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# Design and Integration of an Elastic Sensor Sheet for Pressure Ulcer Prediction: Materials, Methods, and Network Connections †

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**Abstract:** This paper discusses the design and integration of an elastic sensor sheet for SENSOMATT, a smart device that predicts pressure ulcers caused by prolonged skin pressure. It covers the mechanical and electrical aspects of the sensor sheet design, including material selection, mould and tooling design, and network design. The paper describes testing of different configurations of the sensor sheet and various network structures. The final design of the sensor sheet is successfully constructed and tested, and the article provides a brief introduction to the printed circuit board design and manufacturing process.

**Keywords:** elastic sensor sheet; pressure ulcers; smart device; I2C network; pressure sensor; PCB design



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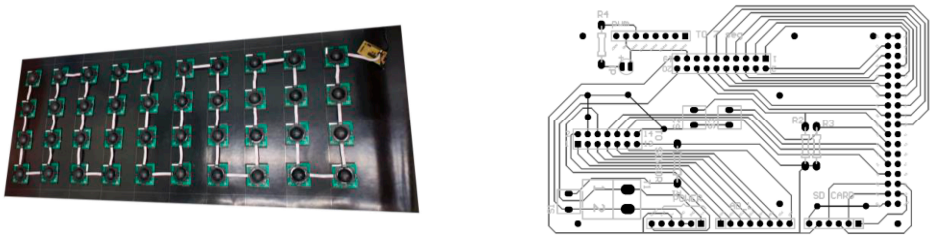
## 1. Introduction

SENSOMATT has a product that predicts pressure ulcers caused by prolonged skin pressure. The focus of the paper is on the design and integration of the elastic sensor sheet, which senses pressure changes and relays information to the master board for processing. The report covers mechanical and electrical aspects of the sensor sheet design, material selection, mould and tooling design, network design, and a brief introduction to printed circuit board (PCB) design and manufacturing process [1].

## 2. Materials and Methods

The development of the elastic sensor sheet involved careful study and testing of different pressure sensors, rubber materials, and network structures. The team used a rubber sheet as the base for the elastic sensor sheet, which had a 4 × 10 arrangement of 40 sensors connected to each other, as shown in Figure 1a, and they tested different configurations to determine the optimal size and arrangement. The electrical design and integration of the elastic sensor sheet included different types of networks and electrical structures, with an I2C network ultimately implemented. The article provides a detailed overview of the design and integration of the elastic sensor sheet for SENSOMATT, useful for those interested in developing similar smart devices [2].



(**a**) (**b**)

**Figure 1.** (**a**) Flexible sensor sheet with 40 × 10 sensors arrangement. (**b**) Master board PCB design to receive and analyze signal data.

## 3. Discussion

The article provides an extensive discussion on the design and integration of the elastic sensor sheet for the SENSOMATT product. The paper covers mechanical and electrical aspects of the sensor sheet design, including material selection, mould design, tooling design, and network design [3]. The article also provides a brief introduction to the PCB design (see Figure 1b) and manufacturing process, which is crucial for ensuring accuracy and preventing short circuits or incomplete circuits. The article offers different designs of sensor sheets and their network connections and describes the final network design, a custom-designed serial network compatible with the final sensor cell module. The paper is an essential guide for those interested in the development and integration of smart devices for predicting pressure ulcers [4].

## 4. Patents

The sensor cells being used in this research are registered in Portugal National Patent with no. 117507 and they are under PCT protection for international registration until with no. PCT/IB2022/059658.

**Supplementary Materials:** The following supporting information can be downloaded at https://drive.google.com/file/d/1Tkc0G6kyAzXbgnPAj7Au9uG-KOSClbY6/view?usp=sharing, Pressure sensors datasheets, Processor and processing units' datasheets, IC and micro controllers data sheet and architecture.

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**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the Polytechnic Institute of Castelo Branco (protocol code 36 CE-IPCB/2021).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are openly available in GitHub: https://github.com/rdionisio1403/PoPu/ accessed on 1 July 2023.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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