Emotional GaRage: A Workshop On In-Car Emotion Recognition And Regulation

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Abstract

In-car emotion detection, monitoring as well as emotion regulation have become an emerging and important branch of research within the automotive domain. With the shift from manual to autonomous driving, the focus of emotion recognition and regulation changes from safety to user acceptance. However, different emotional states can greatly influence human driving performance and user experience both in manual and automated driving conditions. The monitoring and regulation of relevant emotional states is therefore important to avoid negative effects, critical driving scenarios with the human driver being in charge as well as in autonomous driving with human passengers who want to feel safe and secure. In this workshop we want to discuss the empathic user interface research to address challenges and opportunities and to reveal new research directions for future work. This workshop provides a forum for exchange and discussion on empathic user interfaces, including methods for emotion recognition and regulation, empathic automotive human-machine interaction design, user evaluation and measurements, and subsequent improvement of autonomous driving experience.

Fig.1: Driver in a simulator with eye tracking and visible light camera. Which other sensors do we need to measure the driver's emotional state? Photo from DLR Braunschweig.

Fig.2: Dynamic driving simulator at the German Aerospace Centre (DLR). Photo from DLR Braunschweig.

Author Keywords

Emotion recognition and regulation; empathic vehicles; driver state assessment; user acceptance.

ACM Classification Keywords

• Human-centered computing → Human computer interaction (HCI); HCI theory, concepts and models*;* Interaction design

Introduction

Despite the advancements in Automated Driver Assistance Systems (ADAS), driving itself is still a complex and often challenging task. Accordingly, the main factor for car accidents is driver behavior, i.e., Human Factors. In addition, the issue of driver's emotions has received considerable critical attention lately. A growing body of literature recognizes the importance of emotions for driving behavior and performance. One of the emotions that occur most often in driving is anger [10, 13]. Previous research has shown that especially driving anger might lead to riskier driving behavior and increases speeding and smaller time headways [14, 11, 15]. While anger is well-researched, also other emotions significantly affect driving behavior. Jeon et al. show that not only anger, but also fear, depressed feelings, curiosity, embarrassment, urgency, boredom and relief are critical affective states that occur during driving [6]. In a follow-up study, it has been shown that even happiness degrades driving performance [7]. Jeon states that affect mechanisms influence attention, judgement and decision-making [5]. The influence of anxiety on driving performance is revealed in [2]. A broad overview over the influence of several emotions on driving performance can be found in [5].

Being able to measure emotions plays a vital role not only in manual driving, but for all levels of automation. In autonomous vehicles, confused (e.g. by HMI design) or scared (e.g. by the driving style) drivers could be supported if emotions are recognized on time. In semi-autonomous driving, the timing of the takeover request could be adjusted depending on the driver's emotions. Taking together this evidence, emotion recognition is crucial to ensure safety in manual driving. Additionally, it helps to increase user acceptance in terms of comfort in autonomous driving.

Research on in-car emotion detection has shown that it is possible to recognize frustration by camera and functional Near-Infrared-Spectroscopy (fNIRS) [4, Fig. 2]. Lee et al. recognizes aggression using infrared light cameras [8]. Additionally, evidence suggests that recognition of fear and amusement [9], anger and excitation [1], stress and anger [12] in the car are also possible. Sensors used for measurement include neuropysiological measurements (EEG, fNIRS), physiological measurements (ECG, Skin conductance, respiration rate, skin temperature, blood volume pressure, electrodermal response), cameras (visible light and infrared camera, eye tracking, Fig.1), speech (content and tone) and gripping force. While there are means of recognition, individually these methods may still fall short on accuracy. One solution is to combine these techniques. Another is to augment solutions from other fields such as machine learning techniques to develop accuracy over time.

As soon as an emotion is detected, appropriate countermeasures can be taken. In manual driving, options to counteract frustration and aggression are speech-based systems, playing music, or a massaging

function in the seat, to name a few. In autonomous driving, the countermeasures could be even more manifold. Solutions for anxious drivers could be to apply cognitive emotion regulation strategies, or to suggest relaxing movies and music from the in-car shop, or simply changing to an adapted smoother driving style, for example. These countermeasures are crucial for the user acceptance of autonomous cars and safety in manual cars. In this workshop, domain experts and novices from industry as well as academia will work together towards finding most relevant research questions and answers.

Goal

This workshop will examine the emerging role of emotions in the context of self and automated driving. To achieve this, experts from academia as well as industry will get together to reach a common definition of the current state of the art. Furthermore, relevant use cases and critical scenarios for emotion recognition will be identified. Depending on the outcome of that, it can be evaluated which emotions are the most crucial to recognize. For these, suitable means of measurement and counteraction will be found. The workshop aims to bring together multidisciplinary researchers and practitioners interested in driving emotion recognition and regulation. In particular, we hope to address experts from the field of emotion recognition, human-machine interaction, psychophysiology, emotion regulation, and traffic psychology. Through this workshop participants will share experiences and ideas, and discuss design and technology goals for the future. We will discuss prospective research directions and develop ideas on how to tackle them. Ultimately, a road map on how to continuously improve automotive HMI design by emotion recognition and regulation will be designed using a participatory approach. By highlighting methods for User Evaluation and pointing towards user experience as aspects of autonomous driving, this workshop fits the conference scope and is relevant to future automotive user interfaces.

