AFFECTIVE COMPUTING AND AUGMENTED REALITY FOR CAR DRIVING SIMULATORS

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ABSTRACT

Car simulators are essential for training and for analyzing the behavior, the responses and the performance of the driver. Augmented Reality (AR) is technology that enables virtual images to be overlaid on views of the real world. Due to its capability to improve the perception of reality, to support teamwork, visual display of virtual objects, and to enable transitions between real and virtual environments, AR can be used to create novel interfaces for face-to-face and remote collaboration for training [2]. Affective Computing (AC) is the technology that helps reading emotions by means of computer systems [3][4][5], by analyzing body gestures, facial expressions, speech and physiological signals. The key aspect of the research relies on investigating novel interfaces that help building situational awareness and emotional awareness, to enable affect-driven remote collaboration in AR for car driving simulators. The problem addressed relates to the question about how to build situational awareness (using AR technology) and emotional awareness (by AC technology), and how to integrate these two distinct technologies [1], into a unique affective framework for training, in a car driving simulator.

INTRODUCTION

AR-based technologies for car driving simulators have the capability to lower cost access to expertise (by reducing the need to move experts to where their expertise is needed), and to increase the availability of expertise. This applies primarily to multi station driving simulators. AR technology can support new types of visualization and can help develop new learning experiences for the trainee. The whole driving simulation can be rendered using AR, using AR glasses, screens or windshield projections.

The trainee can be presented various stimuli taking the form of virtual representations. In addition, visual notifications can be presented, as generated automatically by the system or as specifically instructed by the expert. In addition to AR, reading driver's affect by AC has the capability to adapt the simulation given the affect state of the trainee.

Augmented Reality

AR [6] is technology that enables virtual images to be overlaid on views of the real world. Due to its capability to improve the perception of reality, to support teamwork, visual display of virtual objects, and to enable transitions between real and virtual environments, AR can be used to create novel interfaces for face-to-face and remote collaboration. For example, AR enables users to see virtual representations of remote people in front of them and have spatial interactions with them, as if being there in person.

Wearable computers and cameras can be combined with AR information display to support remote collaboration and significantly improve performance on physical tasks. However, new research on interaction paradigms, presence and situational awareness needs to be conducted to create an AR system that naturally collaboration and establishes virtual co-location. In this case, situational awareness is defined as the perception of a given situation, its comprehension and the prediction of its future state.

Augmented Reality-based driving simulator

Affective Computing

AC is a technology that "relates to, arises from, or deliberately influences emotions" [7]. Emotions guide cognition to enable adaptive responses to the environment, and can have a major impact on the perception, attention, memory and decision-making. Also, affect can have a significant impact on the driving behavior [10]. The affect reading by computer systems [3][4][5] is realized through the analysis of body gestures, facial expressions, speech and physiological signals.

Hybrid AR-AC for driving simuations

The research aims to find solutions to specific challenges regarding the integration of AC technology with the AR technology, with application in car driving simulations. The motivation is the lack of understanding on emotional awareness models in AR-based interactions between users and driving experts. Previous studies indicate advantages of combined AR and AC for different scenarios.

The research will address the following questions:

- What are the **best means for sensing and collecting affect data** from car drivers engaged in driving training sessions? Two sensing hardware will be investigated first, namely the Empatica E4 wristband and e-Health Sensor. Multimodal approaches for affect recognition will be studied.
- **How to build emotional awareness** among car drivers and the expert/the trainer? How to integrate and maintain emotional awareness?

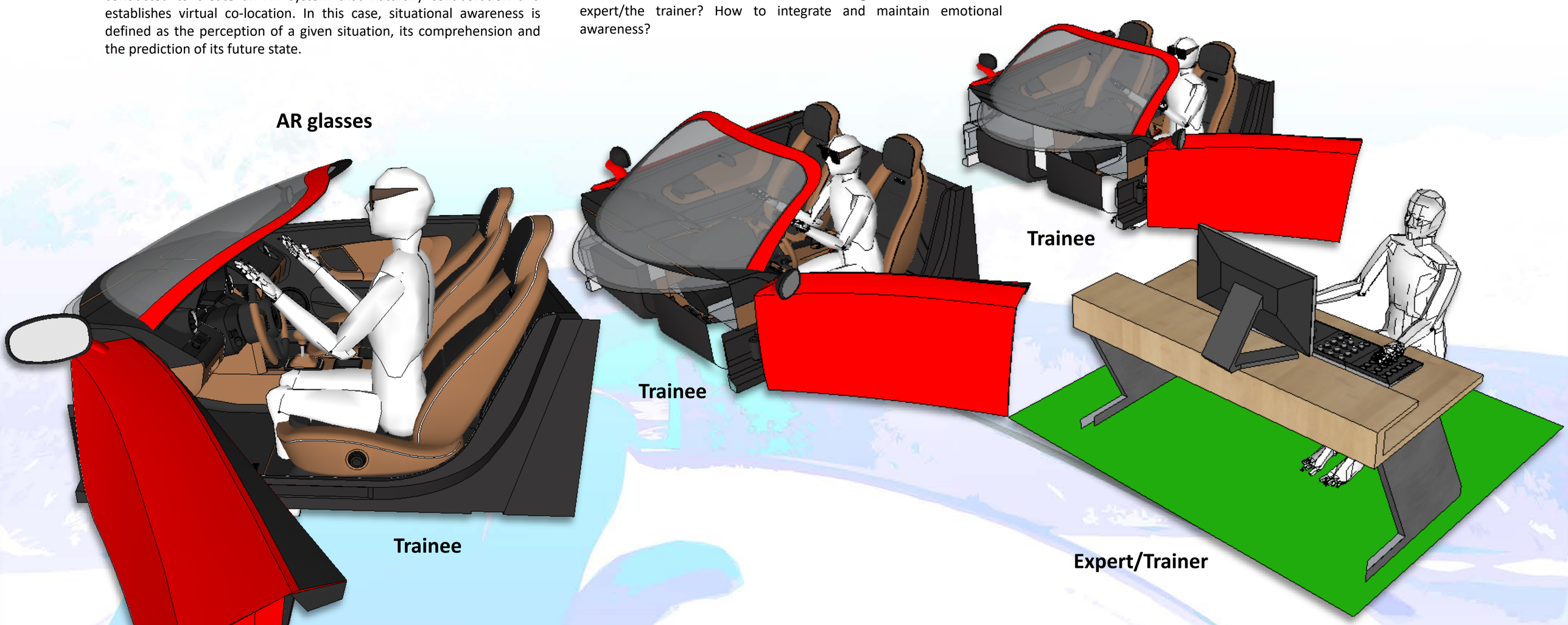
EPSON BT-200
optical see-through AR glasses

Empatica E4 wristband
physiological signal monitoring
https://www.empatica.com/e4-wristband

- **What driving performance model** can be built to automatically adapt the AR system support (such as the user interface, etc.) given the emotional awareness? Using this, for instance the AR-based simulation can be dynamically adapted according to the trainee's affect state, so that to increase the drive learning performance.

CONCLUSION

This is the first research to address the study on the role of affect in AR-based simulation. The research findings will contribute to a deeper knowledge on the integration of situational and emotional awareness, and the benefit for car driving training.



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