

A Seamless T-shirt Design with Textile-based ECG Electrodes, Respiration and Posture Monitoring Sensors

İrem Nur Yüncüler¹, Nada Al-azzawi², Uğur Ayvaz², Münire Sibel Çetin¹, Kadir Özlem², Aslı Atalay¹, Gökhan Ince² and Özgür Atalay^{1(*)}

¹ Istanbul Technical University, Faculty of Textile Technologies and Design, Istanbul, Turkey,
(*) e-mail: atalayoz@itu.edu.tr

² Istanbul Technical University, Faculty of Computer and Informatics Engineering, Istanbul, Turkey

Abstract: Wearable technologies with bio signal monitoring are growing interest day by day owing to their high degree of flexibility, comfort, reusability, and ability of continuous and long-term monitoring.

Adhesive, single-use electrodes are currently the most widespread ECG monitoring method. Nevertheless, they are not ideal for long-term monitoring since the conductive gel dries out over time, adversely affecting signal quality and frequently irritating the skin. Textile-based ECG electrodes are more user-friendly and less prone to skin irritation compared to traditional ECG electrodes since they are dry and non-adhesive. However, the drawbacks of textile-based electrodes are that they are more susceptible to a variety of conditions, including contact pressure, contact surface area and electrode location, which can affect the accuracy and dependability of ECG data recorded by e-textiles.

The aim of this study was improving the signal qualities and comfort properties while integrating the electrodes and strain sensors with seamless knitting technology. In this study, the integration of ECG, respiration and posture monitoring into the seamless t-shirt offers an easy-to-use, visually unobtrusive, comfort and continuous method for tracking vital health metrics and detecting abnormalities over extended periods.

Thanks to the textile-based capacitive strain sensors in the t-shirt, detection of the incorrect posture position that many people have today due to the reasons such as having sedentary lives is possible. Capacitive sensors were selected as not only they have higher linearity in comparison to resistive sensor but also their repeatability outperforms the resistive sensor's performance over an extended length of time.

Even though textile-based ECG electrodes have some prementioned demerits, better signal quality was obtained with this t-shirt design by comparing the single jersey, rib and pique knitting pattern trials. In addition to ECG signals, respiratory data can also be obtained from electrodes.

It has been observed that the t-shirt can be an alternative to the technology used today because of its adaptability to the human body and the advantages of

prolonged wearability and extended monitoring durations.

Keywords: textile-based electrodes, textile-based strain sensors, ECG monitoring, posture monitoring, respiration monitoring, seamless smart t-shirt.

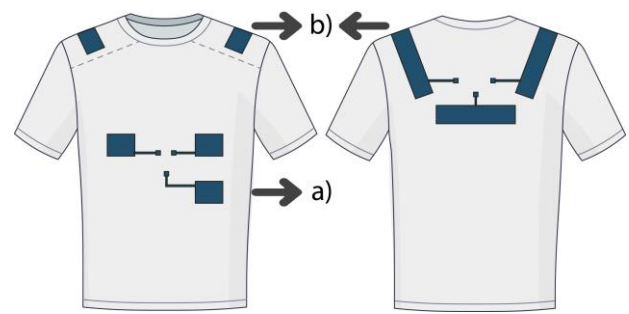


Figure 1 a) Positions of the textile-based 3-lead ECG electrodes, b) positions of the posture monitoring strain sensors.

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