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Abstract

Driver Position Measured Based on Textile Capacitive Sensor Array †

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Abstract: A woven textile capacitive sensor array fully integrated on a car seat is presented to detect the driver's position. The sensor array consists of two planar interdigital capacitive sensors located on the base and the backrest of the seat. With this sensor array, the position of the driver can be continually measured in real time with potential detection for events such as back detaching or buttocks displacement, which could indicate a risk of traffic accidents.

Keywords: woven; sensor; driver position; automotive; textile

1. Introduction

Sensors on car seats have been developed for years to provide the seat belt system with seat occupancy information to activate the alarm if the seat belt has not been fastened by the driver and/or passengers. This information has been commonly gathered by means of a Force-Sensitive resistor (FSR), although this sensor does not supply additional information such as the correct sitting posture during driving. Several works in the literature [1–4] present pressure sensors integrated into office chairs that could be used as a replacement for FSRs and also provide sitting posture information. However, these sensors are not fully integrated in textile seats. In this sense, the authors demonstrated the functionality of a fully integrated woven capacitive sensor for seat occupancy detection [5]. Based on this previous work, in this paper a textile sensor array is integrated on the base and backrest of a car seat to measure the driver's posture, providing useful information to prevent traffic accidents.

2. Sensor Array

The sensor array layout consists of 2 × 1 interdigital capacitive sensors centered on the car seat. One unit cell is located on the seat base; meanwhile, the other unit is located on the seat backrest. Both sensor units are measured continuously by means of a microcontroller to obtain information about the driver's position. Each sensor unit is based on the interdigital structure, which is integrated into the woven fabric structure. The sensor was manufactured using a commercial conductive Bekaert yarn. The thread was produced by the ring yarn method, in which the conductive stainless-steel fibers were mixed with polyester fibers in a proportion of 40/60%, as shown in Figure 1.

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Figure 1. Sensor array unit.

3. Results

Sensor values are gathered by a charge–discharge method and the microcontroller cycle count is used as the sensor value. Figure 2 shows the preliminary experimental results in four different cases: without a driver (Figure 2a), driver sat correctly (Figure 2b) and driver detaching from the back in two different cases (Figure 2c,d).

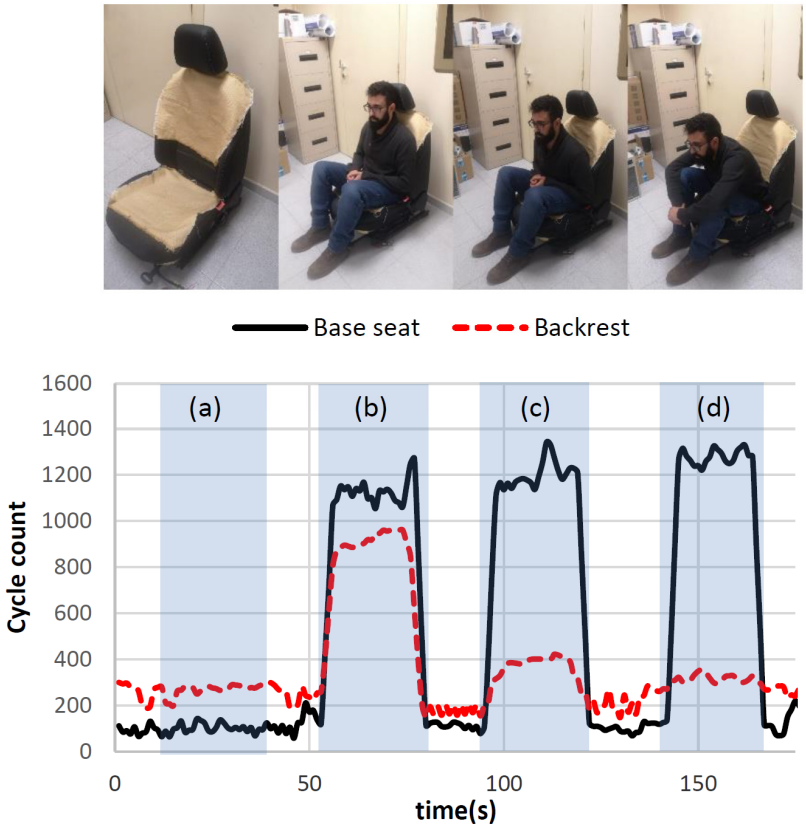

Figure 2. Experimental results for four different cases: without driver (**a**), driver sat correctly (**b**) and driver detaching from the back in two different cases (**c**,**d**). Continuous black line corresponds to base seat sensor and dashed red line corresponds to backrest sensor.

It is observed that without a driver, the capacitance of the base and backrest seat sensor corresponds to a cycle count lower than 300 (Figure 2a). However, both values increase by about 850 cycles when the driver is sitting correctly. In the case of detaching from the back, the base seat remains almost constant and the backrest seat sensor decreases, which denotes that the driver is not sitting correctly.

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