Emotion GaRage Vol. III: A Workshop on Affective In-Vehicle Display Applications

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ABSTRACT

Empathic in-vehicle interfaces can address driver affect and mitigate decreases in driving performance and behavior that are associated with emotional states. Empathic vehicles can detect and employ a variety of intervention modalities to change user affect and improve user experience. Challenges remain in the implementation of such strategies, as a broader established view of practical intervention modalities and strategies is still absent. Therefore, we propose a workshop that aims to bring together researchers and practitioners interested in affective interfaces and in-vehicle technologies as a forum for the development of displays and alternatives suitable to various use case situations in current and future vehicle states. During the workshop, we will focus on a common set of use cases and generate approaches that can suit different user groups. By the end of this workshop, researchers will create a design flowchart for in-vehicle affective display designers when creating displays for an empathic vehicle.

CCS CONCEPTS

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

KEYWORDS

Empathic vehicles, emotions, user experience, interaction design, human-centered computing, affective computing

1 INTRODUCTION

Over the past few years, in-vehicle display technologies and applications have expanded and addressed an increasing number of factors affecting driving response in road vehicles. In partially automated vehicles, in-vehicle interfaces can help drivers in taking control over the vehicle [1]. Affect is a major factor that has emerged and been shown to influence driving behavior and performance. Negative affect such as road rage [2] and anxiety [3, 4] can deteriorate driving performance, behavior, and attitudes towards automation technology. As such, empathic in-vehicle displays that can detect and mitigate affect have been developed to address affect in driving.

Affect detection and mitigation use a wide variety of displays and modalities. Skin conductance and heart rate are examples of physiological measures that can be taken to detect affect [5]. Speech and facial expressions are also discrete methods to identify affect in drivers, as software can be trained to determine affect through tone inflection and facial movements [6].

In terms of emotion mitigation technologies, interventions utilize a wide range of modalities to regulate vehicle occupant affect. Auditory cues such as speech and music [5, 7] can reduce driving anger and improve driving performance. Visual cues using visual notifications and ambient lights can also serve in mitigating sadness and anger [8]. Olfactory displays using the release of pleasant scents have also demonstrated their ability in improving driver affect and promote safer driving [9]. Thus, empathic vehicle displays are an important component of the wider in-vehicle system, motivating our efforts in organizing two previous iterations of the workshop on the topic of empathic in-vehicle interfaces.

During the first iteration of the workshop [10], experts sought to explore why empathic vehicle displays were important and the relevance of these displays to both current and future driving applications. A primary aim [11] of the empathic displays is to detect and mitigate negative affect that can influence driving performance, such as anger. In partially automated driving and beyond, empathic displays were envisioned to play a role in regulating driver and occupant confusion and frustration following interaction with the automated driving system.

During the second iteration of the workshop [12], the topic of who can benefit from empathic vehicle displays was discussed with experts in the automotive field. As vehicle automated technology increases and drivers switch to the role of vehicle occupants, access to mobility will be extended to a larger amount of people. Experts identified that, beyond general users [11], empathic display designers should consider different age groups in their work, since younger and older users will face different challenges and have specific needs. In addition, vulnerable users could benefit from the displays as well. Stress and anxiety in deaf users and individuals with other disabilities should be mitigated through empathic display modalities that fit best for their needs.

While experts developed use cases for a range of situations in both workshops, reasoning behind the choice of modalities and intervention methods given were limited in scope. As a wide number of intervention methods exist, the current workshop seeks to identify and develop alternatives adapted to user group characteristics found in the previous workshops.

