ROBOTIC TEXTILE AS COACH FOR CHILDREN WITH DYSFUNCTIONAL BREATHING

Implementing Motivation through Design

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This thesis is part of the collaboration between fashion designer Hellen van Rees, the University of Twente and the MST. The aim of this collaboration is to design a working prototype of a wearable breathing trainer in the form of a vest that can train children aged 6-12 years with dysfunctional breathing to normalize their breathing pattern.

> *NOTE: Dysfunctional breathing is defined as chronic or recurrent changes in the breathing pattern treatable with physical therapy (Barker et al. 2015; Morgan, 2002). Children with dysfunctional breathing suffer for instance from chest pain, chest tightness, hyperventilation and breathlessness during exercise (Thomas et al., 2003; de Groot, 2011).*

Starting point of this project is the square-like shape changing textile developed by Hellen van Rees. The flexible textile consists of squares made of recycled textile fibres. Through a unique approach the different shapes can move and respond to each other, creating a flexible, expanding and contracting surface *(see figure 1).* When adding technology to the shape-changing textile, a robotic textile is created. This robotic textile offers the possibility to create a different way of feedback providing a tactile experience with generating varying levels of pressure.

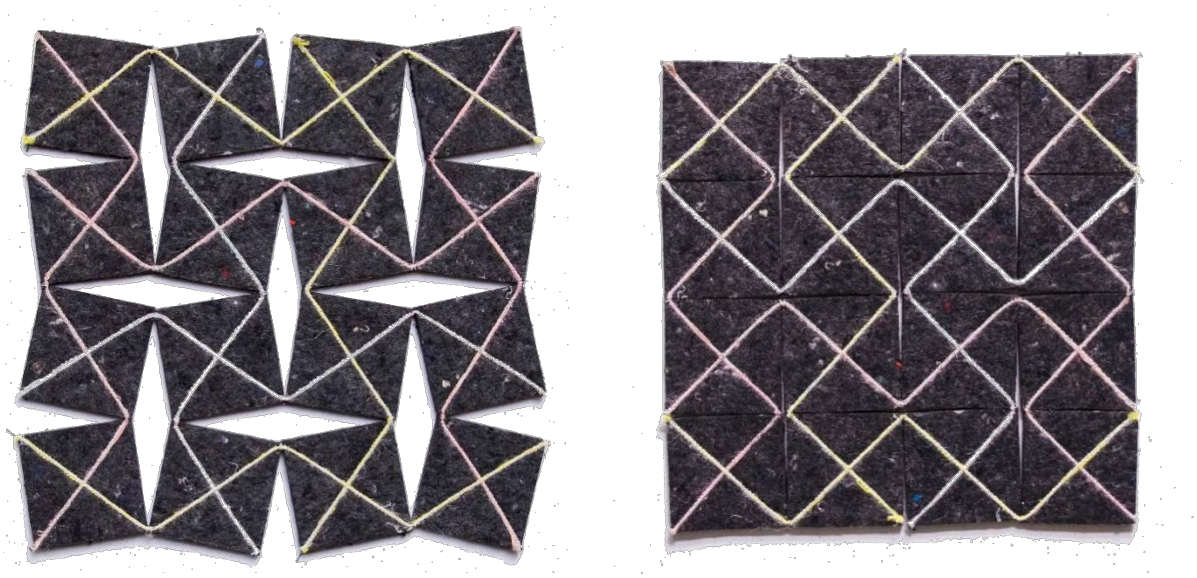

Figure 1: Robotic textile expanded - contracted

The possibilities of the robotic textile led to the idea to use this textile as coach for children with dysfunctional breathing during the breathing retraining. Within this project, the present thesis scrutinizes the interaction of the wearable breathing trainer with the child wearing it.

The goal of this assignment was to develop a conceptual design of the breathing trainer with a focus on use and motivation for children. This conceptual design will be combined with the design of the prototype vest by Hellen van Rees. The aim of this assignment was to find an answer to the following question:

To what extent could motivation be integrated in the design of the breathing trainer to obtain a sustained use throughout the therapy?

The design process consisted of an analysis phase, ideation and conceptual phase which resulted in prototypes of the developed conceptual design. For this process, the approach to develop the conceptual design from theories of motivation in therapy was chosen. The motivational framework was derived from the SCOPE-IT model and the related Rocket Motivation Model (Poulsen et al., 2013). The central element of this framework is the fulfilment of the physiological needs Autonomy, Competence and Relatedness to obtain intrinsic motivation. With the implementation of game elements, a way was found to address these needs through the design. From this theoretical foundation a set of design guidelines was derived. These guidelines were considered during the further exploration and design of a concept for the breathing trainer.