Topics

The central aim of this workshop is to discuss different ways of emotion recognition and visions for emotion regulation in the automotive field. To do so, it is necessary to clarify a common vision of future mobility. Thereby, possible use cases of emotion recognition and regulation will be developed. In the following, emotions that essentially influence driving performance and user experience will be worked out. After assessing the best sensors to measure these emotions with, possible countermeasures will be discussed. In the end, there will be time to address which other questions urgently need to be answered in the context of emotional user interfaces. Examples would be how to identify semantics of feelings (e.g. find out why someone is frustrated), or the challenge of ensuring user acceptance of emotion recognition and regulation itself.

Outcome

Recently, emotion recognition has shifted into the focus of major players in automotive industry as well as academic research. Therefore, experts on the topic work in parallel on very similar research questions. By highlighting challenges and opportunities in the field, this workshop will pave the road to identify the following:

- relevant use cases and critical scenarios
- emotions important to recognize

Goal summary

- 9.00 – 9.30 Introduction *connect researchers with the common interest of emotion recognition and regulation*
- 9.30 – 10.00 WHY is the topic important? - *collect relevant use cases, critical scenarios and emotions important to recognize*
- 10.00 – 11.00 WHAT are we working on? – *insight into the current State-of-the-Art*
- 11.00 – 12.00 HOW are we solving the problem? – *which sensors to measure emotions with, and collect ideas for countermeasures*
- 12.00 – 13.00 WHAT IF this would become reality? – *collect research questions and how to tackle them; further interesting questions to ask; advertisement videos as a summary for other AutoUI participants*

- which sensors to measure them with
- ideas for effective countermeasures

A catalogue of these points will be collected in the course of the workshop. Altogether, participants will exchange knowledge on the current state of the art, get the chance to connect with potential future collaborators, and learn about important implications for future practice. After uniting AutoUI participants with the common interest of emotional User Interfaces by this workshop, we hope to establish the topic at AutoUI with the long-term vision to create sessions on the topic at future AutoUI conferences.

Schedule

The outline of the workshop is based on the 4mat System (Why, What, How and What if) [3]. Accordingly, the workshop is divided into four parts. The organization is aimed to host about 30 participants.

Introduction (30 min): After a short introduction of the workshop organizers, workshop participants will get to know each other by speed-dating (one minute per partner).

Why (30min): Driving scenarios in different automation levels will be studied to then examine which use cases for emotion recognition and regulation are present in each. The driving scenarios will be reenacted by e.g. body storming in smaller groups. In the following, emotions that would be most critical in these scenarios are collected per group. Then, use cases will be collected in a plenum with the whole group.

What (1h): Myounghoon 'Philart' Jeon and Ignacio Alvarez will each give a 15-20 minute keynote on their latest research. There will be a ten minutes time for questions and discussion after each.

How (1h): The group will be divided into five parts. Each group will identify measurement methods and countermeasures for one emotion (that was worked out as most important in the 'why' part). Each group will hold a five minute presentation at the end.

What if (1h): The relevance of the topic and future application scenarios will be combined to give an outlook on future research directions. Five concrete research questions will be collected and ideas on how to tackle them will be added. If there is time, a catalogue of further interesting research questions will be made. In the end, groups of five will make 'advertisement' (cell phone) videos on the topic. These videos will be made available for all participants of AutoUI 2018.

Presenter biographies

Esther Bosch is a Human Factors researcher at the German Aerospace Center (DLR) especially interested in driver emotion recognition. She studied Neural and Behavioral Sciences at the Max Planck Graduate Training Centre of Neuroscience in Tuebingen, Germany. In her previous research, she investigated on takeover time from highly automated to manual driving at Robert Bosch GmbH.

Michael Oehl is a senior Human Factors researcher at the German Aerospace Center (DLR) and a senior lecturer for Traffic Psychology at the German Police University. His research focuses on emotions in traffic and emotional interfaces in Human-Machine Interaction.

Myounghoon "Philart" Jeon is Associate Professor of Cognitive Science and Computer Science at Michigan Tech. He directs the Center for Human-Centered Computing at Tech. His research on AutoUI includes affect, auditory interaction, and accessibility. He has recently published a book, "Emotions and Affect in Human Factors and Human-Computer Interaction."

Ignacio Alvarez is Research Scientist at Intel Labs, USA. He obtained his PhD in Computer Science at University of the Basque Country, Spain. His background is in Human Computer Interaction. His research interest is on automated driving systems, intelligent transportation and the practical application of cognitive sciences to affective computing and ADAS.

Christophe Jallais Christophe Jallais is a senior Researcher at IFSTTAR, in Lyon, France, since November 2007. During his thesis, he studied the impact of emotions on cognition and the efficiency of the mood induction procedures. His research interests concern now 1) the impact of emotions on visuo-attentional processes and driving behavior, 2) the identification of drivers' internal states using physiological measures, 3) interactions between ADAS and drivers' emotions.

Wendy Ju is an Assistant Professor of Information Science at Cornell Tech in New York City. She was formerly the Executive Director of Interaction Design Research at the Center for Design Research at Stanford University. Her research focuses on interaction design in the realms of everyday robotics, autonomous vehicles, and interactive spaces. She also studies how novel technologies change the nature of the design process. She is a graduate of the Center for Design Research at Stanford University, and the founder of Ambidextrous Magazine, Stanford University's Journal of Design. Wendy has taught Interactive Device Design in Stanford's Electrical Engineering Department, as well as Physical Interaction Design at Stanford's Center for Computer Research on Music and Acoustics.

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