Development of a new attachment method used for conductive textile

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Background

Running is a wide-spread activity which is recognised to improve overall health; however, its popularity brings the issue of many people getting injured during running activities. 660,000 cases of running related injuries out of the total 5.1million sports related injuries were reported in 2022 in the Netherlands[1].

To reduce the number of running related injuries, Movella, the motion capture technology company, and Saxion University of Applied Sciences are in collaboration to create a running garment made of e-textile, which will focus on injury prevention of the lower extremity of the body by giving haptic feedback to the runner using coin vibration motors. The project combines Movella's motion sensors to detect risks of injuries, and Saxion's expertise in e-textiles and user-centred design to notify the runner through haptic feedback.

Aim

One of the main difficulties of the ongoing project is creating a sturdy physical and electrical connection between the garment made from e-textile (conductive textile), and the vibration motors used to give feedback. The difficulty lies in the fact that the garment is flexible and follows the runner's body, while the vibration motors are made from rigid components. Another challenge lies in enabling the detachment and re-attachment of the vibration motors from the garment, which is important to aid the customisability of the locations where vibration motors can be placed. This not only increases the comfort of the user, but also facilitates easy maintenance of the vibration motors and the garment.

The role of this assignment is to describe and show how those challenges can be overcome through **the development of a method or a product** that enables a **modular**, **sturdy physical and electrical connection** between the vibration motors and the garment made from e-textile.

Approach

The process that was followed during the assignment started with background research to understand the context of use of the product, after which the technical possibilities were explored. Based on the gathered knowledge, new ideas were found through experimentation. These ideas were then prototyped, and finally the prototypes were evaluated through

[1] https://www.veiligheid.nl/sites/default/files/2023-08/cijferrapportage_sportblessures_2022_0.pdf last accessed on 15 September 2024

functionality testing conducted in a lab and usability testing with potential users. This approach is visualized in Figure 1.

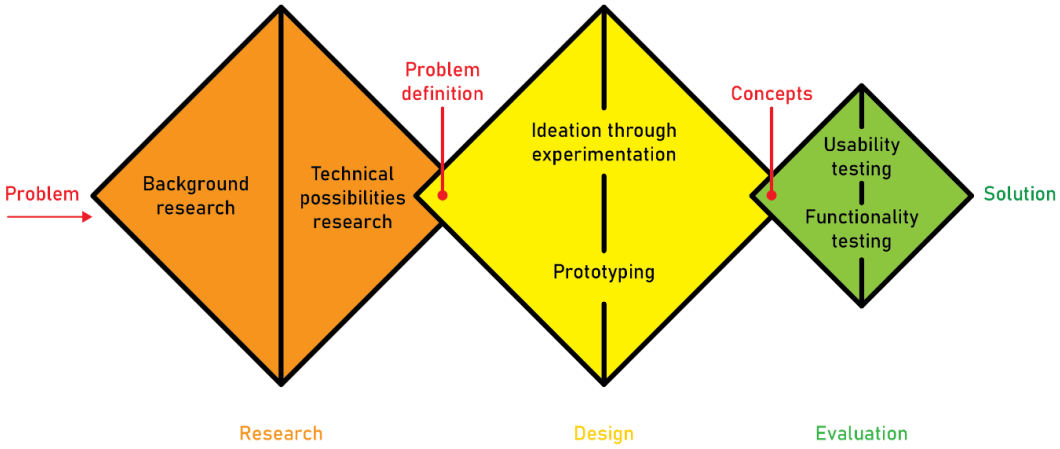

Figure 1. The design process that was used during this assignment

Results

By researching the most user-friendly locations on the human body for vibrotactile stimulation, best places to attach wearables, and attachment methods found both in nature and in people's everyday environments, a product that encases a coin vibration motor was created. Throughout the design process, the user was taken into consideration, which is reflected in the fact that product uses modified already existing attachment methods to assist the users in understanding how the product works and should be attached to the garment made of e-textile. Multiple ideas were prototyped, and three concepts were functionality and usability tested. These prototypes were the Lego brick (Figure 2), the Pins (Figure 3) and the Brooch (Figure 4) prototypes.

Figure 2. Lego brick prototype

Figure 3. Pins prototype

Figure 4. Brooch prototype

The results of the tests favour different prototypes. In terms of usability, the Lego brick prototype performed the best, while in terms of functionality the Pins prototype excelled. Nonetheless, evaluating all prototypes against the requirements, the Lego brick prototype was the most effective. However, this concept should be enhanced based on the feedback given by the participants to further increase its user-friendliness. This can be done via design changes such as adding visual/audio/tactile feedback when the product is secured on the garment or adding tactile markings to show where to unclip the product from the garment. Additionally, the functionality of the product needs to be improved based on the conclusions that were drawn after the functionality testing. A way of achieving this is to combine the Lego brick and the Pins concepts into one to create a new attachment method that incorporates the best aspects of both.

The attachment methods that were created can be used to attach vibration motors to a running garment made of e-textile, thus, the collaborative project between Movella and Saxion University of Applied Sciences can move forward. Once the attachment methods are improved, it is possible to potentially attach other electronic modules as well to e-textiles, besides vibration motors. Therefore, in the future, using the attachment methods that were created during this assignment, the running garment could incorporate motion sensor modules, heartrate sensors, LEDs and other technologies that could be useful for the runner. Moreover, the attachment methods could be utilised for garments used in other activities as well, not only for running. This way a standardised suit could potentially be created, that can change its functionality depending on what modules are attached to it, thus, enabling the same suit to be used for running, sports, rehabilitation, navigation and so on.