Chapter 10
Collaborative Video Surveillance for Distributed Visual Data Mining of Potential Risk and Crime Detection

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ABSTRACT

Thanks to fast technology advancement of micro-electronics, wired/wireless networks and computer computations in past few years, the development of intelligent, versatile and complicated video-based surveillance systems has been very active in both research and industry to effectively enhance safety and security. In this chapter, the authors first introduce the generations of video surveillance systems and their applications in potential risk and crime detection. For effectively supporting early warning system of potential risk and crime (which is load-heavy and time-critical), both collaborative video surveillance and distributed visual data mining are necessary. Moreover, as the surveillance video and data for safety and security are very important for all kinds of risk and crime detection, the system is required not only to data protection of the message transmission over Internet, but also to further provide reliable transmission to preserve the visual quality-of-service (QoS). As cloud computing, users do not need to own the physical infrastructure, platform, or software. They consume resources as a service, where Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), and pay only for resources that they use. Therefore, the design and implementation of an effective communication model is very important to this application system.

DOI: 10.4018/978-1-61692-865-0.ch010

INTRODUCTION

In the past few years, the application studies of intelligent and versatile video camera were very active in both research and industry due to the fast advancement of micro-electronics, communication networks and computer vision technologies. Now, video surveillance systems have played an important role in the early warning of potential risk (such as fire accident, flood disaster, and debris flow) and potential crime (such as a man to tail after an old woman or to spy on a bank truck) to protect lives and properties.

In this chapter, we introduce the generations of video surveillance systems and their applications in the potential risk and crime detection. For supporting these load-heavy and time-critical applications, a system with collaborative video surveillance and distributed visual data mining would be necessary. The concept of collaborative video surveillance was first presented in (Wang, et al., 2003). Start from the collaborative commerce based on Internet Web-based information system for providing users ubiquitous video surveillance services. We treat the surveillance data and service as a kind of digitized product in E-marketplaces.

By collaborating different surveillance data with different value-added services, diverse applications for the early warning of potential risk and crime can be provided. Notably, these value-added services are distributed and may require visual data mining techniques (Simoff, et al., 2008). In this chapter, the design and implementation of an effective communication model to support collaborative video surveillance are introduced. As the visual mining data for safety and security is very important for all kinds of risk and crime detection, our system will protect the surveillance information transmission on public and prevalent Internet by Diffie-Hellman key exchange algorithm and AES encryption (Wang, Li, Liao, 2007; FIPS-197). Moreover, open-loop error control of forward erasure correction (FEC) is applied for reliable transmission of live surveillance video to preserve the perceptual quality.

The main objectives of this chapter are to illustrate a framework for effective detection of potential risk and crime via visual data mining of real-time surveillance videos and then to describe the development of this early warning system (EWS) using related information technologies.

BACKGROUND

Video surveillance services have been active for decades to protect lives and properties of individuals, enterprises and governments such as homeland security, office-building security and traffic surveillance on highways. Video surveillance systems have evolved to the third generation (Fong & Hui, 2001; Liang & Yu, 2001; Marcenaro, et al., 2001). In the third-generation systems as shown in Figure 1, all applied devices and technologies are digital. The digital camera can further compress the video data to save the bandwidth for providing users ubiquitous video surveillance services through the prevalent Internet (Ho, et al., 2000). Therefore, we can aggregate different surveillance information from different cameras to provide users more value-added surveillance services (Fong & Hui, 2001; Liang & Yu, 2001; Juang & Chang, 2007) such as fire accident, flood disaster, and debris flow. More details are presented later in this book chapter.

The major advantage from the third-generation surveillance systems over previous generations is their highly increasing functionalities in video surveillance services. For example, by collaborating with distributed visual data mining functions that support by different service nodes, we can create new and diverse "digitized products (services)" for supporting different applications. For example, by applying services such as face-recognition, moving object tracking, abandoned object identification and emerging data mining technologies (OpenIVS, 2009; Xie, et al., 2006)