Re-FREAM

Re-Thinking of Fashion in Research and Artist collaborating development for Urban Manufacturing

Work Package WP 5

Hub "Electronics and Textile"

Deliverable 5.2

Report on State of affairs in Re-FREAM m1-m18

(Activity Report)

Grant agreement no.:	**825647**
Call identifier:	**H2020-ICT-2018-2 – ICT-32-2018 – STARTS**
Objective:	**The Arts stimulating innovation**
Start date of the project:	**01.12.2018**
Duration	**36 month**

Due date of deliverable: 31.08.2020

Actual submission date: 31.08.2020

Lead Beneficiary for this deliverable: IZM

Contributions by: Ivan Parati, Jessica Smarsch and Giulia Tomasello

0.1 Purpose and Scope of Deliverable D5.2

This deliverable reports on the results of first call 2019 for the Hub Berlin. Two e-Textile and one Eco-Design demonstrator have been co-created with the awarded projects Lovewear (by Team Witsense), Constructing Connectivity (by Jessica Smarsch) and Alma (by Giulia Tomasello). Due to the COVID-19 situation the co-creation phase paused in spring 2020 for 3 months as travelling was not possible and date of this deliverable has been adjusted accordingly.

1 Work progress and achievements during the period (month 1-12)

1.1 WP 5: Hub "Electronics and Textile"

Fig. 1: Hub Berlin members with granted artists from the first call 2019 at Fraunhofer IZM Sart-A-Factory facility. Upper row from left to right: Tommaso Busolo (Alma), Dr. Agnieszka Psikuta (Empa), Christian Dils (IZM), Jessica Smarsch (Constructing Connectivity), Dr. Max Marwede (IZM), Tapani Jokinen (IZM), Ioana Puscasu (WearIT); Lower row from left to right: Ivan Parati (Witsense), Giulia Tomasello (Alma) and Thomas Gnahm (WearIT).

The Berlin hub received 24 applications. All projects were assessed according to the evaluation criteria and the best 6 projects were passed on to the jury, which selected the 3 winners.

The 3 projects are assigned as follows:
E-Textile Challenge: Lovewear & Constructing Connectivity
Eco-Design Challenge: Alma

Due to the COVID-19 pandemic, all 3 projects were paused in March 2020 and, after consultation with the EU project officer, extended by 3 months until the end of August 2020. This made it possible for all partners to meet the time of attendance in the Hub Berlin and to finalize the projects.

Since the Textile Prototyping Lab (TPL) was looking for a new physical location in Berlin during the project and was not available, we connected the artists with Start-A-Factory, the hardware incubator of Fraunhofer IZM, and set up a workplace there for the entire duration of the project.

1.1.1 Project Lovewear

Overview

The project objectives were to conceive, design and manufacture a system that would empower hands movement impaired to explore autonomously their intimacy. The system is composed of an underwear garment, a detachable device, a wireless connected pillow and a phone app.

The System

The underwear comprises the following parts:

- Knitted textile part that integrates pocket and hollow channels
- series of heat sealed inflatable chambers
- a support pad for a detachable device embedded into the textile
- tubes and connectors that distributes airflow among the chambers

Detachable device incorporates the followings:

- PCBs for communication and control
- electrical equipment to generate and distribute airflow through miniaturized solenoids valves, miniaturized pumps and a custom manifold
- battery
- a hard shell that contains all the equipment
- a belt that helps keeping the device comfortably close to the body

The pillow comprises the following parts:

- a communication and control PCBs with sensitized pads to detect human interaction
- a foam padding
- a knitted textile cover

The phone app comprises the following functions:

- pillow interaction detection & controlling of device functionalities

The Workflow

The work has been brought forward following several parallel strategies that in the end converged toward a unique objective and outcome. These main following objectives where integral part of the project since its beginning.

- Involvement of a disability sexologist to create distribute and interpret questionnaires within 3 different languages groups. Recruiting significant cases for an interactive series of focus group. Reporting through a profiling document, different user case and scenarios.
- Co-creation phase with Fraunhofer scientists. The core of the collaboration was the integration among textile and the technology used, the inflation. The achievement of the objective was determined by an accurate testing and selection of materials and manufacturing processes to ensure the reliability of the techniques used. Co-creation at Fraunhofer also included some phases of eco-design benchmarks validation in order to determine the proper market positioning and product lifecycle.

