Use Your Head: An Interface for Computer Games Using Head Gestures

Ovidiu-Ciprian Ungurean, Stefan-Gheorghe Pentiuc, and Radu-Daniel Vatavu

University Stefan cel Mare of Suceava, Romania
ungurean.ovidiu@gmail.com, pentiuc@eed.usv.ro, vatavu@eed.usv.ro

Abstract. We describe in this paper an improved algorithm for tracking and recognizing head movements using simple computer vision techniques and low-cost web cameras. We demonstrate the usefulness of our technique in a practical scenario for controlling computer games via head gestures.

Keywords: perceptual user interfaces, head tracking, gesture recognition

1 Introduction

We describe in this paper a simple technique for the acquisition and recognition of simple head gestures in the form of rotations (left - right) and nodding. The kernel of our framework is a finite state machine with two stages: frontal face detection and head tracking followed by gesture recognition. We show an immediate application of our head interface for controlling computer games.

2 Detecting head gestures

Head tracking for the purpose of human-computer interaction needs to be achieved in real-time and to provide robustness to variations in lighting, background noise and user skin color. In order to track the user head, we use as a model the user face skin color. When the AdaBoost[1] method finds a frontal face, skin color model is initialized as a 2D histogram using Hue Saturation channels from HSV. The search area on which AdaBoost can be applied again, for an eventual search will be smaller than the entire frame received from the webcam, but larger than the window returned by CAMShift[2]. Using this approach, we benefit from the advantages offered by those two methods: efficiency in face detection and tracking speed. The direction of the head movement is computed using motion history gradients [3].

Tests performed with a standard low-cost web cam on a 1.7 GHz laptop computer showed an accuracy rate of over 90% for our gesture recognizer with a CPU load ~ 30% due to video processing. Five subjects were asked to replicate the head movements of a virtual character after which recognized gestures were matched to the ground truth.

3 Controlling computer games

Head movements may be easily and naturally mapped to the directional keys and mouse movements which allow direct control over characters in computer games. We applied our technique for two game environments: Pac Man (an arcade game) and Counter Strike (FPS game). Players were able to control the movements of the Pac Man character in order to navigate in a 2D labyrinth world trying to accumulate points whilst avoiding ghosts. During Counter Strike, users found the extra option of modifying the point of view (usually achieved with the mouse) via left and right head movements. Each implementation provides alternative techniques for the keyboard (Pac Man) and mouse (Counter Strike).

After several test plays, five subjects were asked to answer a questionnaire that will assess their game experience. Subjects appreciated that accommodation with the techniques was not difficult at all because no training or calibration was required and rated it 4.6 on a 1-5 scale where 1 stood for difficult and 5 for easy accommodation. After practice, the technique was perceived as easy-to-use (4.2 out of 5). With regards to the perceived recognition accuracy, the rating was 3.2 (1-5 scale, 5 means very accurate). Due to the fact that neck muscles are large in volume, the effort was much bigger than using finger movements (keyboard and mouse). Being asked how they perceived effort, the average score was 2.2 (1-5, 1 is effort demanding). When generally questioned about the new interaction technique for playing games, subjects considered it to be useful (4.4 out of 5 rating).

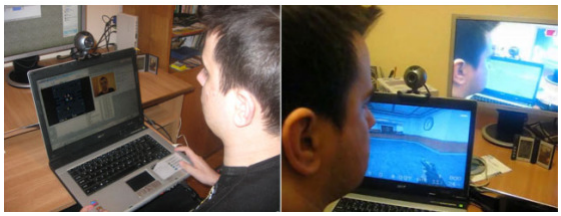

Fig. 1. Controlling computer games via simple head movements.

One of the subjects told us that he involuntary moved his head when he tried to play the Pac Man game at home on his computer. A video demonstration of our technique may be downloaded from http://eed.usv.ro/~vatavu/videos/head4games.wmv.

References

1. P. Viola and M. Jones. Rapid object detection using a boosted cascade of simple features. In Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition, Kauai,Hawaii, 12-14 2001.
2. G. Bradski. Real time face and object tracking as a component of a perceptual user interface. In Proc.Wkshp. Applications of Comp. Vis., pages 214–219. IEEE, 1998.
3. Gary R. Bradski & James W. Davis Motion segmentation and pose recognition with motion history gradients Machine Vision and Applications (2002) 13: 174–184.