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Images Analysis for Classification and Counting of Vehicles on Roads using OpenCV

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Abstract: As web and digital cameras have become cheaper and wide-spread, the number of applications using vision techniques has increased significantly. Traffic detection (vehicles) and classification is one such application based on vision system. In this study, we propose a system for detection, classification and counting of vehicles on highway or expressway without explicit camera calibration. Frames taken from camera are processed to detect moving object on a logical line which enables counting of vehicles. Our experiments on several real traffic video sequences demonstrate good results for our foreground object detection, tracking, and classifying vehicles as light vehicles, heavy vehicles and motorcycles.

INTRODUCTION

Rapid increase in capacity of storage digital devices and innovations in digital cameras and video compression lead to growth of video contents availability. Not only on highways but in the metro cities, many important roads are installed with cameras. But the video captured from those cameras seat ideal in the storage devices. These are not analyzed to get important information. Vision based surveillance and intelligent traffic monitoring system has attracted significant interest.

Vehicle detection, tracking and counting is very important for military, civilian and government applications, such as highway monitoring, traffic planning, toll collection, traffic flow. For the traffic management, vehicles detection is the critical step. Computer vision based techniques are more suitable because do not disturb traffic while installed and they are easy to modify. In this study, we present inexpensive, portable and vision based system for moving object (vehicle) detection and classification and counting of vehicles on roads. Image from video are taken to detect moving vehicles, so that background is extracted from the sequence images. The extracted background is used in subsequent analysis to detect moving vehicles.

The system is implemented using OpenCV and experimental results are demonstrated from real time video taken from single camera. This system is also capable of counting moving vehicles from pre-recorded and real time video.

MATERIALS AND METHODS

Vehicle detection system: Vehicles detection must be implemented at different environment where the light and the traffic status changing. In our proposed system, we accept the traffic video from a camera and convert into frames, and extracts reference backgrounds. Later, we perform detection of moving objects. The system, we propose consists of three stages.

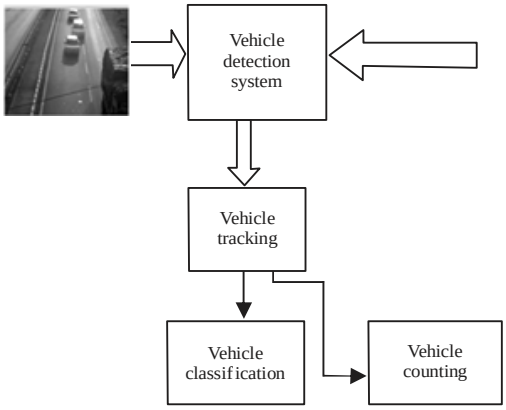

Fig. 1: Overall system of vehicle detection

System initialisation: System gets initialised and set up in this stage. Camera records continuous stream of data and sends to the system for analysis.

Background subtraction: In this stage, a set of frames are taken into focus and on successive analysis and operations background subtraction takes place.

Vehicle detection: In this stage, using the subtracted background image all the moving vehicles/objects can be tracked and counted.

Our system works in two modes, pre-recorded video mode and real-time camera mode. We can provide pre-recorded traffic flow video for detection and counting of vehicles. Real-time camera mode application accepts the video from a camera mounted at a fixed position. System is capable of playing almost every different avi files provided codec itself is installed on the machine. It also works with any type of USB camera device connected to the system, giving the option to the user to accept input in color mode or gray scale mode. Due to varying screen resolution we restrict the user to change resolution to 1024×768 or higher for desired results. The main system can be divided into several subsystems, which perform various tasks like: User Control subsystem, Video Detection subsystem and Vehicle tracking subsystem. These subsystems and their relations are shown on Fig. 1. Various models in video subsystems are given below:

Conversion of video to frames: This module is responsible for converting video captured by the camera to frame/image format so that it can be processed further for background extraction.

Frame external object extraction: This module is responsible for removing all external entities present on the captured images so that a pure background can be obtained for better detection capability of the system.

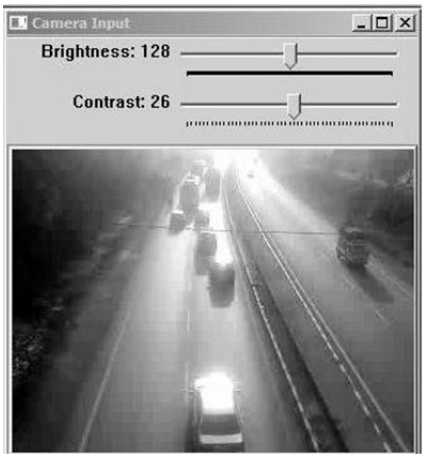

Fig. 2: Camera Initialization

Video detection: In this module, using background subtraction algorithm external entities can be identified by comparing it with the extracted background.

Data storage: In this module, detected objects are stored in the database for future reference if the need so arises.

