AGEDESIGN

The project

The project consists of a joint research activity (Veneto-Salzburg) in order to define, develop and test new products and services for ageing people. The goal is to provide in the near future suitable tools to improve and preserve health and wellness of elderly people and to safeguard them from physical and psychological problems. Such new future tools smartly integrate existing technologies at affordable prices, are deeply interconnected and easily wearable.

Joint Research

In the long term the objective of the project partners is to originate and maintain innovative, long term research on devices that can help improvement and preservation of health and wellness for elderly people. This through cooperative University type research efforts and joint research activities. A regional cross-border network for applied research that includes companies and technological start-ups. The QUALIFE DESIGN platform "the platform where projects and production meet each other" (http://www.qualifedesign.eu), was created within the project with the aim of favouring sustainable cooperation among cross-border organisation on the topic.

The partners

- Fondazione Centro Produttività Veneto CPV
- Università IUAV di Venezia
- Azienda ULSS n. 1 Dolomiti -
- Salzburg Research Forschungsgesellschaft
- Paris-Lodron-Universität Salzburg

Scenario: Home based Long Term Care in Italy and Austria

A minority of persons in Austria receive care in their private environment with the help of live-in care providers, which are often from neighbouring countries such as from Eastern Europe. They work 24 hours/7 days per week. Currently this kind of care is organised by agencies and NPOs. Challenges in Austria In 2020, the province of Salzburg will face a 10 % lack of professional caregivers (Rottenhofer et al., 2013). Regarding the increasing demand in home based services, issues of providing adequate care will be raised

While the primary care system has served its role up to now, Italy now faces a demographic and epidemiological shift with a growing ageing population and a rising burden of chronic conditions. The share of the population aged over 65 years in 2011 was the third highest among the OECD countries and it is expected to grow 1.7 times by 2050. This inevitably implies an increased prevalence of chronic illnesses and long-term conditions. Comparative data strongly indicates that community, long term care and preventive services are underdeveloped in Italy compared to the other OECD countries. Italy spends less than one-tenth of what the Netherlands and Germany spend on preventive care, for example, and has the lowest share of long-term care workers (as a share of the population aged 65 years or over) in the OECD. Italy should without delay place chronic care management and prevention at the forefront of the health care system.

The LTC system in Italy is characterized by high level of institutional fragmentation, as sources of funding, governance and management responsibilities are spread over local and regional authorities, with different modalities.

Long-term care in Europe can be clustered in 4 clusters (Styczynska, 2012):

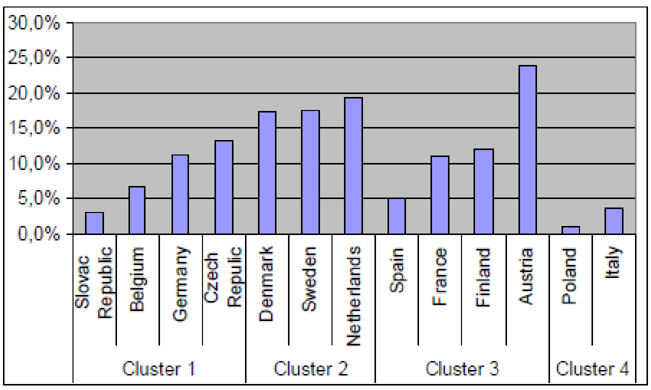
• Cluster 1: includes mainly continental countries (Belgium, Germany, Czech Republic and Slovakia) and is characterized by its orientation towards informal care (IC) provision with IC support. Additionally, low spending on formal LTC, low private funding and modest provision of cash benefits describe this cluster.

• Cluster 2: inherits Scandinavian countries (Denmark, Sweden) and the Netherlands. The LTC systems are generous, accessible and formalized. The public sector has a greater role and offers high provision of formal LTC. Informal LTC is low and cash benefits have a small role in these countries.

• Cluster 3: is intermediate between cluster 1 and cluster 2 and consist of Western European countries (Austria, France, Spain), England and Finland. The system is oriented towards IC with high level of support. The public spending on formal LTC is medium; cash benefits and private funding are high.

• Cluster 4: describes LTC system in Poland and Italy. It is characterized by low public spending on formal LTC, low support of IC, medium cash benefits and high level of private financing.

The following graph shows received formal care (65+) 2009 per country.



The products of the Project AGEDESIGN are meant to improve independent living. The devices will increase the impact of the AGEDESIGN model to reach a wider audience of seniors and to support a process of behavioural change for active and healthy living lifestyles therefore preventing diseases and maintaining healthy conditions.

THE AGEDESIGN JOINT RESEARCH

The project starts from the definition of four research lines, then collected in three main issues to address considering the state of art of elderlies' lifestyle in both Italy and Austria. The research continues with the identification of the "design brief", then developed into the "design concepts" that will be realized in form of "kits" to be tested in laboratory and in an external environment with real users. The demonstrative panel of end-users is selected in both the regions for the check of the usability of the kits, composed of wearable devices and supporting software running on smartphones. The completion of the research implies the validation of the outcome systems, the verification of the market appeal and the drafting of possible implementation of the research. The aim of the resulting kits is supporting the users to adopt a healthier lifestyle in a home-based environment.

The present document introduces the research areas addressed by the AGEDESIGN project, focusing on the design of the wearable devices by distinguishing them with the differentiation of the research lines of reference.

The first section describes the research lines and the premises for the brief, the following sections concern the process that drove from the brief to the concept development. Each section addresses the sketching phase, the definition of the electronics and the modelling, to synthesize the results into the prototypes of which consists AHAMS, the final kit subjected to the users.

The last section presents the development of the QUALIFEDESIGN platform.

DESIGN BRIEF

The future of wearable devices integrates existing technologies at affordable prices, encouraging the adoption of health monitoring technologies in everyday life. These facilitate home assistance during the performance of physical activities inside and outside the home perimeter in a friendly way, becoming tools that look like fashionable accessories and clothing which collect and manage specific physiological and behavioural data. By the term "design brief" we intend here the specification of the typology and the characteristics of the products on which the researchers have worked to address the four research lines introduced in the AGEDESIGN Project Agreement. The characterization implies the study of technical components, ergonomic aspects, performance, aesthetics and the interaction expected.

Despite the identification of four research lines into the Interreg Ita-Aus Agedesign agreed document (vascular circulation, muscular control and balance, sensory abilities and dehydration), the preliminary research phase has driven to the identification of two research lines as similar and addressable with the same technology: to avoid the design of products with analogous functions and features, "muscular control and balance" and "sensory abilities" have been merged in a single research line (Table 1). Once defined the typology of sensors the partners agreed upon the design brief to combine three aims – muscular control, balance and sensory abilities into a unique smart tracksuit. Eventually, the design brief and the concepts developed into the project are two:

- **vascular circulation and dehydration;**
- **muscular control, balance and sensory abilities;**

The first approach to the research lines has been oriented to a general identification of the physical parameter to monitor in order to get the relevant data that give an overview on the user's situation. The users have been identified as persons over 65, with an healthy lifestyle and without existing pathologies: they might have familiarity with diseases such as diabetes, high or low pressure, hypertension, arthritis, sarcopenia but they have not been diagnosed with any of these; therefore the use of medical terms in the development of the project shall not imply the treatment of the user as a patient but the goal of the research is to develop a product, or a series of products, that address the lifestyle of different personas in a programme of prevention of any disease that can occur in connection to the ageing process. The wearable devices designed through the project will provide support to the users for reaching a healthier lifestyle in an home-based environment, therefore they won't be registered as medical devices.

The second step after the identification of the parameters has been the research on the existing technologies that monitor such parameters. The decision to work towards the prevention of the disease instead of the treatment of the same has oriented the researchers to exclude the technologies that require invasive monitoring techniques. A brainstorming phase was necessary to understand and define aims and electronic components for each project's lines. A list of possible sensors to use for the development of the project has been provided by SRFG and PLUS in the document "First sensors assessments" shared with the partners in June 2017.

The details of the two research concepts will be exploited in the following paragraphs.

