Chapter 70
A Method for Identifying Fatigue State of Driver's Face Based on Improved AAM Algorithm

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ABSTRACT

The change of lighting conditions and facial pose often affects the driver's face's video registration greatly, which affects the recognition accuracy of the driver's fatigue state. In this paper, the authors first analyze the reasons for the failure of the driver's face registration in the light conditions and the changes of facial gestures, and propose an adaptive AAM (Active Appearance Model) algorithm of adaptive illumination and attitude change. Then, the SURF (speeded up robust feature) feature extraction is performed on the registered driver's face video images, and finally the authors input the extracted SURF feature into the designed artificial neural network to realize the recognition of driver's fatigue state. The experimental results show that the improved AAM method can better adapt to the driver's face under the illumination and attitude changes, and the driver's facial image's SURF feature is more obvious. The average correct recognition rate of the driver's fatigue states is 92.43%.

DOI: 10.4018/978-1-7998-0414-7.ch070

1. INTRODUCTION

Fatigue driving has become one of the important causes of traffic accidents. According to the World Health Organization, 35%-45% of traffic accidents are caused by fatigue driving (Khushaba, Kodagoda, Lal & Westenberg, 2011). Fatigue driving usually refers to the emergence of psychological and physiological dysfunction of the driver after a long drive in a row, which in turn leads to the decline of the driver's driving ability. Driving fatigue, as a physiological response, almost occurs on every driver under certain conditions; therefore, the study of the driver fatigue level identification technology on real vehicle operating conditions has a positive effect on reducing traffic accidents due to fatigue driving (Qu, Cheng & Lin, 2013).

According to the data sources of driver's fatigue monitoring systems, driver fatigue monitoring systems are divided into two categories: intrusive and non-intrusive. Intrusive fatigue monitoring system mainly relies on the acquisition of the driver's physiological data, to analyze how the physiological characteristics of the driver change, so as to monitor his fatigue state. The data used in such systems include ECG signals, EEG signals and eye signals, etc. (Picot, Charbonnier & Caplier, 2012; Zhang, Wang & Fu, 2014; Correa, Orosco & Laciar, 2014). Non-intrusive fatigue monitoring system will not interfere with the normal driving of the driver in the monitoring process, the data acquisition and fatigue monitoring can objectively reflect the driver's actual operating behaviour or state. At present, the non-intrusive method has become a hot spot in the field of driver fatigue monitoring.

Fatigue monitoring system based on driver's face video is a kind of non-intrusive method, and the driver's facial video data acquisition is easier. Therefore, the research of fatigue monitoring based on facial state has become a research hotspot (Jung, Shin & Chung, 2014; Cheng, Zhang & Feng, 2007; Ma & Cheng, 2010). Driver's facial feature point location and extraction has been an important research content in face image processing (Wang, Qu & Bi, 2013); however, due to frequent light changes on the driver's face during the process of driving, the facial features extraction, positioning and registration are often inefficient or even fail.

In order to achieve accurate registration of driver's face images in real vehicle condition, this paper analyzes the existing classic AAM algorithm and proposes an improved method, and designs a driver fatigue state identification method using neural network classifier.

This remainder of this paper is organized as follows: Section 2 shows the details of the proposed algorithm. Section 3 presents experimental results and section 4 concludes the paper.

2. METHOD

2.1. Overview

This method describes the whole process of driver facial fatigue recognition based on video images. In the real vehicle driving condition, the intensity of the driver's facial image is greatly affected by the change of lighting and its position, which makes the face registration of the driver's video image poorly robust. The Active Aesthetic Model (AAM) is one of the classical algorithms for the feature extraction of facial features (Iain & Simon, 2004; Suo, Zhang & Sun, 2013). In this paper, the popular method of facial feature localization, AAM, is applied to the facial registration of drivers and the reasons for the influence of illumination variation on AAM algorithm are analyzed, and an improved AAM algorithm is