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Multimodal Data Collection System for Driver Emotion Recognition Based on Self-Reporting in Real-World Driving

Geesung Oh [1], Euiseok Jeong [1], Rak Chul Kim [1], Ji Hyun Yang [2], Sungwook Hwang [3], Sangho Lee [3] and Sejoon Lim [2,*]

[1] Graduate School of Automotive Engineering, Kookmin University, Seoul 02707, Korea; gsethan17@kookmin.ac.kr (G.O.); euiseok_jeong@kookmin.ac.kr (E.J.); valance95@kookmin.ac.kr (R.C.K.)
[2] Department of Automobile and IT Convergence, Kookmin University, Seoul 02707, Korea; yangjh@kookmin.ac.kr
[3] Chassis System Control Research Lab, Hyundai Motor Group, Hwaseong 18280, Korea; gazz@hyundai.com (S.H.); imprince@hyundai.com (S.L.)
* Correspondence: lim@kookmin.ac.kr; Tel.: +82-2-910-5469

Abstract: As vehicles provide various services to drivers, research on driver emotion recognition has been expanding. However, current driver emotion datasets are limited by inconsistencies in collected data and inferred emotional state annotations by others. To overcome this limitation, we propose a data collection system that collects multimodal datasets during real-world driving. The proposed system includes a self-reportable HMI application into which a driver directly inputs their current emotion state. Data collection was completed without any accidents for over 122 h of real-world driving using the system, which also considers the minimization of behavioral and cognitive disturbances. To demonstrate the validity of our collected dataset, we also provide case studies for statistical analysis, driver face detection, and personalized driver emotion recognition. The proposed data collection system enables the construction of reliable large-scale datasets on real-world driving and facilitates research on driver emotion recognition. The proposed system is avaliable on GitHub.

Keywords: driver emotion recognition; multimodal; self-report; real-world driving

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1. Introduction

In recent decades, the use of data-driven state-of-the-art techniques such as deep learning has increased interest in and performance of human affect recognition [1]. This has increased interest in the development of driver emotion recognition systems. Since driving is significantly affected by the driver's emotions [2–4], driver emotion recognition studies have been conducted for various purposes such as driving safety, adjusting vehicle dynamics, and emotion elicitation of drivers [4–6]. All studies are affected by the quality and quantity of data. Therefore, research on quantitative and qualitative datasets for driver emotion recognition is being actively conducted [7–14].

Although large-scale and high-quality datasets are collected through various studies, the collection conditions vary significantly. First, the experimental environment is largely divided into simulation and real-world driving. Second, the modalities of collected signals are also diverse. When broadly classified, there are video, audio, bio-physiological, and controller area network (CAN) data. In detail, the position of cameras and microphones differ, and the collection list of biophysiological or CAN data is not unified. Lastly, the annotation of emotional states is various, which is critical for emotion recognition. The simplest way to classify a driver's emotional state is by driving experiments (e.g., assume that heavy traffic on the urban is high stress, and light traffic on the highway is low stress) [7–9]. There is also an approach in which external annotators judge a driver's emotional state based on the collected information about the driver. However, this approach has limitations in that it has