Table 1 - Definition of the design concept (WP3.2)

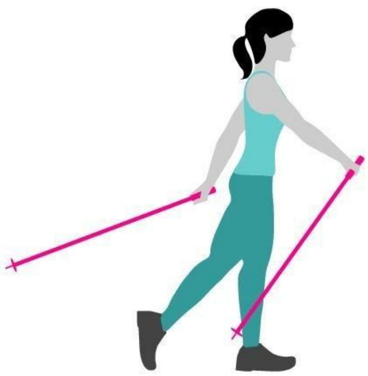
Research lines	Vascular circulation	Dehydration	Muscular control and balance	Functional abilities
Design Brief	to monitor heart beat and detect cardiac anomalies	to monitor the dehydration during the day	to monitor physical activities, lack of balance and loss of muscular tone	to monitor the lack of balance during physical activities
	Photoplethysmograph	Bioimpedance sensor	Inertial measurement units sensors	Inertial measurement units sensors

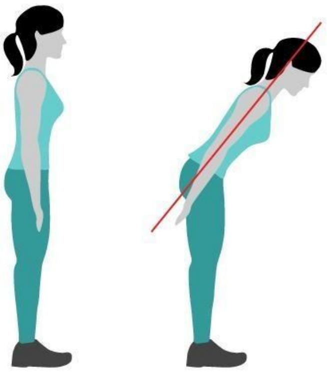
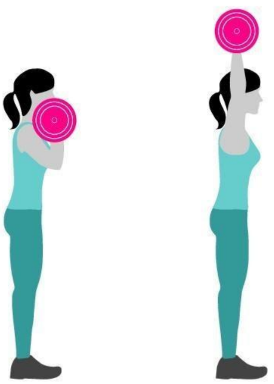
Concept	wristband + hub	smart suit

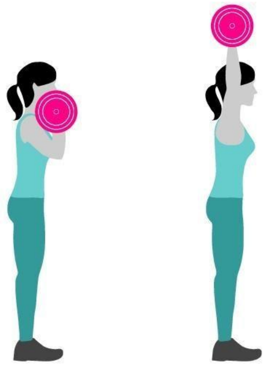
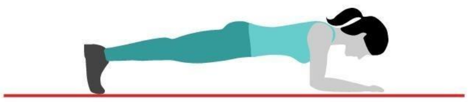
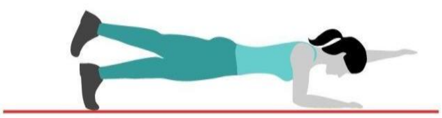
INTELLIGENT SUIT: IDEA GENERATION AND SCREENING

The concept of the suit arises from the need to monitor and encourage physical activity in the elderly. At first, it was necessary to define precisely which exercises are best suited to strengthen the musculoskeletal system and improve muscular control. Thus, SRFG and PLUS defined the physical exercises to be monitored in June 2017 and afterward, the exercises were verified and confirmed by the ULSS 1 Dolomiti in July 2017 (Table 2).

Table 2 - Excerpt from exercise selection

Exercise	Sensors	Measurement Variables
Nordic Walking *(or Brisk walking, jogging, running)* 	• Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • knee angle • knee angle velocity • knee angle acceleration • varus/valgus • use of the sticks (impact forces) • gait cycle (e.g. asymmetries)
Squat (*Kniebeuge*) 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • knee angle • knee angle velocity • knee angle acceleration • varus/valgus • lumbar spine

Exercise	Sensors	Measurement Variables
Hinge (*Kreuzheben*) 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • knee angle • knee angle velocity • knee angle acceleration • varus/valgus • lumbar spine
Lunge *(Ausfallschritt)* 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • knee angle • knee angle velocity • knee angle acceleration • varus/valgus • lumbar spine
Military press *(Schulterdrücken)* 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • height of shoulders • extended elbows

Exercise	Sensors	Measurement Variables
Military press *(Schulterdrücken)* 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • height of shoulders • extended elbows
Plank *(Unterarmstütz)* 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • shoulder blades • long neck • lumbar spine
Plank (*Unterarmstütz*) remove feet/hands from floor 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • shoulder blades • long neck • lumbar spine

Standing on one leg 	• Kinect • Ambient • IMU • LVL	• heart rate • breathing hard and fast (pulmonary expansion) • hip

In agreement with all the project partners, two of the listed exercises have been selected for the development of the smart suit: squat and lunge. These exercises have been identified as the most effective for their completeness in the engagement of the entire body, in terms of balance and musculoskeletal strengthening. SRFG and PLUS suggested the Inertial Measurement Units as the most appropriate sensors to monitor the body during physical activities. They might be placed all over the body and, through the produced data, it is possible to recognise the exercises performed by the wearer and verify if these have been acted in a correct way.

The correctness of the performed exercises is a key index of the improvement of balance control and muscular tone: the more exercises are correct, the more the user is strengthening his musculoskeletal system.

As a matter of fact, the smartphone application is designed to provide to the users a guided experience in performing the exercises and, at the end of the session, they can see the result of the performance: the app shows the number of the exercises performed correctly and those performed incorrectly. Furthermore, users can also see what was incorrect during the exercise (like wrong back posture, or wrong knee bending, etc.).

WRISTBAND AND HUB: IDEA GENERATION AND SCREENING

To address the vascular circulation and dehydration research lines, partners agreed on the development of a wristband to be worn on a daily basis, which monitors constantly the wearer's heartbeat and, at regular intervals during the day, the body hydration. As shown in table 3, the most suitable sensors for the detection of the mentioned parameters are photoplethysmograph for the former, and bio-impedance sensor for the latter. Besides the measurement of the blood pulsation, what is important to detect are the cardiac anomalies (bradycardia, tachycardia and arrhythmia). Thus, the system will send alerts to the user when cardiac anomalies and body dehydration are detected through the smartphone application (see 2.3 APP). In addition, ULSS1 Dolomiti highlighted the relevance of the cardiac frequency and the blood saturation as parameters to be measured in order to have a complete framework of the vascular circulation status of the user. Following these recommendations, it has been agreed to develop an additional non-wearable device: the hub, a self standing desk-device designed to accomplish the daily measurement of blood saturation and cardiac frequency.

Table 3 - Definition of the sensors and parameters to be measured

Research lines	Vascular circulation	Dehydration	Muscular control and balance	Functional abilities
Design Brief	to monitor heart beat and detect cardiac anomalies + Blood saturation and cardio frequency	to monitor the dehydration during the day	to monitor physical activities, lack of balance and loss of muscular tone	to monitor the lack of balance during physical activities
	Photoplethysmograph + ECG plates	Bioimpedance sensor	Inertial measurement units sensors	Inertial measurement units sensors

Heartbeat and blood saturation are detected by the same technology: the photoplethysmograph, an unobtrusive optical sensor which needs to be in contact with the skin to reliably detect the parameters. In spite of this, the body position for the detection of these parameters are different: wrist is the most suitable body part for the detection of heartbeat and finger phalanges for the blood saturation. The bioimpedance sensor, instead, which consists of two copper plates positioned at a certain distance to one another, detects the electrical resistivity of the skin. It needs to be in contact with the skin as well, but it does not require ti he positionef on a specific body part.

For the reasons mentioned above, the sensors have been merged into a single device which can be removed from the wristband to be inserted into the hub (the table-device), allowing the measurement of the blood saturation.

For the detection of the cardiac frequency, it has been opted to the implementation of two silver plates in the external shell of the hub. Therefore, the hub is the tool that allows the measurement of blood saturation and cardio frequency. Besides these two functionalities, it also works as a charger for the sensor.

FIG.1 - How to use the system.

DESIGN DEVELOPMENT

In order to satisfy the above mentioned premises, the design concepts of the different research lines have been developed. Starting from the sketches, then moved on the development of the electronics, and finally to the implementation of 3D models.

Dehydration and circulation system (wristband and hub)

Sketches

The sketches were designed to investigate the morphology of the hub and the technical structure of the different devices. While drawing, the researchers make hypothesis on the possible materials and the interaction with the users. The drawings are made with different techniques, and their elaboration allowed the discussion of the team on the possible alternative designs.
The sketches included different levels of development, from shape studies to assembly techniques. Colour variations have also been investigated following the references identified with a research of the competitors and a moodboard collection.

