Medical technology in smart cars

Project work of group 5

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Abstract

This document is part of our project in the course artificial intelligence at the Gjøvik university college. The paper describes the architecture and framework for a system to help elderly and/or people with chronic illnesses with detection and prevention of potential harmful incidents while driving a car.

Contents

1 Formal

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2 Introduction

Throughout this paper, we will design an AI system, which could later be implemented in a smart car application. The primary goal of the system is, to assist elderly or sick people during everyday driving situations in a car.
We begin this paper with a look on the state of the art in the area of in-car vital parameter monitoring, where we give a short overview and look at three system in a little bit more detail. In the following section we introduce our proposed system in more detail.

3 State of the art

Apart from systems designed to prevent drunk driving or systems with eye recognition to detect if the driver falls asleep, there are so far surprisingly few public used or commercially available systems in the area of in-car vital parameter monitoring. Therefore, we focus here on research done in this area. In [4], the authors research on the validation of electrocardiography (ECG) measurement in a car-integrated test framework.
In [5] the authors describe the relevance of the heart rate variability (HRV), extracted from the ECG, for driver workload detection in real world driving.
In [6] the authors describe the development and testing of a smart cart seat to measure vital signs with non-contact methods.
In the next three sub sections we describe the work in [1], [2] and [3] in more detail.

3.1 System 1 as described in[1]

In the paper "A Preliminary Study on Driver's Stress Index Using a New Method Based on Differential Skin Temperature Measurement" the authors describe the effects of long monotonous driving in a simulated session. Their architecture consists of several sensors, to measure different vital parameters like skin temperature, peripheral resistance and normalized pulse volume. As actuators they used a display for real-time monitoring and they saved the data for offline-analysis. The system itself only measures and presents the data, without taking further actions based on it.

3.2 System 2 as described in [2]

In the paper "Physiological parameters variation during driving simulations", the authors use a system of sensors to find correlations between vital parameters like galvanic skin resistance, peripheral temperature and heart rate variability to determine the psychophysical state of the driver. This is especially to detect sleep attacks and micro-sleeps. The architecture consists of several sensors for vital parameter measurement and the actuators consist of a display and several computers to see the data in real-time and to save the data for later analysis. Their long-term goal is, to develop a learning agent system which adjusts itself over time to the person usually monitored.

3.3 System 3 as described in [3]

4 Our proposed System

Our system, the smart car, is to assist sick and/or elderly people when they need to drive by regularly checking their health. To do so, we will implement sensors in the car to measure heart rate, blood pressure and skin resistance. By using the gathered data, the car calculates the stress level, the state of consciousness and the general health of the driver. With that, it can warn the driver to, depending on the situation, consider an appointment with a doctor or to call an ambulance. If the driver has to poor health, the car will first ask whether to call for an ambulance or not. If no answer is given, then it will call the ambulance anyway. If, once the call is made, the driver does not talk, the car will send the coordinate using the data from the GPS.

4.1 PEAS Description

Performance The car needs to be able to detect when the drivers state is harmful for himself and/or other (for example, if the blood pressure is too low there is a risk of losing consciousness) and to warn the driver of his condition.

Environment For this project, we only consider the driver, the car (which include all the built in material) and two external devices (heart belt and pressure sensor) which will be more developed in the next paragraph. The environment outside of the car does not influence this system and we assume that the data is not invalidated by the drivers clothes.

Actuators We have three actuators. First, a mobile phone which is built in the system. It will call the ambulance if needed. Secondly, speakers that are built in too. Were using the radio speakers. If the driver is listening to it, then the car will overwrite it in case of an emergency. Thirdly, an interface (touch screen) placed next to the radio that can display what the car said.

Sensors We have three sensors for medical data and two other kinds of sensors. For the medical data, both the blood pressure and the heart beats will be sensed using an external device. We will use a sphygmomanometer (blood pressure meter) for the blood pressure and a heart belt for the heart pressure. Those devices will be put directly against the drivers skin. As for the skin resistance, we will put the sensors on the stirring wheel. Supposing that the driver drives normally and without gloves, then we can read the data from the tip of the finger (which is the best). The last two sensors are a GPS, either built in the car or from a mobile phone, and the touch screen. The last one is used by the driver to interact with the car (for example when it asks to call for an ambulance).

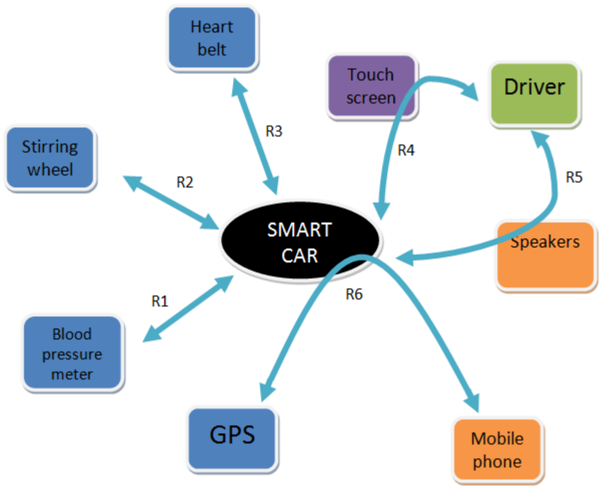

Figure 1: System Architecture

4.2 System architecture

Our system architecture is presented in Figure 1.

R1: The blood pressure meter gets the blood pressures data (sensor).
R2: The stirring wheel gets the data about the skin resistance (sensor).
R3: The heart belt gets the data about the heart rate (sensor).
R4: The driver gives his answer using the touch screen (sensor & actuator).
R5: The smart car informs the driver of his state using the speakers (actuator).
R6: The smart car calls an ambulance using a mobile phone (actuator). If needed, it uses the GPS coordinates (sensor).

Our systems main difference with the other existing project is that we reunite both the capacity to check the drivers health and the capacity to call someone (here, the ambulance). The combination of this two functionality as yet to be reunited in the same smart car.

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