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REAL-TIME VIDEO BASED VEHICLE DETECTION, COUNTING AND CLASSIFICATION SYSTEM

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Abstract:

Traffic Analysis has been a problem that city planners have dealt with for years. Smarter ways are being developed to analyze traffic and streamline the process. Analysis of traffic may account for the number of vehicles in an area per some arbitrary time period and the class of vehicles. People have designed such mechanism for decades now but most of them involve use of sensors to detect the vehicles i.e. a couple of proximity sensors to calculate the direction of the moving vehicle and to keep the vehicle count. Even though over the time these systems have matured and are highly effective, they are not very budget friendly. The problem is such systems require maintenance and periodic calibration. Therefore, this study has purposed a vision based vehicle counting and classification system. The system involves capturing of frames from the video to perform background subtraction in order detect and count the vehicles using Gaussian Mixture Model (GMM) background subtraction then it classifies the vehicles by comparing the contour areas to the assumed values. The substantial contribution of the work is the comparison of two classification methods. Classification has been implemented using Contour Comparison (CC) as well as Bag of Features (BoF).method.

I. INTRODUCTION

The need of efficient management and monitoring of road traffic has increased in last few decades because of the increase in the road networks, the number and most importantly the size of vehicles. Intelligent traffic surveillance systems are very important part of modern day traffic management but the regular traffic management techniques such as wireless sensor networks[1], Inductive loops[2] and EM microwave detectors[3] are expensive, bulky and are difficult to install without interrupting the traffic. A good alternative to these techniques can be video based surveillance systems

Video surveillance systems[4-8] have become cheaper and better because of the increase in the storage capabilities, computational power and video encryption algorithms[9]. The videos stored by these surveillance systems are generally analyzed by humans, which is a time consuming Job. To overcome this constraint, the need of more robust, automatic video based surveillance systems has increased interest in field of computer vision

The objectives of a traffic surveillance system is to detect, track and classify the vehicles but they can be used to do complex tasks such as driver activity recognition, lane recognition etc. The traffic surveillance systems can have applications in a range of fields such as, public security, detection of anomalous behavior, accident detection, vehicle theft detection, parking areas, and person identification. A Traffic surveillance system usually contains two parts, hardware and software. Hardware is a static camera installed on the roadside that captures the video feed and the software part of the system is concerned with processing and analyses. These systems could be portable with a microcontroller attached to the camera for the real-time processing and analyses or

just the cameras that transmit the video feed to a centralized computer for further processing.

Various approaches were made to develop such systems that can detect, count and classify the vehicles and can be used for traffic surveillance in intelligent transportation systems. This section covers the discussion about such systems and the knowledge about the methods used to develop such systems.

Computer vision technology is using for traffic monitoring in many countries [10], [11]. The development of computer vision technology over video based traffic monitoring for detecting moving vehicles in video streams become an essential part in ITS [12], [13]. A good number of work has been done on vehicle tracking and detection using computer vision technology. In 2005, Hasegawa and Kanade [14] introduced a system for detecting and classifying the moving objects by its type and colour. In this process, a series of images of a specific location were supplied and vehicles from these images were identified. In 2013, Nilesh et al. designed and developed a system using python with OpenCV for detecting and counting moving vehicles. It can automatically identify and count moving objects as vehicle in real-time or from recorded videos, which basically used background subtraction, image filtering, image binary and segmentation method. In 2014, Da Li et al. developed real-time moving vehicle detection, tracking, and counting system also using python with OpenCV including adaptive subtracted background method in combination with virtual detector and blob tracking technology. Virtual detector constructs a set of rectangular regions in each input image frame and blobtracking method generates input image frames, the absolute difference between the background image and foreground blobs corresponding to the vehicles on the road. The above systems have some limitations like tackling shadows, occlusion of multiple vehicles that appear in a single region. Peek Traffic Corporation commercially developed several video traffic detection systems at the present time.

II. LITERATURE SURVEY

Tursun, M and Amrulla, G [4] proposed a video based real-time vehicle counting system using optimized virtual loop method. They used real time traffic surveillance cameras deployed over roads and compute how many vehicles pass the road. In this system counting is completed in three steps by tracking vehicle movements within a tracking zone called virtual loop. Another video based vehicle counting system was proposed by Lei, M., et al. [5]. In this system surveillance cameras were used and mounted at relatively high place to acquire the traffic video stream, the Adaptive background estimation and the Gaussian shadow elimination are the two main methods that were used in this system. The accuracy rate of the system depends on the visual angle and ability to remove shadows and ghost effects. The system's incompetency to classify vehicle type is the core limitation of the system

Bas et al. proposed a video analysis method to count vehicles [10] based on an adaptive bounding box size to detect and track vehicles in accordance with estimated distance from the camera. The Region of Interest (ROI) is identified by defining a boundary for each outbound and inbound in the image. Although the algorithm is improved to deal with some weather conditions it is unable to track vehicles when they change their directions.