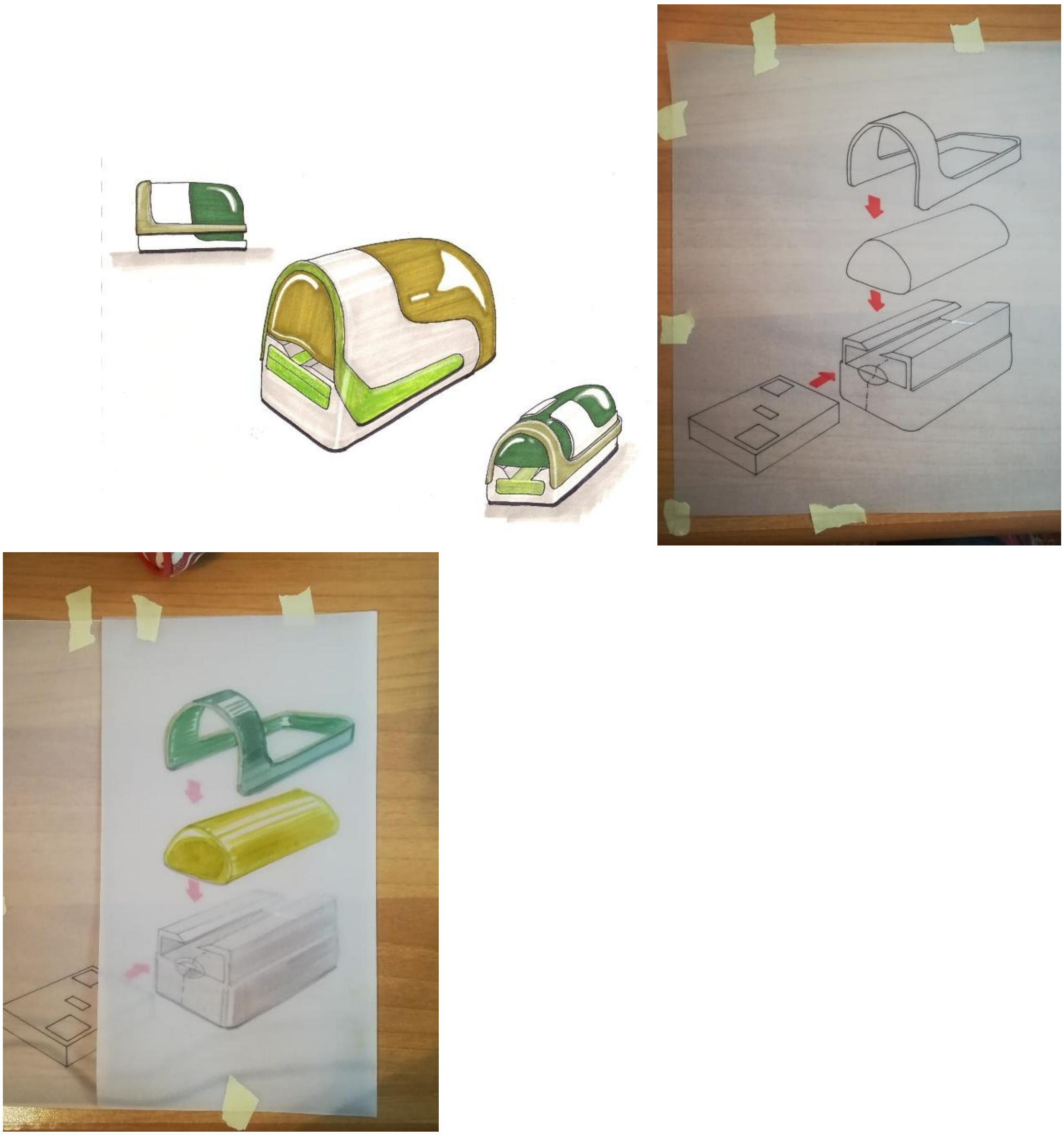


FIG.2-3-4 - Preliminary sketches of the hub development.

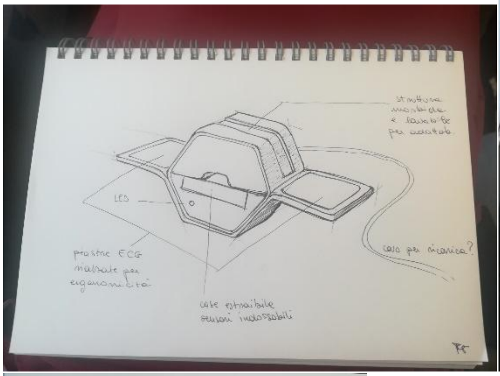
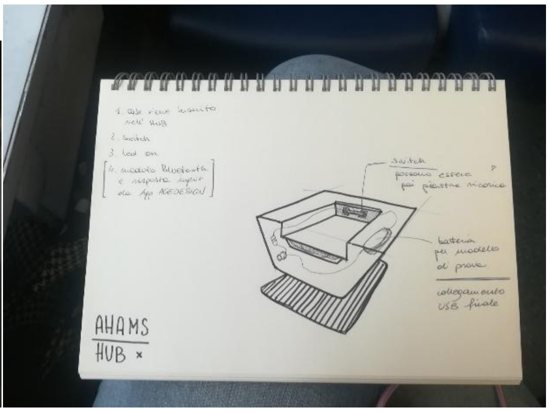
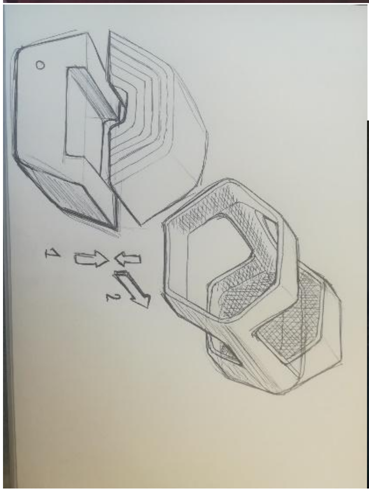
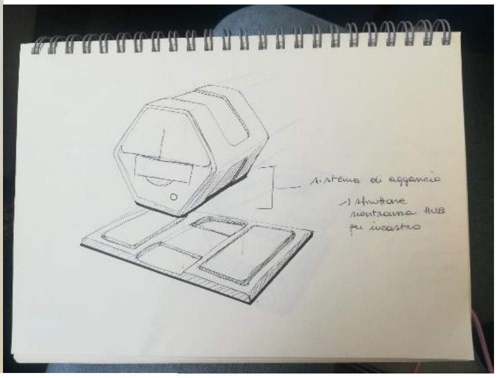
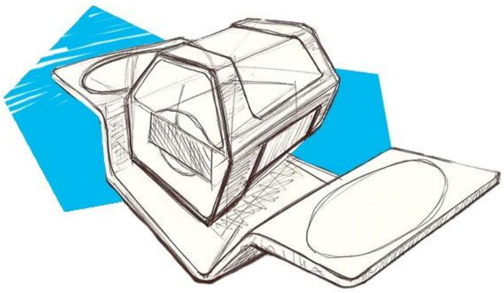
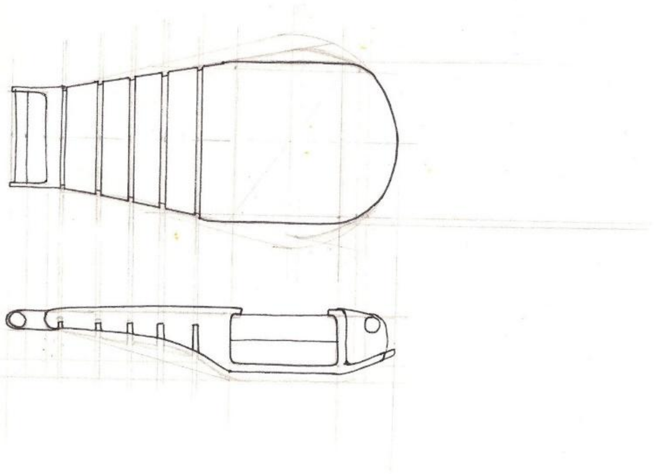
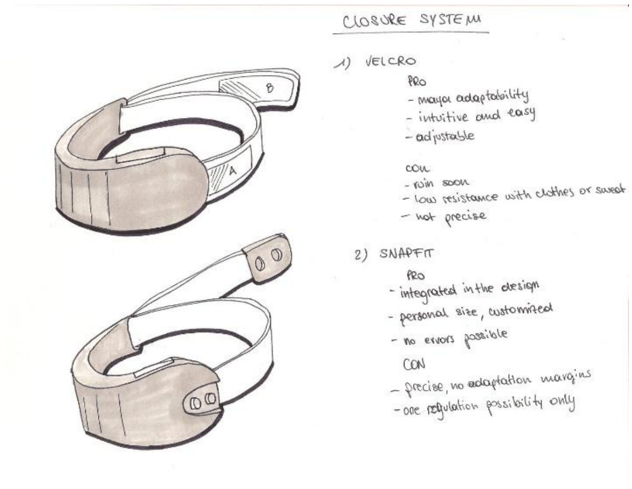
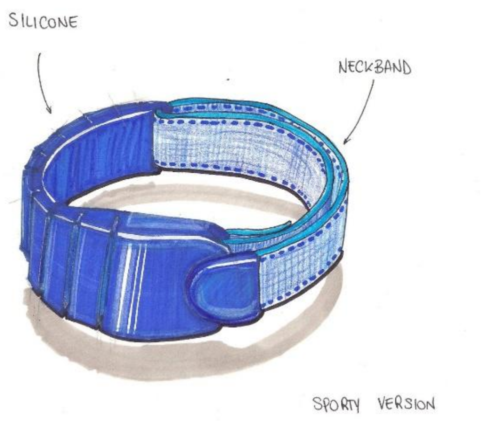






FIG.5-6-7-8-9 - Sketches of the hub




CLOSURE SYSTEM
1) VELCRO
PRO
- mayor adaptability
- intuitive and easy
- adjustable
CON
- ruin soon
- low resistance with clothes or sweat
- not precise
2) SNAPFIT
PRO
- integrated in the design
- personal size, customized
- no errors possible
CON
- precise, no adaptation margins
- one regulation possibility only
A
B


