Hochschule Niederrhein
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knetex

Abstract

The KneTex research project is concerned with the development of a textile-integrated sensor system for feedback-supported rehabilitation after surgery on the anterior cruciate ligament. The tear of the anterior cruciate ligament leads to anatomical changes of the knee structures, which is expressed as a biomechanical disturbance of the knee. This is perceived as a feeling of instability, which is also referred to as “giving-way” Phenomenon. The aim of this research project is the development of a knee bandage with integrated sensor technology for the identification of harmful movements and feedback function for the purpose of immediate correction of the incorrect movement.

Materials and Methods

The KneTex project is developing a smart knee bandage that identifies and localizes unhealthy movement patterns that can lead to "giving-way." The bandage system consists of sensors, actuators and a server to process the data. The bandage's textile-integrated sensors detect the position of the knee and the knee angle in the context of movement.

Three different knee angles (flexion/extension, internal/external rotation, varus/valgus) and the position of the knee are determined by Initial Measurement Units. The knee angle is measured using **piezoresistive, textile and elastic bending sensor**. The bending sensor consists of a carbonsilicone coated ribbon with metallic particles. Upon stretch and induced by the movement of the knee, the electrical resistance increases. The results give conclusions about the knee angle.

In addition, an actuator system is integrated into the KneTex Bandage, which provides direct feedback in the event of unfavorable movement patterns by means of targeted, initiated stimuli. The sensors and actuators are connected with flexible cable system which is embroidered by **Tailored Fibre Placement** process. The data from the combined system is transmitted in encrypted form via the mobile phone network to a server, where it is stored for the physiotherapist or doctor. The data is processed via a standard IT system.

Textile resistive stretch sensors

Tensile testing of the textile stretch sensor in terms of force, elongation and electrical resistance.

Figure 1: Zwick Roell 1455 tensile testing machine with insulation clamps for force, elongation, and electrical resistance measurement

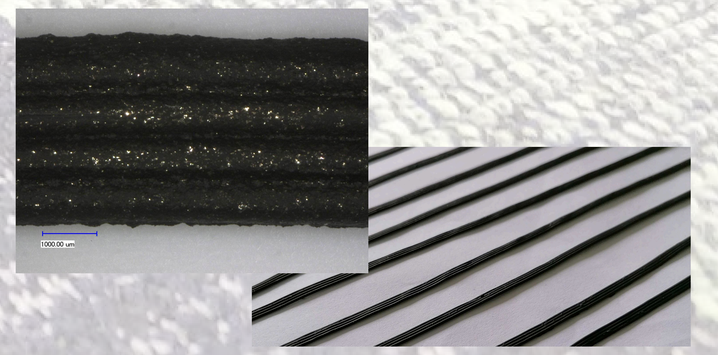

Figure 2: Carbonsilicone coated ribbon with metallic particles for resistive stretch sensing

Knetex prototypes

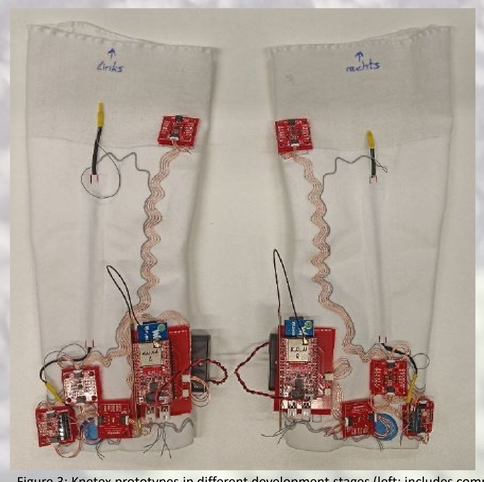

Figure 3: Knetex prototypes in different development stages (left: includes complete electronics; right: fanny pack version with selected electronics)

This project was funded by the European Regional Development Fund (EFRE-0801285).

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