Object detection in OpenCV: OpenCV stands for Open Source Computer Vision Library and is designed in C&C++, specifically for increased computational efficiency, supported by most Operating Systems. Example applications of the OpenCV library include Human-Computer Interaction (HCI), object identification, segmentation and recognition, face recognition, gesture recognition, camera and motion tracking, ego motion, motion understanding, camera calibration and depth computation and mobile robotics[1, 2]. OpenCV library contains over 500 functions which can be used in above application areas.

Simple camera initialization is performed using following code and the corresponding output screen shot is shown in Fig. 2.

- CvCapture *input;
- input = CV capture from CAM(-1)
- //Check if camera is working
- if (!input)
- {printf("\n\t input error");}

System design

Object detection: For the background static object detection, Background Subtraction can be used to detect moving object[3]. This part is designed by using Microsoft visual C++6.0 with OpenCV image development package. System designed to start getting images from web camera. Every frame will be processed to find

a moving object in the video. Figure 3 shows camera input, background subtraction and detected objects.

Interface design: This part is designed up by using Microsoft Visual Studio. Interface is build to enable user to interact with the system and give variousoptions for detecting vehicles. Figure 4 shows the interface of the system with providing several functions as below:

- Activating camera in color mode and grayscale mode
- Detect vehicles
- Detect vehicles from pre-recorded video stream
- Browse and play existing videos

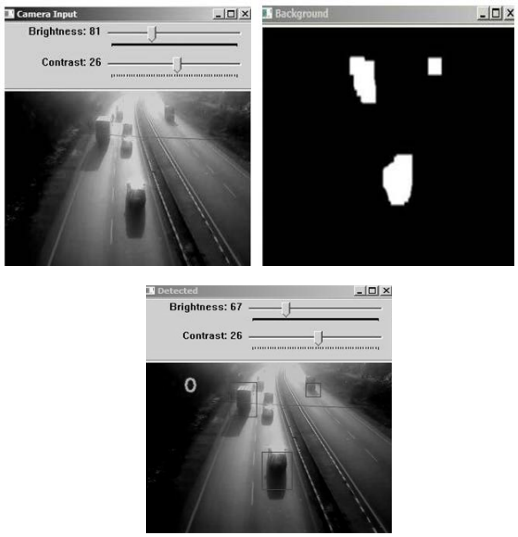

Fig. 3(a-c): Real-time vehicle detection, (a) Input video, (b) Extracted foreground and (c) Detected objects

Fig. 4: Interface design

RESULTS AND DISCUSSION

The system was implemented on a dual Pentium 987 MHz PC equipped with iNTEX IT- 305 WC camera. We tested the system on image sequences of highway scenes. The system is able to track and classify most vehicles successfully. Figure 5 and 6 show some results of our system. List of video recorded and log files can be seen by clicking on Visit Log Repository button. We get the following options given in Fig. 7.

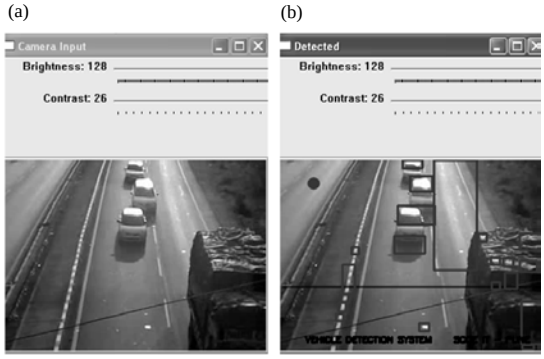

Fig. 5(a, b): Detecting vehicles by pre-recorded cideo

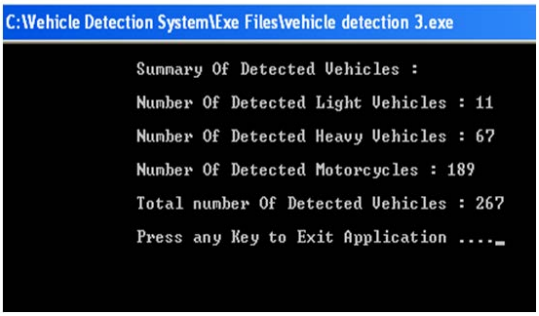

Fig. 6: Classification of detected vehicles

Fig. 7: Log repository

CONCLUSION

Due to increase in expressway, highway and traffic congestion, there is a huge amount of potential applications of vehicle detection and tracking on expressway and highways. In this study we have demonstrated vision based system for effective detection and counting of vehicles running on roads[4].

The main aim of our system is to detect the moments of vehicles by analyzing camera pictures with the help of computer vision. Vehicle counting process accepts the video from single camera and detects the moving vehicles and counts them. Vehicle detection and counting system on highway was developed using OpenCV image development kits. Best part of our system is that it works for any type of avi files and all types of USB connected web cameras. System is very sensitive to camera motion. To get desired results we restrict the screen resolution not <1000×700 pixels. System needs improvement in detecting shadow so that partially hidden objects can be considered[5].

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