STEEL-LIKE COATING
LEATHER
LUXURY VERSION


SILICONE
NECKBAND
SPORTY VERSION

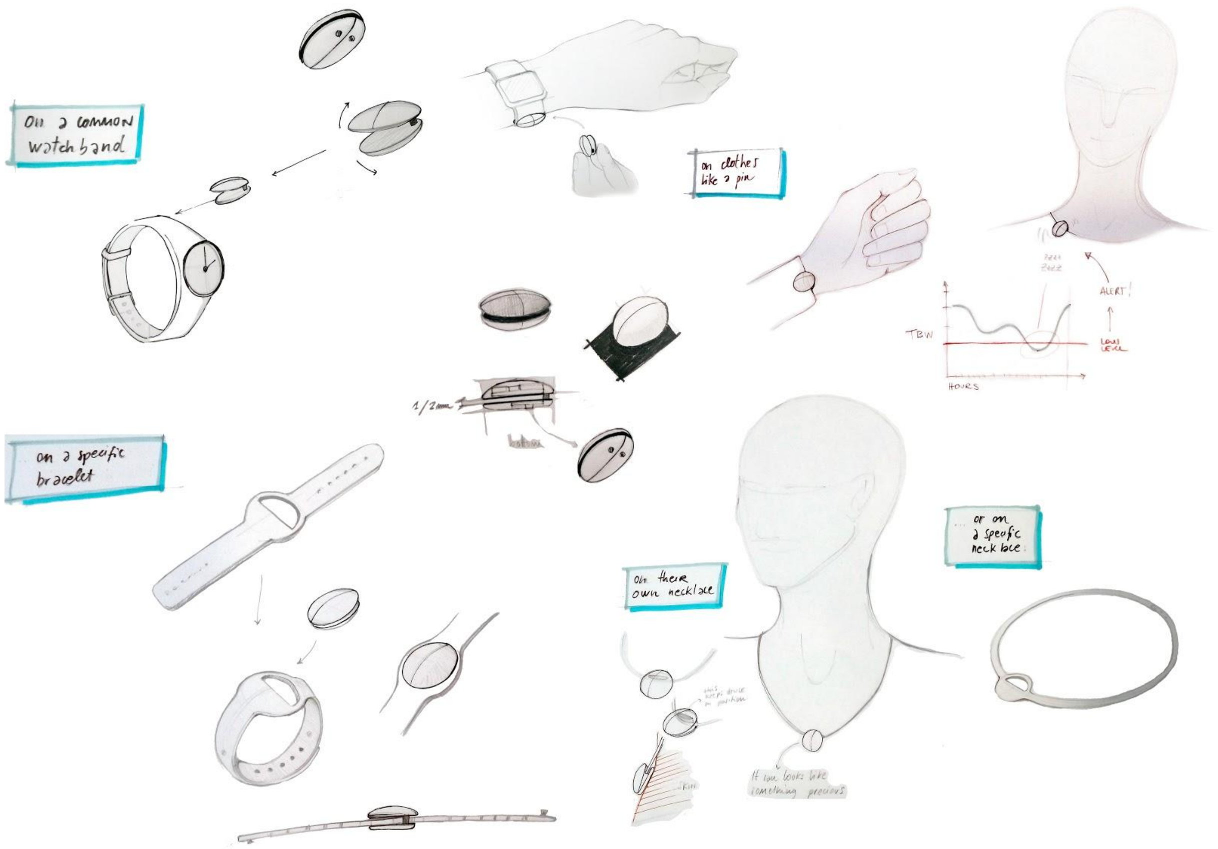


FIG.10-11-12-13-14 - Sketches of the wristband development

Development of the electronics

After the literature study on the technologies used for the monitoring of dehydration and circulation, the researchers have required the production of a specific board including a bio-impedance sensor and a photoplethysmograph. The first version of the board mounting these sensors resulted cumbersome, since the board itself measured 39x28 millimetres and a case was needed to allow any use. A further issue emerged with the positioning of the case on the wrist, for which the relation within the minimum dimension for the adult wrist resulted too thin to accommodate the element and allow a perfect contact between the bio-impedance plaques and the user’s skin. While the first production ended in a non-functioning element, an implementation has followed with the involvement of the tech start-up Re:Lab, whose engineers were able to provide a miniaturized component that allowed the reduction of the case dimensions and the access to the lab testing phase conducted by ULSS 1 Dolomiti.

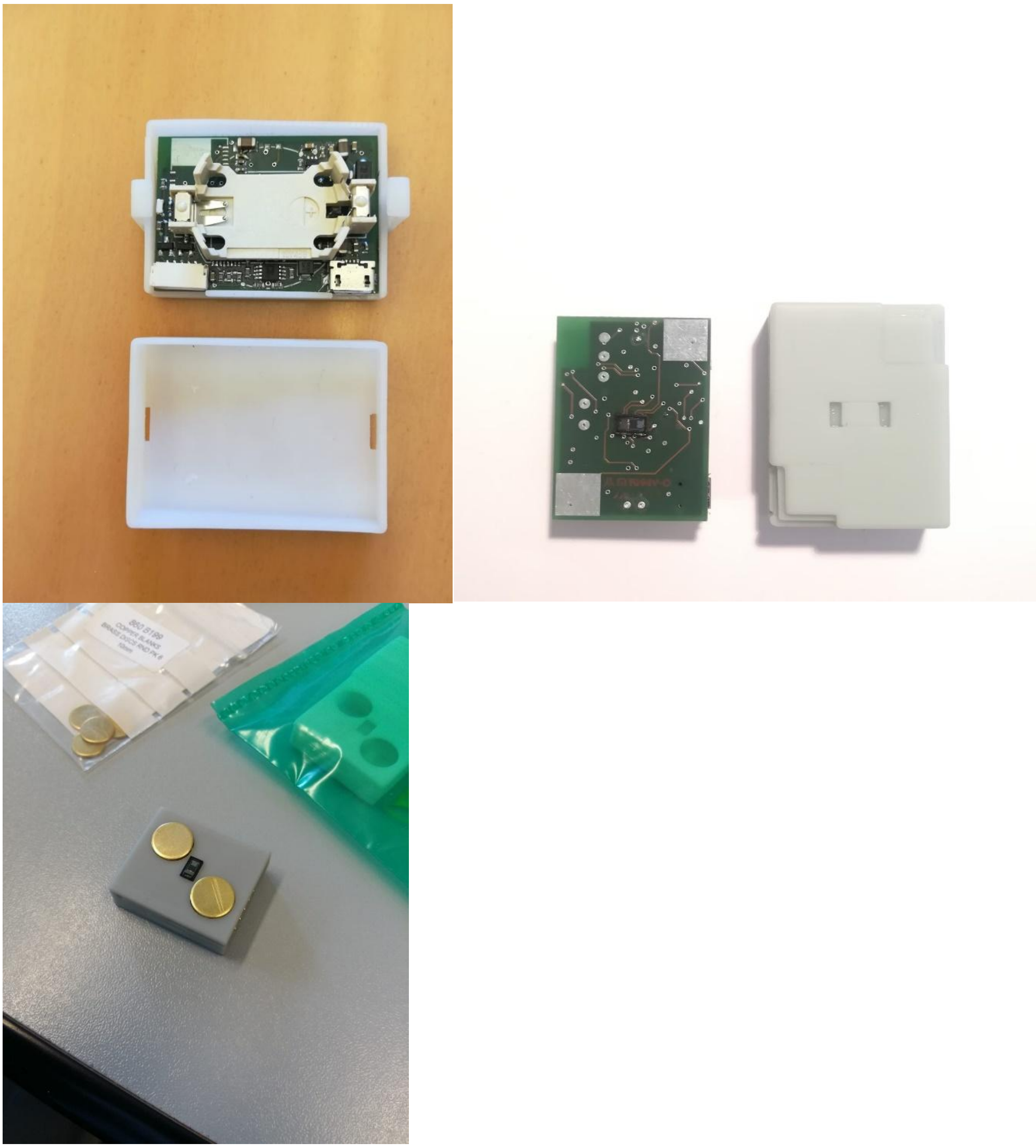


FIG.15-16-17 - Stages of the development of the electronics components

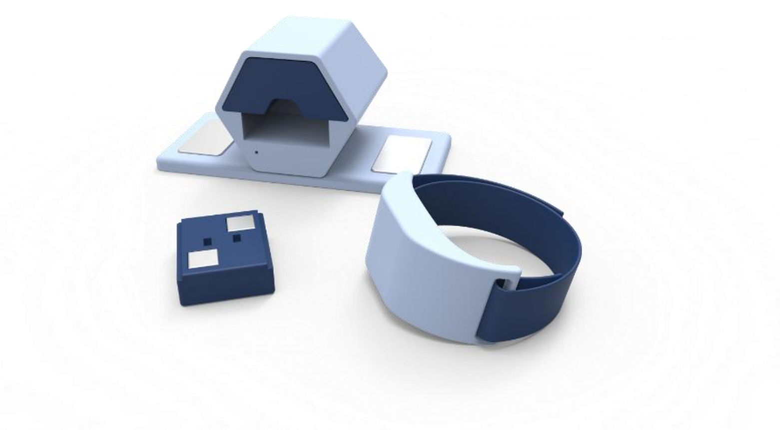
Model

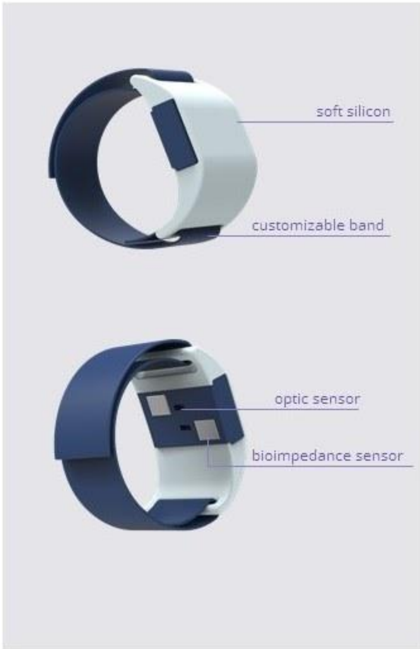
The definition of the electronics and their size has been a compulsory step to define the shape and the dimensions of the other elements of the system, plus the interaction needed within the user and the same system.

To investigate dimensions and interactivity, different study models have been prepared using poor materials and then advanced prototyping techniques (3D printing), testing the resistance of the material, the appropriateness for the intended use and the overall usability of the resulting designs. The models included an evolution of the sensors' case, the study of joints to applique it on the wristband, a study on the wristband and its closure, the design of the charging station and the inclusion of the cardiac frequency monitoring plaques base as additional service provided through the board.

Colors and textures have also been investigated, driving to the choice of polished white finishing for hub/charging station prototype and of a soft, dark plastique for the wristband, designed in an unique solution with the space to integrate the sensor.

