Chapter 51
Video Stream Mining for On-Road Traffic Density Analytics

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ABSTRACT

Traffic congestion problem is rising day-by-day due to increasing number of small to heavy weight vehicles on the road, poorly designed infrastructure, and ineffective control systems. This chapter addresses the problem of estimating computer vision based traffic density using video stream mining. We present an efficient approach for traffic density estimation using texture analysis along with Support Vector Machine (SVM) classifier, and describe analyzing traffic density for on-road traffic congestion control with better flow management. This approach facilitates integrated environment for users to derive traffic status by mining the available video streams from multiple cameras. It also facilitates processing video frames received from video cameras installed in traffic posts and classifies the frames according to traffic content at any particular instance. Time series information available from various input streams is combined with traffic video classification results to discover traffic trends.

INTRODUCTION

The speed and precision of natural vision system for living beings (human, animal, birds or insects) is amazing, yet less explored because of complexity involved in the biological phenomena. Every intelligent system (Intelligent robotics, Intelligent Traffic system, Interactive medical applications and human intension recognition in retail domain etc.) in many industries is attempting to simulate natural vision system. The major hurdles in such process are high computational complexity because of very high dimensional images data and the semantic gap between the image content and the observed concepts from natural images/scenes. Recent progress in computational power and understanding of local and global concepts in images opens path for new line of work in

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dynamic automation. Table 1 summarizes some of the emerging applications in various domains and existing challenges in vision based solutions.

Video cameras are used in various industry segments for security, surveillance and object tracking purposes. Inferences derived from Video analytics systems will be of great importance for taking critical decisions and predictions in varied industry application scenarios. One such application area is traffic and transport management by using video cameras installed at traffic posts in a city. The traffic can be congested in some areas and the vehicular flow towards that area still increases the congestion. To avoid these types of issues, the area under congestion has to be estimated and the vehicular flow has to be directed in other possible routes. Because of the difficulty faced in recent traffic management and suitability of applying vision based approaches, it is of high interest in recent time. In the rest of this chapter, we focus on traffic density problems, issues and solution approach.

Traffic density and traffic flow are important inputs for an intelligent transport system (ITS) to manage traffic congestion better. Presently, this is obtained through loop detectors (LD), traffic radars and surveillance cameras. However, installing loop detectors and traffic radars tends to be difficult and costly. Currently, more popular way of circumventing this is, to develop some sort of Virtual Loop Detector (VLD) by using video content understanding technology to simulate behavior of a loop detector and to further estimate the traffic flow from a surveillance camera. But difficulties arise when attempting to obtain a reliable and real-time VLD under changing illumination and weather conditions.

In this work, we present an approach to estimate on-road traffic density using texture analysis and Support Vector Machine (SVM) classifier, and analyze traffic density for on-road traffic congestion control and flow management. Our system provides an integrated environment for users to derive traffic status by mining available

Table 1. Vision based application in different domain and issues

Domain	Applications	General functions in computer vision systems	Issues of Computer vision Systems
1. Health Care	Computer-aided diagnosis, surgical applications, Mammography Analysis, Detection of Carcinoma tissue, Retrieval of similar diagnosed images.	i. Image acquisition: (Sensors- light, ultra sonic, tomography, radar) ii. Pre-processing (Re-sampling, Noise reduction, Enhancement, Scale normalization) iii. Feature extraction (Lines, edges, interest points, corners, blobs, color, shape and texture) iv. Detection/Segmentation (region of interest, foreground and background separation, Interest points) v. High-level processing (Object Detection, Recognition, Classification and Tracking)	i. Various types of image and videos (binary, gray, color), different data types (GIF, BMP, JPEG and PNG), and sizes (SQCIF, QCIF, CIF, 4CIF). ii. Camera Sabotage (FOV obstruction, sudden pan, tilt, zoom) and Discontinuity in video streams iii. Illumination (varied intensity and multiple source of lights) iv. Blurring v. Occlusion vi. Different object size vii. Changing Field of View in moving cameras
2.Transport	Small to large vehicle detection, Vehicle count, Traffic density estimation, Incident detection, Traffic rule violation detection, Eye and head tracking for automatic drowsiness detection, Lane/Road detection etc.		
3. Security Surveillance	People detection and tracking, Abnormal behavior recognition, Abandoned Objects, Biometric pattern recognition (Face, Finger prints), Activity monitoring in mines etc		
4. Manufacturing	Camber measurement, Item detection and classification, and Vision-guided robotics etc.		
5. Retail	Cart detection, Vegetable recognition etc.		