EMOTION RECOGNITION IN A CAR SIMULATOR

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1 INTRODUCTION

The automobile development in the near future is led by intuitive and natural, driver-car communication. Emotion recognition is therefore a key issue to enhance driver-car interactions. The recent improvements made in sensing technologies, allow accurate and non-invasive behavioural and physiological measures conceivable inside the car while driving. Furthermore, emotional state has decisive impacts on driving performance as "happy drivers are better drivers" [1] with important applications in safety. In this work, we discuss how emotions recognition through behavioural and physiological measures can be implemented while driving to improve driver-car interactions. In order to assess this feasibility, a pilot study will be first conducted in a car simulator with a scenario displaying realistic driving-related emotional situations.

2 STATE OF THE ART AND RESEARCH OBJECTIVES

The term emotion needs first to be defined. "Emotion" is indeed used to describe a wide range of states such as feelings, temperament, character or even mood [2]. In this study, the definition chosen was elaborated by Sander: an emotion is an organized response of the organism related to events that matter for the individual [3]. Emotions are commonly represented using two models, one based on the dimensional perspective, the second based on the classification perspective. The classification approach considers that emotions belong to categories. Plutchik proposed a categorical model with eight primary emotions (inducing universal and specific responses) and secondary emotions, a mixture of two primary emotions. Each petal of the model represents a category of emotion which intensity decreases as the

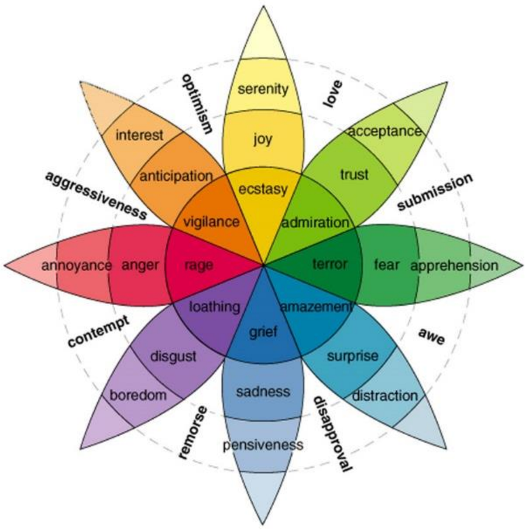

Figure 1 Plutchik circomplex model [4]

distance from the center of the flower increases.[4]

Russel's work in 1980 revealed the dimensional approach in which emotion are characterized by two dimensions. The first coordinate characterizes emotion according to the positive or negative emotional valence (levels of pleasure or displeasure). The second dimension corresponds to the level of arousal varying from allow level (calm, even inhibition) to high level (stimulation, excitement)[5]. Both dimensions are presented as independent in Russel's model, however a recent study on task performance in a driving simulator showed that arousal and valence are not perfectly independent [6].

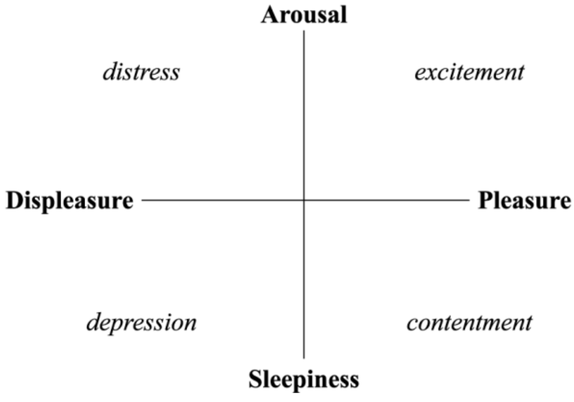

Figure 2 Russel circumplex model of affect [5]

According to Sander's definition, emotion trigger cognitive, physiological and behavioral responses. Many researchers have therefore looked for specific physiological patterns induced during an emotional response. Specific patterns were not found for all the emotions tested [7] but it appears that physiological patterns are context-related as all the studies do not converge towards the same pattern for a given emotion [8]. Moreover, emotions with a low arousal, such as confusion, may induce a strong cognitive response and a weaker physiological one. In order to detect the largest panel of emotions, physiological measures must be supported by other measures such as behavioral ones.

3 OBJECTIVES AND METHODOLOGY

In this study, we discuss how emotions recognition through behavioural and physiological measures can be implemented while driving on a simulator. The purpose of the study has been divided into two main objectives:

- Objective 1: evaluation of the protocol's relevance for triggering emotions.
- Objective 2: evaluation of non-invasive sensors ability to measure emotions while driving on a simulator.

We address these issues by implementing two scenarios on a driving simulator. Both scenarios are composed of the same emotional situations organized in a different order and last about 10 minutes. Each scenario is a succession of emotional situations and transitions. Four emotions are induced twice, so a scenario is composed of eight emotions and seven transitions. The participants drive during demo first to get used to the simulator and then drive while the scenario is displayed. Half the participants will do the experimentation on one scenario and the other half on the other scenario. Two scenarios are displayed in order to evaluate the influence of the previous situations on the response to the following situation and to minimize the amount of non-pertinent responses because of accustoming.

To qualify and measure the emotional responses, physiological and behavioral sensors are implemented. They are measured twice by intrusive and non-intrusive sensors. The non-intrusive sensor is used as reference to evaluate the non-intrusive sensor's performance.
The behavioral responses are analyzed based on video recordings of the driver and three signals from the car simulator (steering wheel and pedals).
In order to assess what emotion were actually induced, an interview is done after the driving.

4 RESULTS

The analysis of the data collected during the experimentation will be conducted according to the objectives of the study.

Step 1

In this step, the following methodology is followed to assess the objective 1. To do so, the percentage of consistency between the emotion induced by the scenarios (theoretical emotion) and the emotion actually felt by the participant is analyzed.

- Above 80% we will analyze that the protocol was able to induce the theoretical emotion
- Between 60% and 80% ameliorations points shall be found.
- Beneath 60%, we will analyze that the protocol wasn't able to induce the theoretical emotion.

Step 2

Further analysis of the measures of the sensors will then be conducted based on the emotion actually felt rather than on the theoretical emotions.

5 CONCLUSION AND PERSPECTIVES

The purpose of this study is to analyze emotions recognition through physiological and behavioural measures in a car simulator. Depending on the results, the non-invasive sensors could be validated or new sensors could be proposed. If the results are conclusive on the experimentation, the next step is to carry out this experimentation on the road.

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