THE CHALLENGES OF TEXTILE SENSORS IN COMFORTABLE WEARABLE HEALTH MONITORING SYSTEMS

Karin Rundqvist, Niina Hernández, Felicia Syrén, Anja Lund and Vincent Nierstrasz
Textile Materials Technology, Department of Textile Technology, Faculty of Textiles, Engineering and Business, The Swedish School of Textiles, University of Borås, SE-501 90, Borås, Sweden
karin.rundqvist@hb.se

This project aims to develop a wearable sensor system monitoring symptoms of epilepsy, Parkinson's disease and the rehabilitation progress of stroke patients. These neurological disorders are chronic conditions and in today's healthcare there is a difficulty in evaluating treatments, due to that the evaluation is based on the symptoms as described by the patient.(Dalton et al., 2012) Therefore there is an interest from the healthcare in an objective assessment tool making it possible to monitor the patient's symptoms and progress during a longer period of time and in the convenience of their everyday life. We aim to develop a wearable system that is accepted by the patients regarding the comfort and that is user friendly. The key challenges concerning the wearable sensor system are the integration of technology in a garment and the patient sensor interface.

To be able to get reliable data from the sensors integrated in a garment, a close-fitting garment is needed to avoid artifacts connected to movement between garment and body. Pattern construction and sensor placement are of importance (Cho and Lee, 2015) both with respect to comfort for the wearer and for noise reduction. Using 3D body scanning in combination with virtual mannequins, personalised wearable sensor systems that fit different body shapes can be developed, where also the sensors are correctly positioned.

Our wearable system is to monitor the heart rate, oxygen saturation, blood pressure and movements of the wearer. The focus of this paper is on fully textile sensors for human motion. Replacing conventional electronic sensors with textiles is expected to enhance the comfort of the wearer and facilitate integration into garments. It is also attractive to reduce the number of connections between soft textile and rigid electronics. One approach to realising movement sensors is to integrate electromechanical material, such as piezoelectric bicomponent fibres, creating structures that produce an electrical output in response to repetitive movements. Piezoelectric bicomponent fibres previously developed in our research group (Lund et al., 2012) are highly suitable for integration into textile constructions.(Rundqvist, 2014) We are currently evaluating a number of textile structures using these fibres, with respect to their sensitivity to movement. Further, the structures are being modelled using COMSOL Multiphysics, as a first step towards using FEM as a design tool in research and development of textile sensors.

In an ongoing interdisciplinary research project, wearITmed, partners from healthcare, electronics and textiles development (Sahlgrenska Academy, Acreo ICT, The Swedish School of Textiles, Swerea IVF and Medtech West) collaborate to develop a novel wearable sensor system for use in healthcare.

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Keywords: Wearable sensor system, textile sensors, motion sensing, 3D scanning, comfort, Comsol and piezoelectric.

References:

CHO, H. & LEE, J. 2015. A Study on the Optimal Positions of ECG Electrodes in a Garment for the Design of ECG-Monitoring Clothing for Male. *Journal of Medical Systems,* 39**,** 1-14.

DALTON, A., PATEL, S., CHOWDHURY, A. R., WELSH, M., PANG, T., SCHACHTER, S., OLAIGHIN, G. & BONATO, P. 2012. Development of a Body Sensor Network to Detect Motor Patterns of Epileptic Seizures. *Biomedical Engineering, IEEE Transactions on,* 59**,** 3204-3211.

LUND, A., JONASSON, C., JOHANSSON, C., HAAGENSEN, D. & HAGSTRÖM, B. 2012. Piezoelectric polymeric bicomponent fibers produced by melt spinning. *Journal of Applied Polymer Science,* 126**,** 490-500.

RUNDQVIST, K., NILSSON, E., LUND, A., SANDSJÖ, L. AND HAGSTRÖM, B. 2014. Piezoelectric Textile Fibres in Woven Constructions. *Ambience 1410i3m.* Tampere, Finland.

Corresponding author:
Karin Rundqvist
Textile Materials Technology, Department of Textile Technology, Faculty of Textiles, Engineering and Business, The Swedish School of Textiles and University of Borås.
Borås, Sweden
E-mail: karin.rundqvist@hb.se

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