propose a traffic surveillance system for vehicle counting. The proposed algorithm is composed of five steps: background subtraction, blob detection, blob analysis, blob tracking and vehicle counting. A vehicle is modeled as a rectangular patch and classified via blob analysis. By analyzing the blob of vehicles, the meaningful features are extracted. Tracking moving targets is achieved by comparing the extracted features and measuring the minimal distance between consecutive frame. The experimental results show that the proposed system can provide real-time and useful information for traffic surveillance.

Keywords: GPS - Global Positioning Service, BLOB - Binary Large Object

Introduction

In modern life we have to face with many problems one of which is traffic congestion becoming more serious day by day. It is said that irrational distribution of the development is main reason for augmented traffic jam. Automatic traffic monitoring and surveillance are important for road usage and management. To solve these congestion problems, we have to build new facilities and infrastructure at the same time to make it smart. It is well recognized that vision based camera systems are more versatile for traffic parameter estimation. In addition to qualitative description of road congestion, image measurement can provide quantitative description of traffic status including speed, vehicle counts etc. which fulfills the requirement of traffic management theory. Image tracking of moving vehicles can give us quantitative description of traffic flow.

The output from the camera based system can give information about the traffic density on particular road and can warn about traffic congestion if it arises. This project is mostly aimed at counting and classifying vehicles at signals from dynamic data obtain from camera. In case of heavy traffic on a particular lane it will balance by adjusting signal timings, this would maintain better traffic flow. The type of vehicles passing in each lane can be counted and classified based of properties (length, width) obtain from image of vehicles.

The system uses a camera for the live video streaming of the traffic. The captured video is then converted into frames at a rate of 25 frames per second. The frames thus obtained are subjected to adaptive background subtraction against an background image. The result of background subtraction gives us an image with only the vehicles in it which in turn can be counted with the blob detection approach, which gives us the vehicle count for a particular frame. For each blob that is obtained, the blob parameters (height, length, width, profile, area) are determined, which can be used to classify a vehicle to the respective category. The obtained vehicle count for each category is constantly updated on a graphical user interface.

Methodology

Following are the steps involved

- Image grabbing & Preprocessing
- Template matching (Emergency vehicles)
- Blob analysis (vehicle counting)
- Signal time allocation
- Identification for traffic rule violation

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1. Image grabbing & Preprocessing
The system uses a camera for the live video streaming of the traffic. The captured video is then converted into frames. From these frames the images will be obtained and these images will be given as input to the system.
Foreground detector (emgucv function) will be applied to an image to get images of vehicles in following manner.

2. Template matching (Emergency vehicles)
System detects the type of vehicles from the video and gives priority for the emergency vehicles like Ambulance and fire brigade vehicle. All priority vehicle identified by Template matching. Database File Folder contains the images of the Template images, Small database (MSSQL) containing information density of traffic.

3. Blob analysis (vehicle counting)
System can calculate the number of centroids of all the blobs available. The number of centroids of the moving vehicles will give information about the number of vehicles that have passed that particular path. System reject the blobs of areas smaller than those of vehicles as they are random noise, thus the first part of classification occurs at the blob detection level.

4. Signal time allocation
Count time required for detected vehicles to cross the road and allocate the time for the Traffic Signal according to the density of traffic. AndSwitch the direction of camera to switch the lane or road.

5. Identification for traffic rule violation
Rule Violation Notification to server (Entry in DB) Detect number of vehicles violating the rules. If vehicle break the rule for zebra crossing, then image gets cropped and saved in local DB and send alert to admin via Email. In this virtual line draws in the control to get rule violated vehicle.

Results:
This project is of image processing which combine to give a standalone system. The project will run on a processor like dual or quad core and will require almost no human dependence. The project will help in traffic surveillance by the help of counting vehicle detected through camera.

Conclusions:
Past researches have showed a promising result for including image processing in traffic light control. Earlier in automatic traffic control use of timer had a drawback that the time is being wasted by green light on the empty. This technique avoids this problem. We have successfully implemented an algorithm for a real-time image processing based traffic controller. Analysis of various contour tracing and object counting methods revealed the Moore neighborhood technique to be more robust when compared to the others. The paper demonstrates that image processing is a far more efficient method of traffic control as compared to traditional techniques. We have also implemented a system for emergency vehicle detection based on image processing techniques. Template matching algorithm is used for this. The increased response time for these vehicles is crucial for the prevention of loss of life.

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