Real-time background subtraction using adaptive thresholding and dynamic updating for biometric face detection

Abstract

Face biometrics is an automated method of recognizing a person's face based on a physiological or behavioral characteristic. Face recognition works by first obtaining an image of a person. This process is usually known as face detection. In this paper, we describe an approach for face detection that is able to locate a human face embedded in an outdoor or indoor background. Segmentation of novel or dynamic objects in a scene, often referred to as background subtraction or foreground segmentation, is a critical early step in most computer vision applications in domains such as surveillance and human-computer interaction. All previous implementations aim to handle properly one or more problematic phenomena, such as global illumination changes, shadows, highlights, foreground-background similarity, occlusion and background clutter. Satisfactory results have been obtained but very often at the expense of real-time performance. We propose a method for modeling the background that uses per-pixel time-adaptive Gaussian mixtures in the combined input space of pixel color and pixel neighborhood. We add a safety net to this approach by splitting the luminance and chromaticity components in the background and use their density functions to detect shadows and highlights. Several criteria are then combined to discriminate foreground and background pixels. Our experiments show that the proposed method possesses robustness to problematic phenomena such as global illumination changes, shadows and highlights, without sacrificing real-time performance, making it well-suited for a live video event like face biometric that requires face detection and recognition.