FIG.18-19-20-21-22-23-24-25 - Development of the Models





Smart Suit

Sketches

The sketches were designed to investigate the wearability of the smart suit and the most adequate fabric to use. While drawing, the researchers made a hypothesis on the possible materials and investigated the best positioning and the most effective coupling of the sensors in relation to human morphology.

The target of the project implied the specificity of a body shape and tone that required the researchers to design an element that empowers the users instead of wrapping and embarrass them, as the majority of training cloths on the market do. To reach the aim, natural elements, bright colors and a combination of textures were investigated.

The need of positioning the sensors on the suit was also matter of analysis during the sketching phase: the need of placement for a variable number of electronic devices on different parts of the body required the evaluation of adjustable elements to fit different body shapes and dimensions, plus at the early stage of the research it was not yet possible to define the specificity of the sensors' position neither their final number. To allow the maximum flexibility and to provide the textile material as soon as possible in the project for the laboratory testing, the system studied comprehended the design of perforated bands in which the cases could have been moved as needed, preferring the solution to reduce the number of components and external elements on the suit itself: other solutions included the sewing of buttons on the suit, limiting the range of shift, the positioning of hooks in specific points of the suit, reducing the comfort of the user, or the use of belts to be positioned without evident constraints and therefore industrious and not precise.

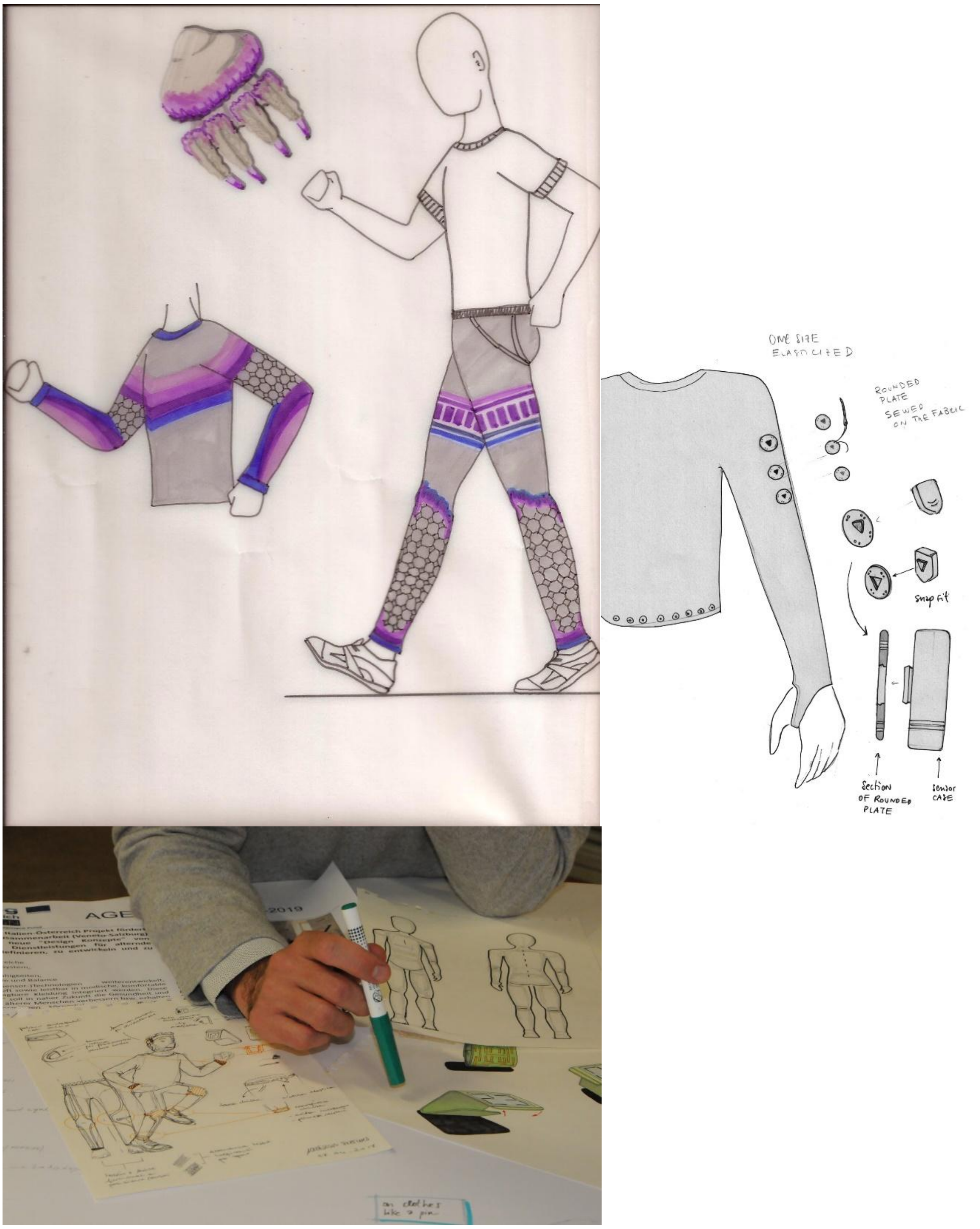


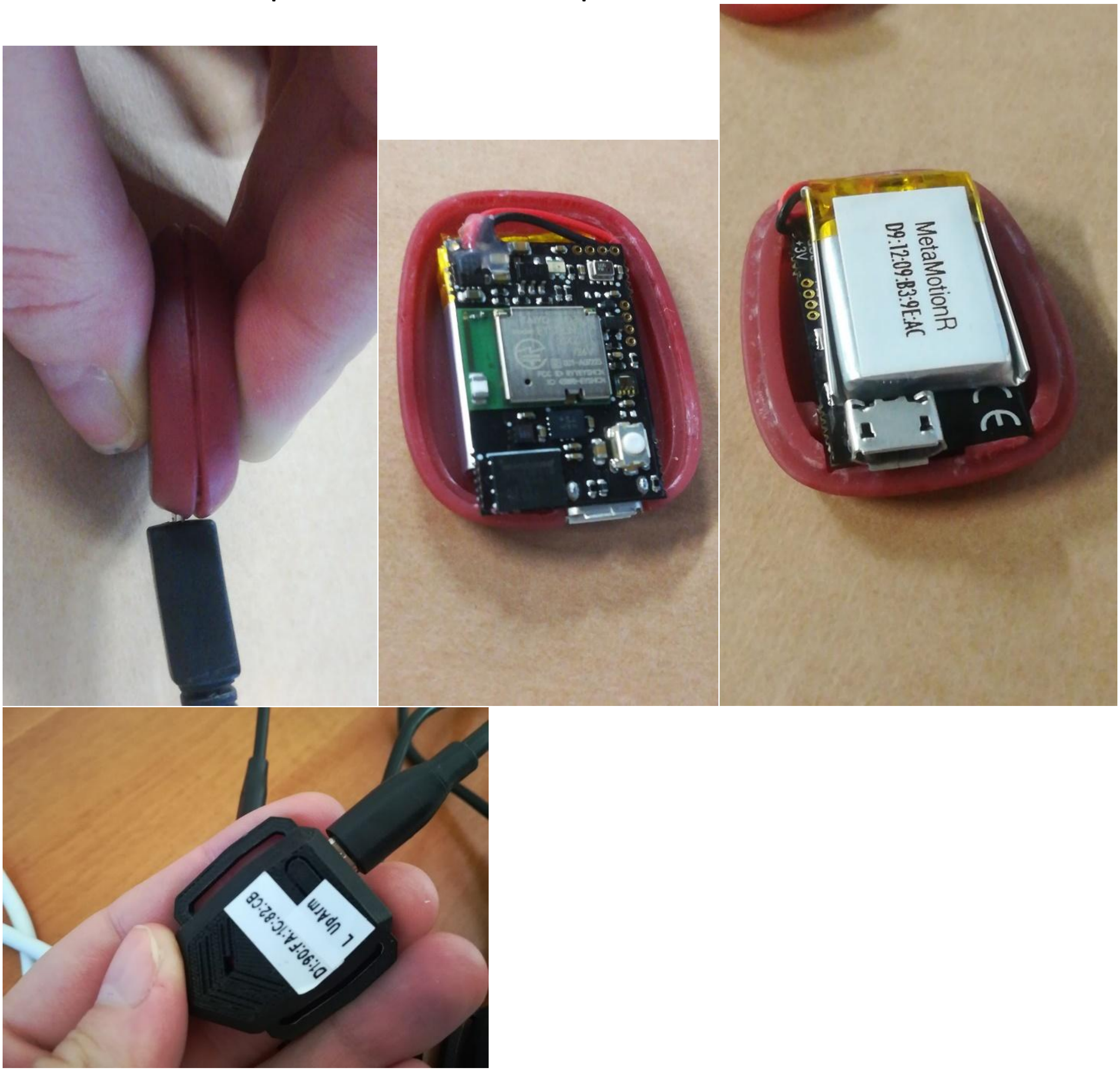
FIG.26-27-28-29 - Preliminary sketches of the smart suit development

Development of the electronics

The research line on motion control was developed based on an existing IMU system, MetaMotionR, selected by the Austrian partners of the project, who had the expertise to test, implement and verify their effectiveness compared to other motion tracking devices.

