Love Postoperative ECG T-shirt (II)

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Keywords: Postoperative garment, Smart clothing, ECG Holter Monitor, Smart T-shirt

Design statement

Ongoing cutting-edge multidisciplinary research in textile fibers, biomedical sensors, and wireless and mobile telecommunications integrated with telemedicine, aims at developing intelligent biomedical clothing (IBC) (Lymberis & Olsson, 2003). Around twenty years ago, smart clothing was introduced to overcome distance in order to get prompt access to medical knowledge and appropriate health care (Lymberis & Olsson, 2003). Related to heart conditions, management of postoperative electrocardiogram (ECG) monitoring becomes essential for continued good health. For this project, smart clothing was created aimed at developing solutions to support the management of heart disease as well as provide support for home care services. This smart clothing design is a two-layer raglan T-shirt with silver fabric sensors in the front lining that decrease allergic reactions and provides heart monitoring for long term optimum health.

Aesthetic Properties and Visual Impact

This ECG T-shirt is a functional garment offering, health benefits, improved appearance and increased comfort. The garment is more comfortable because the high adhesive factor of current commercial hydrogel used in ECG monitoring causes patients skin allergies and pruritus from wearing the hydrogel for a long time (Xiao, Wu, Zhou, Qian, & Hu, 2017). Additionally, since the sensors are attached to the lining of this two-layer raglan T-shirt, the exterior is smooth and makes the user tracking device inconspicuous. An individual can wear the smart garment like their everyday clothes.

Process, Technique, and Execution

The outer shell layer is made of 50% coconut charcoal and 50% polyester interlock (see Fig.1). Flat pattern was used to develop T-shirt and lining patterns. Serge was used to construct shell and cover stitches were used to finish hem. The coconut charcoal fiber is infused with activated carbon from coconut shells and provides moisture management, odor management and UV protection. The fiber is lightweight, comfortable and retain all product features, such as stretch and washability for a longer lasting product. Figure 1 presents the functions of coconut charcoal.

Fig. 1 Coconut charcoal fiber

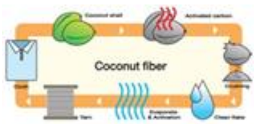
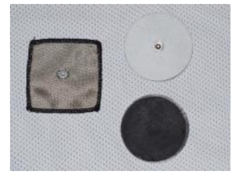


Fig. 2 Silver fabric vs. Traditional hydrogel (black is back view)



For the sensors, electronic textiles with silver fibers were adopted and sewn with zigzag stitches to replace traditional commercial hydrogel (see Fig. 2). The textile-based pressure sensor provides unprecedented sensitivity, excellent durability, a fast response, and a relaxation time based on highly conductive fibers coated with dielectric rubber materials. The conductive fibers were fabricated by coating polyester (styrene-block-butadien-styrene) (SBS) polymer on the surface of polyester (p-phenylene terephthalamide) (Kevlar) fiber, followed by converting a huge amount of silver (Ag) ions into Ag nanoparticles directly in the SBS polymer. The obtained conductive fibers have an excellent electrical property of 0.15 Ω cm –1 owing to the dense electrical connection of the Ag nanoparticles and the good stability against repeated external deformations of 3000 bending tests. By coating polyester (dimethylsiloxane) (PDMS) as dielectric layers on the surface of the conductive fibers and stacking the two PDMS-coated fibers perpendicularly to each other, a capacitive type of textile pressure sensor was successfully fabricated. The obtained pressure sensor exhibited high sensitivity (0.21 kPa −1), very fast response times in the millisecond range and high stability over more than 10000 cycles. The textile-based pressure sensor could be pixelated to matrix- type pressure sensor in the form of fabrics by using a weaving method and imbedded into the shell which was applied to wireless control machines as human–machine interfaces. The smart-clothing adapted with ECG types of sensors for health monitoring is a computing platform utilizing an embedded gateway, smart-phone, and back-end cloud servers designed for long-term sensors data collection and diagnosis. The platform enables wide-range of applications for health service based on smart-phones and cloud services (Lee et al., 2015).

The ECG Monitoring device (see Fig. 3) is adopted for this project. The execution of the APP for the ECG monitoring and smart phone output is also presented (see Fig. 4). Portable 3-Lead ECG Monitor, according to the diagram. A total of four silver-fabrics were sewn by four different color threads as electrodes to collect data. These electrodes were labeled: a) LA for Left side arm, b) RA for Right arm, c) LL for Left-Leg, and d) RL for Right leg (see electrodes' position in the Fig. 5).

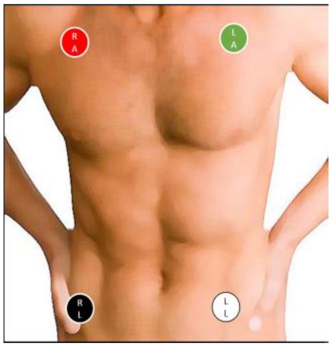
Fig3. ECG Monitor Device

Fig4. App Screen shot from smart phone

Design Contribution and Innovation

Intelligent biomedical clothing refers usually to clothes with sensors that are close to or in contact with the skin (Lymberis & Olsson, 2003). The sensors are enclosed in the layers of fabric, or it is the fabric itself that is used as the sensors-the more light we create. Such sensors can be silver yarns, optic fibers, and colored multiple layers. A two-layer T-shirt including: a) the first layer is the exterior T-shirt and b) the second layer bodice is the mesh that is sewn with silver fiber to collect data. With a normal outer layer appearance, patients can do normal daily activities. Figure 5 presents the sliver fabrics (electrodes) position.

Fig. 5 Silver Fabrics (Electrodes) position



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Materials: Shell layer -50%Coconut charcoal and 50%polyester, Lining: 100%polyester sport mesh; Electronic textiles -Silver fiber.

Date Completed: May/23/2018;

Measurements or **Dimensions:** Chest (1" below armhole):38” Front body length (H.S.P.):26.5”; Sleeve length (S.P.):12.5” Inside pocket (Length x Width) 2”x3.