2 GOAL

This workshop will work on developing different intervention methods of emotion mitigation for use cases that are relevant to affective in-vehicle displays. Experts from both academia and industry will ideate and discuss together to achieve this goal and brainstorm intervention methods. In this workshop, we seek to gather and bring the collective experience of multidisciplinary researchers and practitioners in automotive displays and systems to design practical approaches to addressing affective situations in non-automated, partially automated, and fully automated driving. Specifically, we seek to address the following key question: How can empathic in-vehicle displays be implemented to respond to affective events in vehicles? Through inviting experts from the fields of Human-Machine Interface (HMI), User Experience (UX), and Usability practitioners, we seek to provide an open forum for rapid prototyping of multiple multimodal empathic in-vehicle interfaces for each of the use cases we want to discuss in this workshop. Additionally, we seek to discuss preliminary expectations on the benefits of using different alternate empathic displays that will be developed over the course of the workshop. Finally, we expect our workshop to generate a variety of empathic display systems that can serve as practical design directions for the implementation of these types of displays in future automotive vehicle design, making this workshop fit the scope of the conference.

3 TOPICS

The central aim of this workshop is to brainstorm and develop in-vehicle empathic user interfaces for different targeted intervention approaches to important in-vehicle situations. To achieve this, we will build upon use cases from the previous iterations of the workshop [11] with workshop participants. Participants will have enough time to create storyboards and interface mockups.

4 OUTCOMES

Affect's influence on driving performance has been demonstrated in the past [13], as anger and happiness can significantly influence driving quality and behavior. This effect extends further to opinions on driving, as older drivers may exhibit driving cessation or defensive driving through feeling anxious [14]. Thus, empathic in-vehicle interfaces could significantly improve user experience for both drivers and occupants by detecting and mitigating affect, which will be the focus of experts from both academia and industry in this workshop. By developing upon a set of use cases, this workshop will achieve the following:

- Ideate empathic interfaces for use cases in both current and highly automated vehicles.
- Create prototypes and alternate empathic displays that can address in-vehicle affective incidents.
- Develop a design flowchart for empathic in-vehicle displays, depending on the type of emotion, situation, and degree of emotion mitigation sought after.

A catalogue of these points and results of the rapid prototyping activity will be collected over the course of the workshop. A report will be created and presented in the next Auto-UI conference based on qualitative analysis of insights from the workshop session.

5 SCHEDULE

We expect to conduct a half-day workshop with experts from the automotive field. The workshop session will be divided into the following parts, and will follow the 4mat system [15]:

Introduction (30 min): After a short introduction of the workshop organizers, a summary of the past two workshops will be presented. Workshop participants will familiarize with each other in small groups by completing a short activity. Participants will be able to post a picture and a short biography prior to the start of the workshop so connections could be made early.

Why (30min): Driving scenarios in different automation levels will be looked at. These scenarios will be derived from use cases developed in our previous workshop iterations [11]. Then, each scenario will be analyzed based on what emotions are relevant to the situation, and why differences in user groups and other characteristics could lead to some intervention approaches to work better than others.

What (45min): Myounghoon 'Philart' Jeon and Ignacio Alvarez will each give a 15–20-minute keynote on their latest research. There will be a ten-minute time for questions and discussion after each.

How (1h): Common intervention methods will be highlighted by organizers and participants together. Thereafter, the group will be divided into five parts. Each group will identify countermeasures for the scenarios presented by rapid prototyping. These prototypes will be presented in plenum.

Coffee Break (15min).

What if (1h): The relevance of the topic and alternative application scenarios will be combined to give an outlook on future design directions when creating an empathic vehicle. Arising research questions will already be collected throughout the whole workshop on post-its. Three of those will be picked out 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 why the topic is important and what we achieved in the workshop. Additionally,

the organizers will make a poster about the workshop's outcomes. The best video and the poster will be presented in the respective AutoUI sessions to reach a broader audience of potential interested researchers. By this, we hope to sustain the topic for future AutoUI conferences.

Discussion (20 min): Each team will present concepts created in the insight combination and rapid prototyping activity. Concepts will be discussed before the workshop organizers conclude the session with closing remarks.

All results will be written into a summary analyzed to be submitted to the next conference as a Work-In-Progress report. By this, we hope to sustain the topic for future AutoUI conferences.

6 ATTENDANCE

We estimate around 35 participants in total in our workshop (7 attendees per organizer).

7 SUPPORT

No specific hardware or software is requested for this workshop. We also plan to use sticky notes during the insight combination session.

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