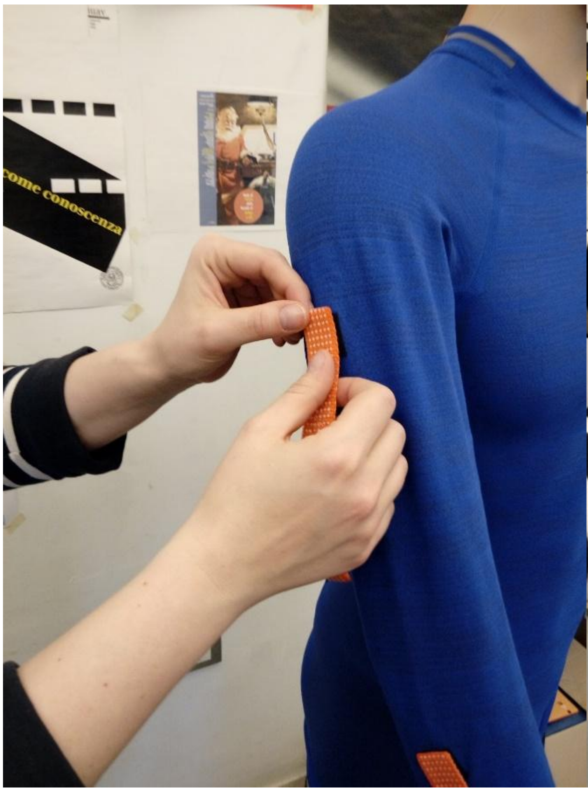
The main qualities that resulted relevant for the design of the physical user interface were the dimensions, which required a specific design of the cases, then implemented according to the suit design and the need to attach them on it, the accessibility of the charging plug and the evidence of the visual feedback represented by the LED positioned on the board.

FIG. 30-31-32-33 - Development of the electronics components



Models

The initial models focused on the attachment of the IMU cases on the suit, therefore the first models implies the use of existing sport textiles to study the wearability and the ease of insertion of the devices on the system. The major step in the design of the casings and on the definition of the suit has been reached with the identification of WKS by Cifra s.r.l. as a producer of specific textile technology that allows to influence the flexibility and the resistance of the textile through the knitting technique: thanks to the expertise of the company, it has been possible to combine different consistencies in the same garment within a singular production process. The first models included a study on the sewing finishing and the distribution of rigid and soft areas according to the male and female body shape, in compliance with the physical changes due to the aging that are still perceived as flaws.



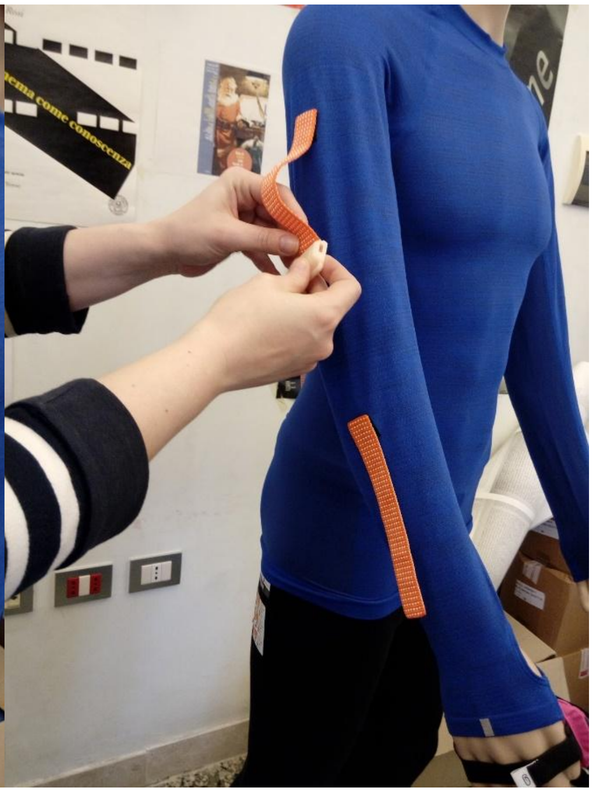


FIG. 34-35-36-37 - Development of the smart suit


FIG. 38 - Development of IMU case 3D model

FIG. 39 - Development of IMU case 3D printed model

The final kit

The final kit consists of a set of wearable devices connected through a smartphone app, following the project requirement. To address the system in its totality, the acronym AHAMS has been coined: it is the union of the initials of the aim of the project result itself, "Active and Healthy Ageing Monitoring System ''.
The prototypes simulate the final morphology of the different designed elements and includes working electronics, still foresee the possibility to implement the design after the user review. The project's aim was to obtain functioning devices to access the testing phase, plus the prototypes allows the discussion with investors for further developments.

FIG. 45 - The final kit

The kit allows us to address the three research lines represented by the icons on the app's homepage, that provide the visualization of the data monitored through the suit plus the IMUs, the wristband and the hub.

The motion control kit is composed of a suit and a set of sensors. The suit prototypes have been produced in Male version, sizes M and L, and Female version, sizes S and M. As a result of laboratory testing conducted by the SRFG and PLUS partners, the IMUs were reduced to a number of 6 sensors for each user.

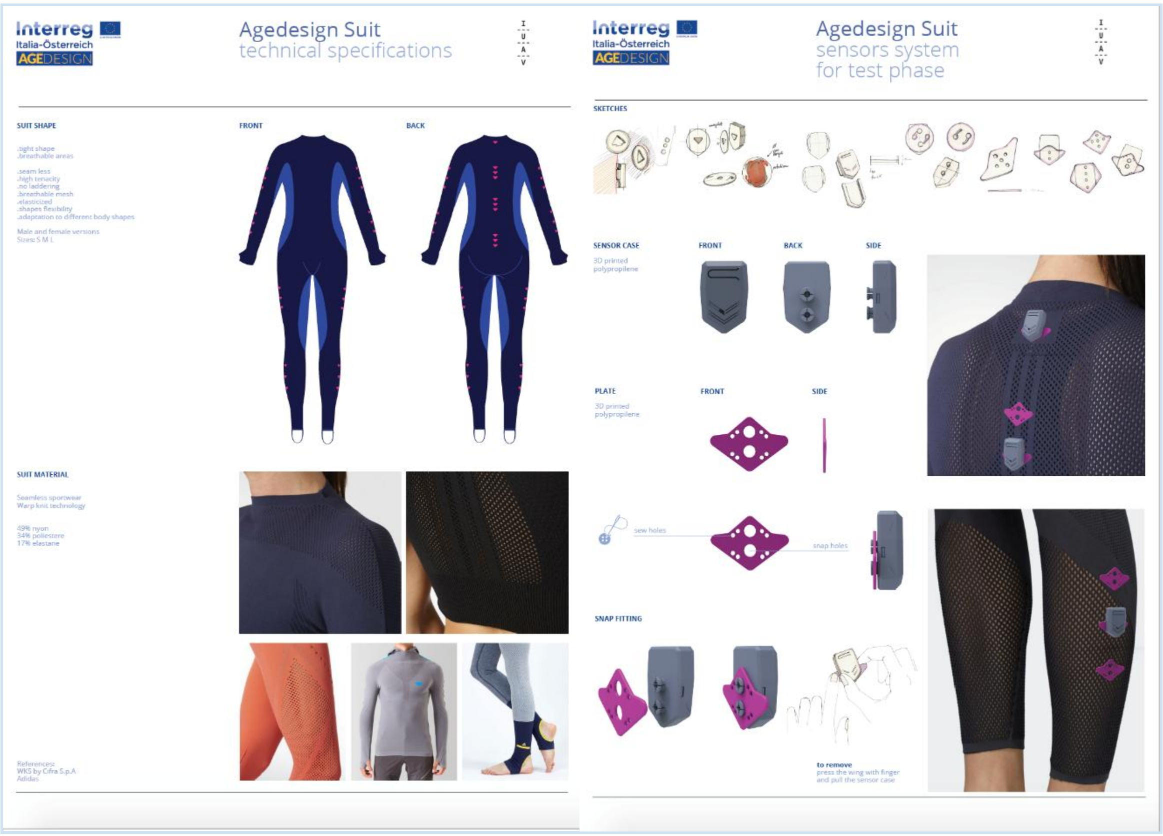


FIG. 46 - First draft of the smart suit (before the reduction in number from 12 to 6)

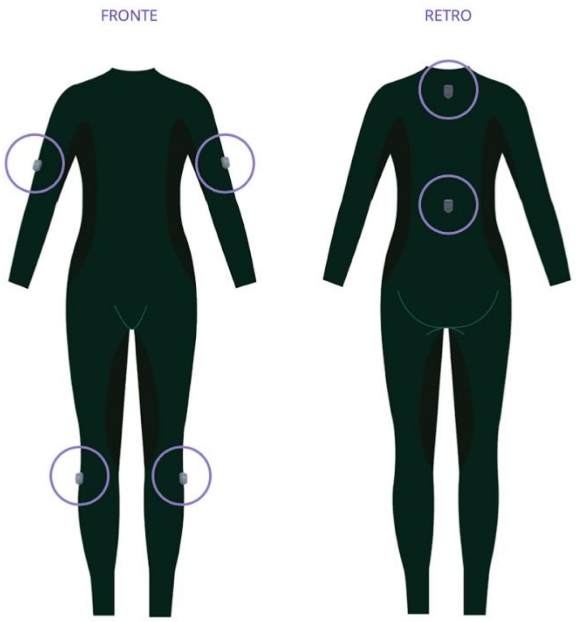


FIG. 47 - The final version of the smart suit

The dehydration and circulation monitoring kit consists of the wristband and the hub.
The wristband is designed to fit a variety of wrist dimensions, following a one-size-fit-all dynamic, therefore the holes distributed on the strap allow the regulation of the adherence of the sensor to the skin. The hub comes in a single size and it is designed to allow further implementations to become a telemonitoring deck.

