Combining Eye- and Head-Tracking Signals for Improved Event Detection

Eye tracking is a technique that enables to estimate where a person is looking. It is a well-established research tool which can be used to investigate different types of eye movements and their relationship to the underlying processes in the brain. Measurements of eye movements are important for basic research in visual attention, perception and cognition, in psychology and linguistics, but also in applied fields such as product design.

The development of lighter, cheaper, and smaller electronics has miniaturised eye-tracking equipment, transforming it from a large box only available in the laboratory to a pair of glasses. This makes it possible to perform eye tracking in everyday environments such as driving a car or shopping in a supermarket, as well as virtual-reality environments. Although mobile eye-tracking glasses allow for greater freedom and more potential applications, they present a variety of challenges, manly related to the fact that nothing is static anymore. Subjects are able to freely move their head and body and interact in a natural way with a changing environment. All of these factors cause the eye-tracking signal to not only include eye movements but also head movements. This in turns makes the classification of different types of eye movements in the eye tracking signal more difficult. In order to draw the correct conclusion about the underlying processes in the brain, therefore, it is important to compensate for head motion. Since the tools for analysing eye-movement signals are mainly developed for data recorded with other types of eye trackers, researchers are forced to perform tedious manual encoding to enable analysis of the recorded signals. Thus, a new set of algorithms and methods is needed, specifically geared towards mobile eye-tracking data.

The goal of this master's thesis is to develop a method that can automatically detect the three most common types of eye movements from an eye-tracking signal recorded using eye-tracking glasses. Furthermore, the method should compensate for head movements which are simultaneously recorded. To achieve the goal, the head-tracking signal and the eye-tracking signal are combined in order to generate a new signal that is as free of head movement as possible. In addition, a new enhanced algorithm for the detection of the three most common types of eye movements is developed.

The results show that by compensating for head movements the proposed algorithm is able to accurately classify eye movements based on mobile eye-tracking data. Moreover, it clearly outperforms two existing algorithms which were used for comparison.