Mithun, N.C., et al proposed a vehicle detection and classification system using time spatial image and multiple virtual detection line[6]. A two-step K nearest neighborhood (KNN) algorithm is adopted to classify vehicles via shape invariant and texture based features. Experiments confirm the better accuracy and low error rate of proposed method over existing methods since

it also considers the various illumination conditions

Habibu Rabiu proposed a vehicle detection and classification for cluttered urban intersection [11]. In this system background subtraction and kalman filter algorithm are used to detect and track the vehicles and Linear Discriminant Analysis classifier is used for proper classification of vehicles.

III. SYSTEM ANALYSIS

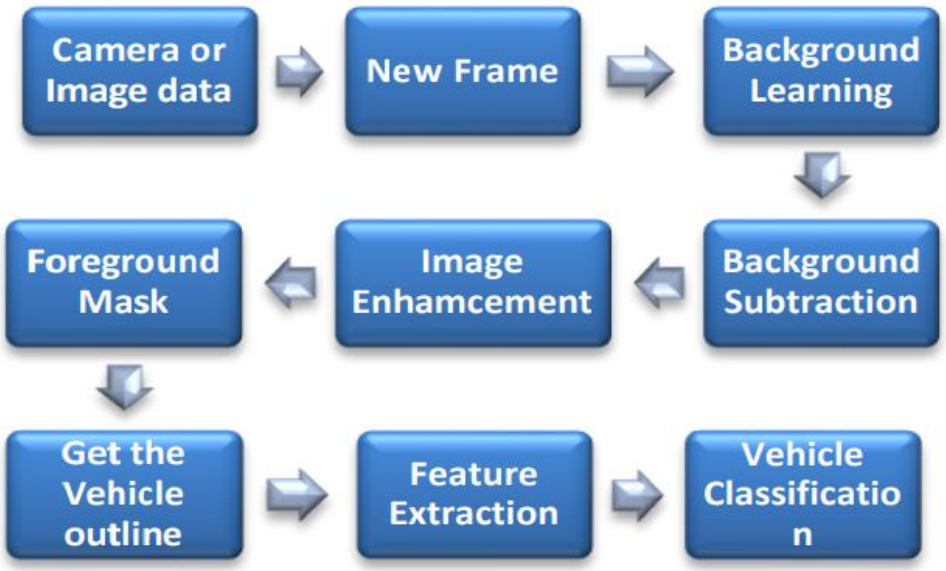
Existing System

A vehicle detection and classification system using time spatial image and multiple virtual detection line[6]. A two-step K nearest neighborhood (KNN) algorithm is adopted to classify vehicles via shape invariant and texture based features. Experiments confirm the better accuracy and low error rate of proposed method over existing methods since it also considers the various illumination conditions. People have designed such mechanism for decades now but most of them involve use of sensors to detect the vehicles i.e. a couple of proximity sensors to calculate the direction of the moving vehicle and to keep the vehicle count. Even though over the time these systems have matured and are highly effective, they are not very budget friendly. The problem is such systems require maintenance and periodic calibration.

Proposed System

The system could be used for detection, recognition and tracking of the vehicles in the video frames and then classify the detected vehicles according to their size in three different classes. The proposed system is based on three modules which are background learning, foreground extraction and vehicle classification as shown in fig. 1. Background subtraction is a classical approach to obtain the foreground image or in other words to detect the moving objects. We have proposed an adaptive video based vehicle detection, classification, counting for real-time traffic data collection. The proposed system was built using python programming language and OpenCV. The main objective for developing this system is to collect vehicle count and classification data. So that we can build intelligent transportation network based on historical traffic data. The proposed system can engender traffic data by detecting, classifying, counting It's a plug & play system and applied YOLO algorithm as a background subtraction technique. The proposed system was tested at different six locations in Hyderabad under different traffic and environmental conditions.

SYSTEM ARCITECTURE



IV. IMPLEMENTATION

Background Learning Module

This is the first module in the system whose main purpose is to learn about the background in a sense that how it is different from the foreground. Furthermore as proposed system works on a video feed, this module extracts the frames from it and learns about the background. In a traffic scene captured with a static camera installed on the road side, the moving objects can be considered as the foreground and static objects as the background. Image processing algorithms are used to learn about the background using the above mentioned technique.

Foreground Extraction Module

This module consists of three steps, background subtraction, image enhancement and foreground extraction. Background is subtracted so that foreground objects are visible. This is done usually by static pixels of static objects to binary 0. After background subtraction image enhancement techniques such as noise filtering, dilation and erosion are used to get proper contours of the foreground objects. The final result obtained from this module is the foreground

Vehicle Classification Module

The third and the last module in the proposed system is classification. After applying foreground extraction module, proper contours are acquired. Features of these contours such as centroid, aspect ratio, area, size and solidity are extracted and are used for the classification of the vehicles.

V. CONCLUSION

The proposed solution is implemented on python, using the OpenCV bindings. The traffic camera footages from variety of sources are in implementation. A simple interface is developed for the user to select the region of interest to be analyzed and then image processing techniques are applied to calculate vehicle count and classified the vehicles. We have developed video based vehicle detection, classification, counting for

real-time traffic data collection. We have used Background Subtraction Yolo algorithm, OpenCV, and python for developing the system. In the proposed system, we have considered all day and night shadowing, and different lighting situations. Also, we have considered the moving shadow of moving vehicles.

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