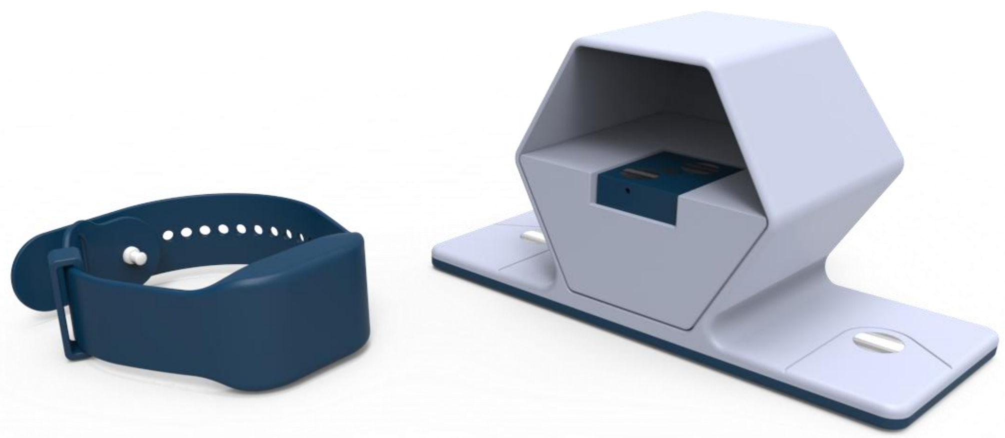


FIG. 48 - The final version of the wristband and hub

APP: CONCEPT DEVELOPMENT & TESTING

The smartphone application has been designed to be as simple as possible. Since the project's target consists of users over sixty years old, we seek to provide a user interface and a user experience that are intuitive and linear. Bearing in mind this consideration, we opted to divide the functions into three different topics, related to heart, body water and physical exercise. The three functions are represented into the homepage of the app, the main screen, in form of three buttons: a red heart, a blue drop and a green silhouette to recall the physical activity. To land in the home screen, it is required an initial phase of logging in, in which the user has to register his profile filling the form with personal data - this is required just the first time, when the user downloads the application from GooglePlay (so far, the application runs only into Android devices). The home screen also shows the button for the dropdown menu in which are listed further options, like for instance settings of the sensors.

The figure below (fig. 34) shows the first wireframe of the application, which is the navigation map of the user interface. In the orange box, it is shown the alert screens which occur when the sensors detect cardiac anomalies, low level of body hydration or the bluetooth is not connected.

Entering into the heart section, a graph illustrates the heartbeat trend and the values in BPM in real time. At the bottom of the screen, two buttons are placed: one for further cardiac measurements (those above mentioned) and the other for checking the history of the cardiac measurements where, touching on a single day all the measurements carried out on that day will occur. Touching the former, the app allows the user to choose between pulse oximetry, cardiac frequency and blood pressure (this last one is not included in the research project, thus we have not developed a digital sphygmomanometer, but in order to have a comprehensive framework of the cardiac status of the user, we opted to provide the chance to manually insert the blood pressure values). As regards the pulse oximetry measurement, the user has to touch the “measure” button and place the index finger of the other hand on the sensitive area of the sensor (previously inserted in its hub location) when a red light occurs. The values will be displayed on the smartphone application (fig. 1, p.11). For what concerns the cardiac frequency, the user has to touch the “measure” button and place both index fingers on the silver plates on the outer side of the hub’s shell. As for the previous function, the collected values are displayed by the app (fig. 1, p.11).

To check the body hydration level, the user has to enter into the drop section, where an illustration shows the level of body hydration (it is not shown the value but an indicative level). As already mentioned, when the level is too low the user will receive an alert in which it is suggested to drink water as soon as possible. And, as for the heart section, a calendar-shaped button is touchable to check the history of the hydration levels.

Last but not least, the section for physical activity has been developed by SRFG and PLUS, and it is designed to work along with the support of the smart suit. At first, the user can choose whether to check the history of activities or to start a new session. Before selecting the new session, the user has to wear the suit and place the sensors on it. After that, a quick calibration is required, then the application allows the user to choose the exercises and the number of repetition. A video shows how to perform the exercise. When the session is complete, the application displays the results, and specifically the number of the exercises performed correctly and those incorrectly (it is also possible to check what has been done wrongly). As the user progresses, a congratulation message occurs which means that the user is improving in performing the activities and so he is strengthening his musculoskeletal system.

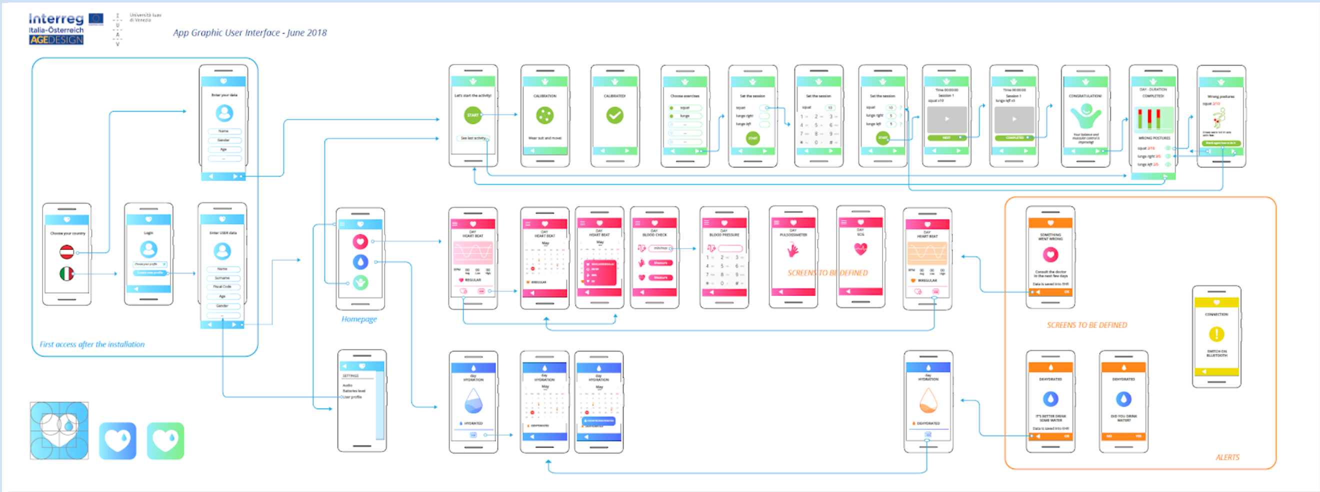


FIG. 40 - APP wireframe

Implemented version

FIG. 41 Initial screens of the APP.

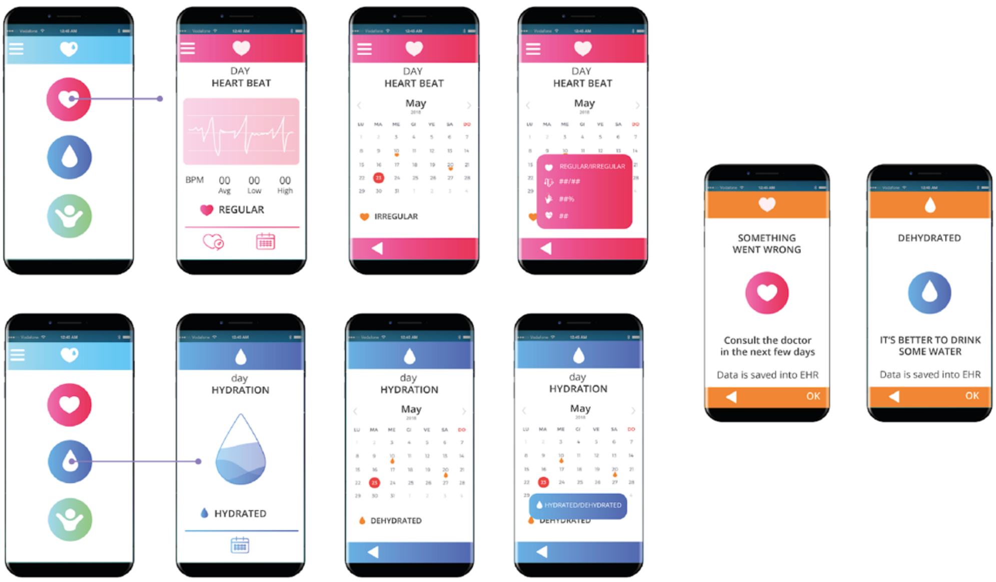


FIG. 42 Final version of the APP (heart and body water sections)