The ideation resulted in a concept combining the vest with a mobile application due to its possibilities of implementing game elements supporting intrinsic motivation. The vest with its sensory feedback supports the child during a training session with information on the performance. Whereas the application stimulates a continuous use afterwards by offering choices, goal setting and a meaningful story *(see figure 2).* Vest and application are linked with an interaction based on the visual feedback.

Figure 2: Concept of the breathing trainer

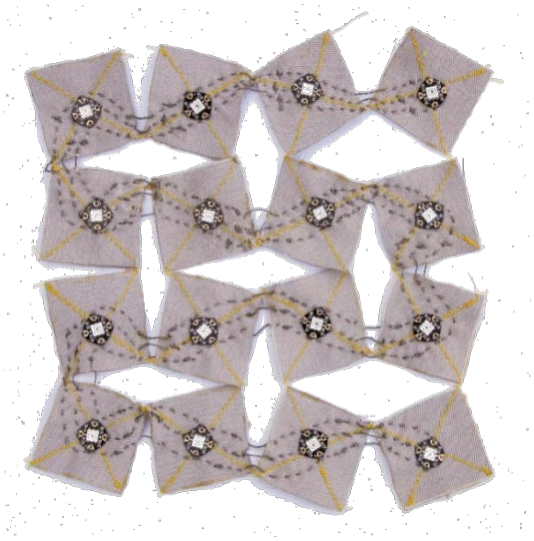

Figure 3: Light matrix with sewable LEDs

Within the conceptual design, the focus was on the implementation of sensory feedback in the vest, the interaction between vest and mobile application and the structure of the application. The sensory feedback in form of the tactile robotic textile and visual light *(in form of a matrix)* guides the breath resp. provides feedback on the performance. The application then visualizes the progress over time in form of a mission in space. The link between vest and application is the light obtained during the training. Within the application, the light has the function to drive the rocket and the mission. As interaction between vest and app it was chosen to "collect" the light with the smartphone via Near Field Communication (NFC).

The interaction prototype is based on an Arduino microcontroller with NFC shield and sewable LEDs *(see figure 3)* in combination with a simple Android application indicating the light transfer. For the mobile application, a simple click-through prototype *(see figure 4)*.

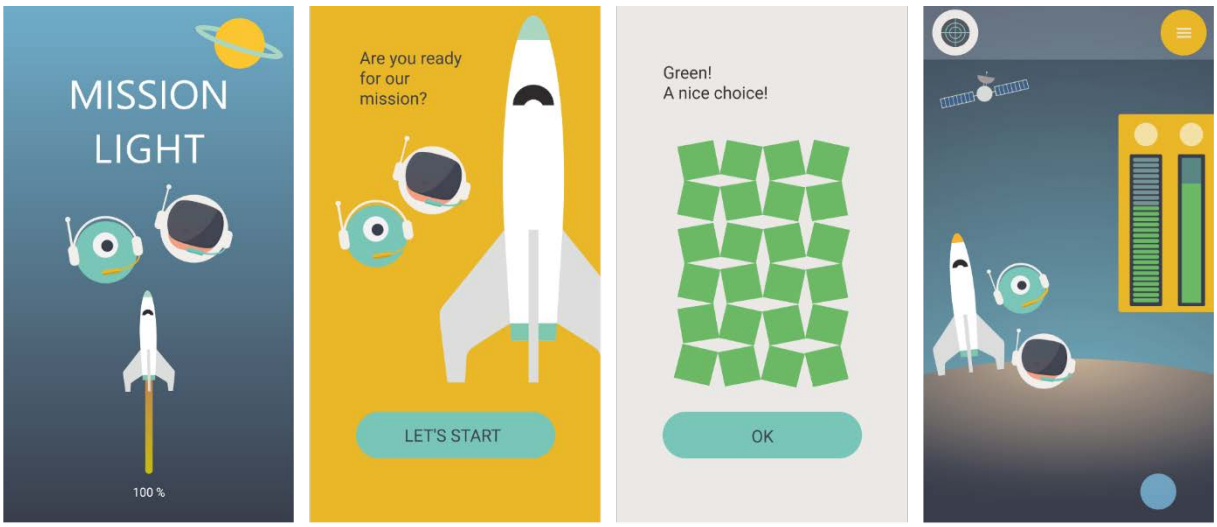

Figure 4: Screens of the click-through prototype of the application

With these prototypes, the user experience will be tested in the following stage of this project to refine the conceptual design. After the evaluation with a child physiotherapist it is already evident that this concept has the potential to complement the therapy of breathing retraining with its motivational and feedback elements.

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