

Chapter 45

Towards Intelligent Human Behavior Detection for Video Surveillance

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ABSTRACT

Computer vision techniques are capable of detecting human behavior from video sequences. Several state-of-the-art techniques have been proposed for human behavior detection and analysis. However, a collective framework is always required for intelligent human behavior analysis. Therefore, in this chapter, the authors provide a comprehensive understanding towards human behavior detection approaches. The framework of this chapter is based on human detection, human tracking, and human activity recognition, as these are the basic steps of human behavior detection process. The authors provide a detailed discussion over the human behavior detection framework and discuss the feature-descriptor-based approach. Furthermore, they have provided qualitative and quantitative analysis for the detection framework and demonstrate the results for human detection, human tracking, and human activity recognition.

INTRODUCTION

Human behavior detection is the process of recognizing human body movements and actions. Extensive efforts have been made for intelligent human behavior detection; still it is a challenging area in computer vision research (Forsyth and Ponce, 2011; Sonka et al., 2014). Due to the emergence of interactive multimedia systems, intelligent video surveillance has become popular in applications such as security, smart homes, clinical applications, biometric applications, human robot interaction, entertainment and

DOI: 10.4018/978-1-5225-7113-1.ch045

education (Porikli et al., 2013; Chang et al., 2014; Zhang et al., 2015; Huang et al., 2014; Hanna and Hoyos, 2017; Yumak et al., 2014; Thompson et al., 2016). This wide range of applications shows that human behavior detection is a significant area of research in computer vision particularly for intelligent video surveillance systems.

A lot of organizations, whether they are private or government, pay attention to visual surveillance systems for security point of view. There are many surveillance systems employed in various places like airports, train stations, shopping malls, as well as private residential areas. For a video surveillance system, analysis and understanding of human behavior are the most important features. Many such schemes have been proposed in the meanwhile (Choujaa and Dulay, 2008; Kuryloski et al., 2009; Luo et al., 2007; Collins et al., 2000; Zajdel et al., 2007). Human behavior analysis systems provide a real-time performance and sufficiently high accuracy for the automatic surveillance systems. Simple and fast surveillance systems have been employed for the analysis of abnormal human behavior like sudden stopping, disappearing from a scene, climbing on a wall and falling. The automatic 3D human behavior monitoring systems have more potential for many other types of behaviors too. There are two types of surveillance systems. First type of systems record video events for later analysis whereas second type of systems simultaneously detect and analyze those events for faster reaction. The security systems have also much importance in security control in homely environment. Incorporating artificial intelligence with surveillance, smart surveillance systems obtain particular information about structure and appearance of people and produce much correct result. Furthermore, they are able to discriminate between normal and suspicious events.

Significance of intelligent video surveillance systems is increasing for many reasons. The most important reason is that these systems minimize human factors which reduce the performance to detect security breaches. For example, with human operators there exist several limitations on the number of scenes monitored simultaneously. Moreover, the human operator's concentration may drop suddenly. These limitations caused by human intervention have been overcome by the intelligent video surveillance systems. However, the 9/11 terrorist attacks in USA and 26/11 terrorist attacks in Mumbai, India have indicated the necessity for improvement in existing systems for automatic monitoring of suspicious human behavior. Therefore, an intelligent human behavior analysis and understanding is required that can detect and track humans and identify their normal and abnormal behavior.

The most common devices used for human behavior detection are sensors and cameras. According to position of sensors and cameras, behavior detection systems can be termed as sensor based systems and vision based systems (González et al., 2012). However, vision based systems are quite popular because they provide more important cues for behavior detection. From a review's point of view, many researchers have presented their reviews on human behavior detection. Based on these reviews, the human behavior detection approaches can be divided into two categories: model based and model free. In model based approaches (Wang & Mori, 2011; Lan et al., 2012; Cheng et al., 2014), a prior shape model is constructed for behavior detection. These 2D and 3D explicit shape models are used to recognize human subjects and their behaviors. Model free approaches (Vrigras et al., 2014; Määtä et al., 2010; Matikainen et al., 2011; Souvenir et al., 2008) overcome the drawbacks of model based approaches. In the model-free approaches, features are extracted from videos for behavior detection. These features are low-level visual features from the region of interest.

An intelligent human behavior detection framework includes human object detection and tracking followed by activity recognition. Since, the framework includes three consecutive modules; therefore, it is important to reduce computational complexity and provide solution of human motion analysis. For

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