Chapter 13
Real-Time Detection of Pedestrians:
A Comparison of Three Segmentation Algorithms in Infrared Video

Juan Serrano-Cuerda
Universidad de Castilla – La Mancha, Spain

María T. López
Universidad de Castilla – La Mancha, Spain

José Carlos Castillo
Universidad Carlos III de Madrid, Spain

Antonio Fernández-Caballero
Universidad de Castilla – La Mancha, Spain

ABSTRACT

Real-time pedestrian detection is a key technology for video surveillance. A widespread approach for detecting pedestrians is the use of color information. In recent times, the use of thermal infrared cameras has revealed to be an excellent alternative that offers good results in people segmentation. Nonetheless, thermal infrared cameras are very sensitive to the overall heat detected at each image. Moreover, a great amount of infrared images has low spatial resolution and lower sensitivity than visible spectrum images due to the technological limitations of infrared cameras. This chapter introduces a comparison of three different algorithms for real-time and robust pedestrian detection in the infrared spectrum. The aim of the paper is to look for the best algorithms prepared to resolve the conflicts that arise in the detection process in image sequences. We propose to use simple rules as conflict resolution mechanism when the outputs of the three algorithms do not coincide.

INTRODUCTION

Electronic surveillance deals with observing or listening to persons, places, or activities with the aid of electronic devices such as cameras, microphones, and tape recorders, among others. Electronic surveillance serves several purposes, such as (1) enhancement of security for persons and property; (2) detection and prevention of criminal, wrongful, or impermissible activity; and (3) interception, protection, or appropriation of valuable, useful, scandalous, embarrassing, and discrediting information.

DOI: 10.4018/978-1-5225-0245-6.ch013

Conflicts in electronic surveillance use to arise when the information gathered from technological artefacts does not provide enough evidence of the accuracy in the events related to people identification. In vision-based electronic surveillance, a first crucial step towards identification is a very precise and efficient detection of people. Here, conflict resolution is the process in which different computer vision algorithms demonstrate their consistency in the segmentation performance in case there is a conflict. A conflict arises when the algorithms hold incompatible views on the segmentation of people in a sequence of images.

Concretely, this chapter faces the comparison of robust algorithms for real-time people detection, a key technology for electronic surveillance. A widespread approach for detecting people is the use of color information. In recent times, the use of thermal infrared cameras has revealed to be an excellent alternative that offers excellent results in people segmentation. This chapter introduces a comparison of three different algorithms for real-time and robust people detection in the infrared spectrum. It is appreciated that people detection based on combining thermal properties and motion information is the best choice among the tested approaches.

This mixed approach is very helpful in reducing conflicts in camera-based electronic people surveillance, as accurate people segmentation is mandatory to achieve further solid people identification. In this sense, this chapter introduces a comparison of three different algorithms for real-time and robust pedestrian detection in the infrared spectrum.

BACKGROUND

Detecting pedestrians is a key technology for many applications, especially in the video surveillance domain (Dollár, Wojek, Schiele, & Perona, 2012). At the same time, it is one of the most challenging problems in computer vision and remains a scientific challenge for realistic and dynamic scenes. Indeed, visual processing of pedestrians, including detection, tracking, recognition, and behavior interpretation, is a key component of intelligent video surveillance systems. A number of surveillance applications require the detection and tracking of people to ensure security and safety (Navarro, Fernández-Caballero, & Martínez-Tomás, 2014), (Costa, Guedes, Vasques, & Portugal, 2013). That is, many video surveillance systems require the ability to determine if an image region contains pedestrians. This is none but a specific case of object classification in which there are only two object classes: pedestrian and non-pedestrian. Object classification in general is difficult and people detection is even harder. In addition, video-surveillance systems must run at video-rate and thus require a trade-off between precision and computing time. Moreover, any pedestrian detection method highly depends on segmentation, which remains a primitive problem. A widespread approach for detecting pedestrians is the use of gray scale (Enzweiler & Gavrila, 2009) and color information (Wan & Liu, 2009; Rodriguez & Shah, 2007), (Schwartz, Kembhavi, Harwood, & Davis, 2009). These are usually problematic when facing changes in lighting in a scene or visibility problems therein. To guard against these failures, you can find an alternative in the use of the infrared spectrum (Sun & Park, 2007).

Thermal infrared images have a number of distinctive features compared to frames acquired by a visible spectrum camera (Li, Gong, Li, & Liu, 2010; Olmeda, de la Escalera, & Armingol, 2011). The gray level value of the objects is usually set by their temperature and radiated heat, and is independent from lighting conditions. This is why a detection system in this spectrum can be applied under day and night conditions. Thus, the most intuitive idea when performing a pedestrian detection algorithm in the