- Collaboration with an electrical engineer to design, manufacture and program the system device.
- Collaboration with a mechanical engineer to determine components specifications and to design, manufacture and test parts of the system that comprises the entire electronic component including airtight connectors and a channel distribution manifold.
- Collaboration with an innovative manufacturing establishment that produced the knitted elements using an innovative typology of WSK (warp seamless knitting). In this way the textile was produced in one phase without the need of further complex stitching and refinement.
- Collaboration with a graduation student in biomedical engineering to determine user cases, materials, processes to be followed during development and production and use of a digital fashion software that could help exploring inflation dynamics and predict in an accurate way the deformation of inflated textile chambers. Determine wearability requirements of the assembled product.

Fig. 2a: The underwear that includes the inflatable chambers.

Fig. 2b: The Lovewear system with the pneumatic underwear and pillow interface.

Fig. 3: The pneumatic controller box.

Fig. 4: The inflatable chambers placed on the knitted underwear.

The co-creation process was conducted by expert from different fields:

Emanuela Corti, Ivan Parati; Project's assistants: Aesun Kim, Valeria Serra; Fraunhofer IZM: Christian Dils, Max Marwede, Robin Hoske; Empa: Agneszka Psikuta; Psychologist: Paola Tomasello; Mechanical engineers: Ali Mohammed Zulfikar Tinwala, Sarfaraz Ahmed; Electrical Engineer: Emil Oommen Varughese, Hub management: WearIT Berlin and Textile Manufacturer: Cifra.

1.1.2 Project Constructing Connectivity

The co-creation research performed by Jessica Smarsch and Fraunhofer IZM partner Christian Dils focused on the integration of textile-based sensors (TexPCBs) into clothing for the functional purpose of gathering EMG data for stroke rehabilitation. Sensitive considerations were also made in the design of the garment to enhance the wearer's experience with the system. Many external partners were also involved in the research, which culminated in a 2-day Stakeholder Workshop, facilitated by Fraunhofer IZM partners Max Marwede and Robin Hoske. The garment design was developed in collaboration with The Knitwear Lab and Paula de Andrés of POL Studio. The design for the external processing module is based on new developments from ItoM-Medical. Physiotherapeutic guidance was received from Han Franck of Adelante Rehabilitation Centre.

Fig. 5: Textile tracks, sensor, substrate and electronic module for measuring EMG data.

Fig. 6: Constructing Connectivity demonstrators.

Fig. 7: Constructing Connectivity demonstrators inside out.

1.1.3 Project Alma

Alma is a wearable biosensor designed to monitor vaginal fluids. The Alma project strives to support and educate women about their intimate health through technology. A team of designers, anthropologists, scientists and engineers has co-developed with the Re-FREAM science and technology partners, Fraunhofer IZM and Empa, a new type of underwear capable of measuring vaginal fluid pH. Quantifying vaginal chemistry is an important step to close the medical gender gap and raise awareness about the female body. The entire design process was driven by the data and insights from the Alma meets Flora survey and co-design workshops held in the first phase of the project.

The Alma Demonstrator showcases the 'live' measurement of the vaginal fluid pH using newly developed smart underwear. The pH will be measured using the textile sensor integrated in the gusset and the data will be wirelessly transmitted to a phone.

Fig. 9: Alma with BTLE module.

Fig. 10: Alma with embroidered antenna for energy harvesting.

Fig. 11: Alma with laminated 2-layer TexPCB antenna.

Fig. 12: Textile ph-sensor made of an embroidered reference electrode (left) and working electrode (right).

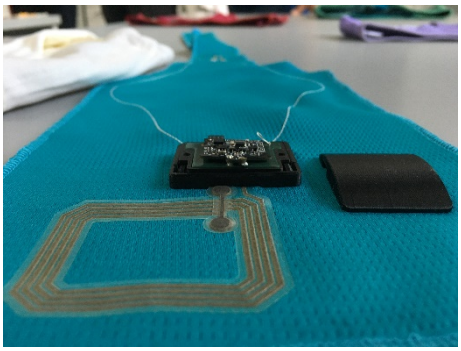

Fig. 13: Textile-integrated antenna and detachable electronic module with 3-D printed housing.

Alma Team collaborated with Christian Dils, Max Marwede, Raphael Marius Mgeladse, Robin Hoske, Sigrid Rotzler, Pauline Stockmann and Tobias Schmidt from Fraunhofer IZM Institute (Berlin); Agnes Psikuta and Simon Annaheim from Empa Institute (St. Galles); Ioana Puscasu and Thomas Gnahm from Wear It (Berlin).

Alma Team: Giulia Tomasello, Tommaso Busolo (University of Cambridge), Ryo Mizuta (University of Cambridge), Isabel Farina, Silke Hofmann, Julia Jover Cano (Central Saint Martins), Eve Barro (Imperial College), Tauras Stalnionis, Beatrice Bertolazzi and all the Females that participated to the workshops and online survey.