Control of Mouse Movements Using Human Facial Expressions

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Abstract

In this paper, a method to create an application which is competent of replacing the traditional input device (mouse) by using human facial features is proposed. Distinctively, using real time videos of the user's face extracted from the video sequence obtained using an off-the-shelf web-camera. It can be applied as an optional input source for those who cannot use their hands due to disabilities or patients who cannot use their hands.

In the proposed technique, a method that combines both feature-based and image-based approach is used. The fundamental approach for detection is fast extraction of face candidates using Six-Segmented Rectangular (SSR) filter and then pass them to Support Vector Machine for face verification.

In face tracking, the patterns of between-the-eyes are tracked with update template matching. A window that has the feature's template size is scanned over the Region of Interest (ROI) and then calculates the Sum of Squared Difference between a frame that has the feature's template and the current frame. Experiments show that 90% of the system behaves satisfactory for a web-camera at frame rate of 15fps with the image resolution of 320 x 240 frame size. The system consumes little amount of CPU resources allowing other processors to run smoothly

1. INTRODUCTION

As computers become faster and more dependable, many applications that use face detection have become an essential part of human life. For example, face recognition systems are being tested and installed at airports to provide new level of security [1]; human-computer interfaces based on facial expression and body gesture are being exploited as ways to replace the traditional interfaces such as the mouse and keyboard [1]. Face detection in real-time is crucial for many of those applications.

Face detection has always been a vast research area in computer vision, considering that it is the backbone of any application that deals with human face. Once face is detected it should be tracked for further analysis.

Many face detection methods have been developed in the literature. Hjelmas [2] organized face detection techniques into two main categories, the feature-based approach and the image-based approach. Most of the image-based approaches exhaustively scan the image for face-like pattern at many scales for face detection, which is time consuming and window scanning techniques requires heavy computation, which makes it computationally expensive. The feature-based approach eventually leads to the localization of face and features that it contains. Hence the majorities of real time applications select the feature based approach and mixes it with various other kinds of fast face candidate extraction methods [3].

The most well-known method that is applied in the feature-based approach is skin model which is effective in image segmentation and face extraction. The inspiration to use skin colour analysis for initial classification of an image into probable face and non-face region stems from a number of simple but powerful characteristics of skin colour [4]. Firstly, processing skin colour is simpler than processing any other facial feature. Secondly, under certain lighting conditions, the colour is orientation invariant. The major difference between skin tones is intensity, e.g. due to varying lighting conditions and different from the colour of most other natural objects in the world [5].

In order to achieve high speed and reliable face detection, a method has been proposed to combine both feature-based and image-based approaches to detect the face by using Six-Segmented Rectangular (SSR) filter.

Real time tracking of eyes is mostly dependent on the location of the area between-the-eyes (BTE) [6]. Hence, in this application SSR filtering technique to extract between eyes in real time is used. This approach is very attractive and the calculation of SSR filter is simple and fast, since it only requires information around the eyes. However, in the case of the entire forehead is covered with hair this method fails. Hence skin tone region is selected as the first face candidate.

In order to calculate the grey level in each segment of SSR filter, an immediate representation of image called "Integral Image" introduced by Voila and Jone [7] is used.