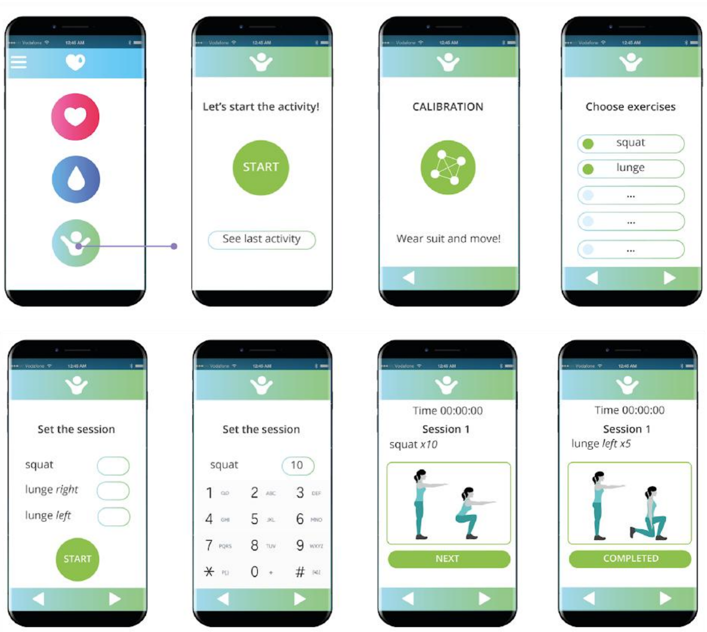


FIG. 43 Final version of the APP (physical activity section)

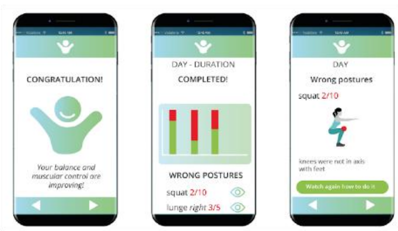
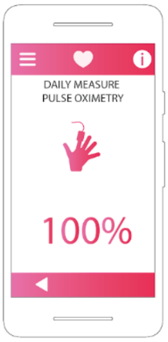


FIG. 44 Results shown by the APP (physical activity section)



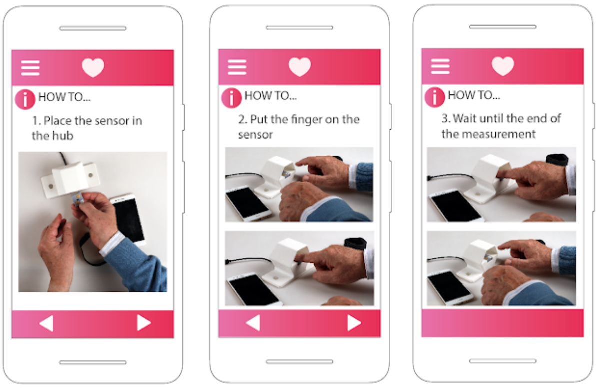
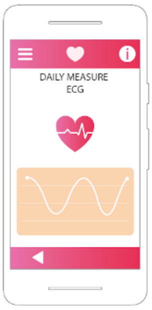


FIG. 49 - Instructions for the use of the pulse oximeter



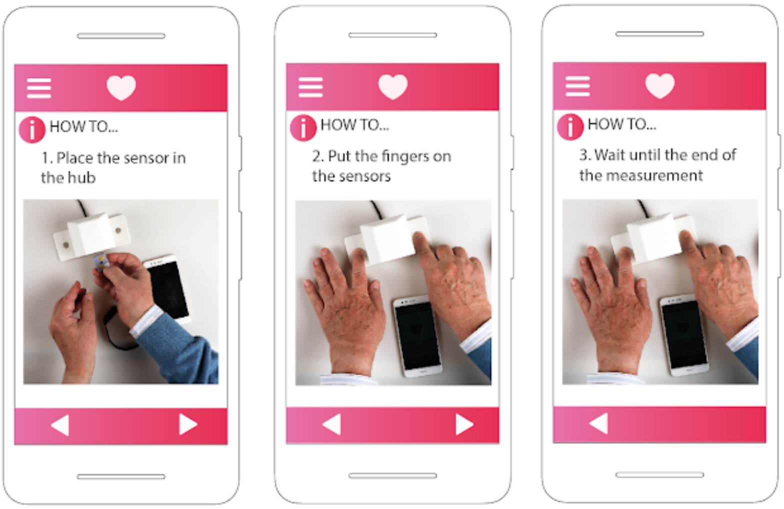
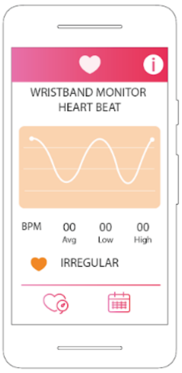


FIG. 50 - Instructions for the use of the cardiac frequency detection



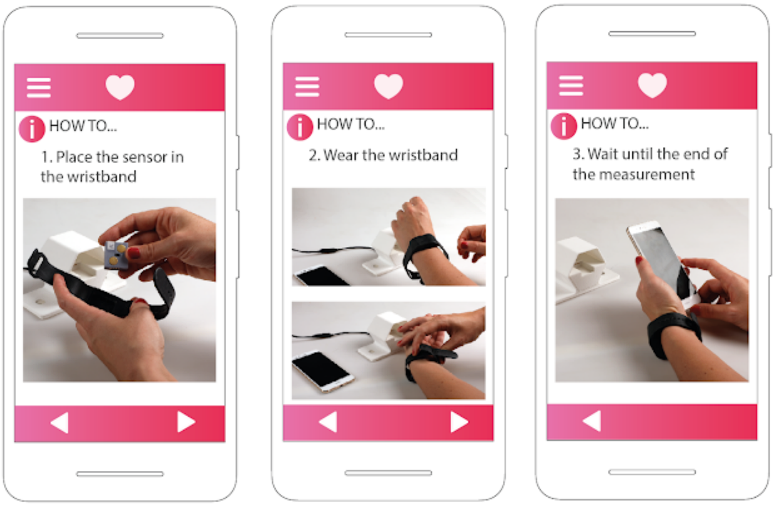


FIG. 51 - Instructions for the use of the bio-impedance sensor and heartbeat detector in wearable mode

The final kit was distributed to the Austrian and Italian partners in order to conduct the user testing, for which the wearability of the devices and the interaction with the system were points of interest.

The usability testing has been designed to include the collection of qualitative data through the User Experience Questionnaire (UEQ) and the Mobile App Rating Scale (MARS).

FIG. 52, 53 - Cardiac frequency monitoring mode

QUALIFEDESIGN PLATFORM

Qualife design is a web platform focused on the promotion of design projects and in creation of networks between students, young designers and companies. On the platform, designers can publish their projects in search of interested companies or lenders, while companies can look for new projects and instantly propose a collaboration to the designers in order to create new solutions (software or hardware development).

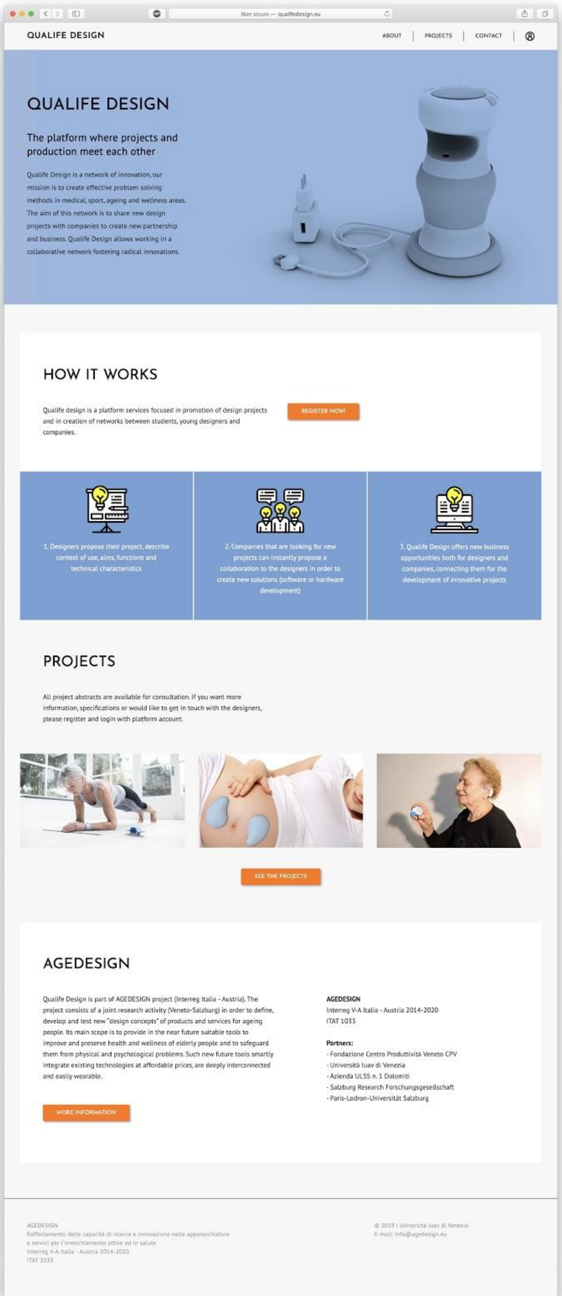


FIG. 54 - Homepage of the QUALIFEDESIGN Platform

All project abstracts are available for consultation.
The Projects section shows the list of all loaded projects, divided into 3 topics: Medical & Diseases, Rescue & Emergency, Sport & Wellness. Projects abstracts can also be filtered by technological components in order to speed up the search.

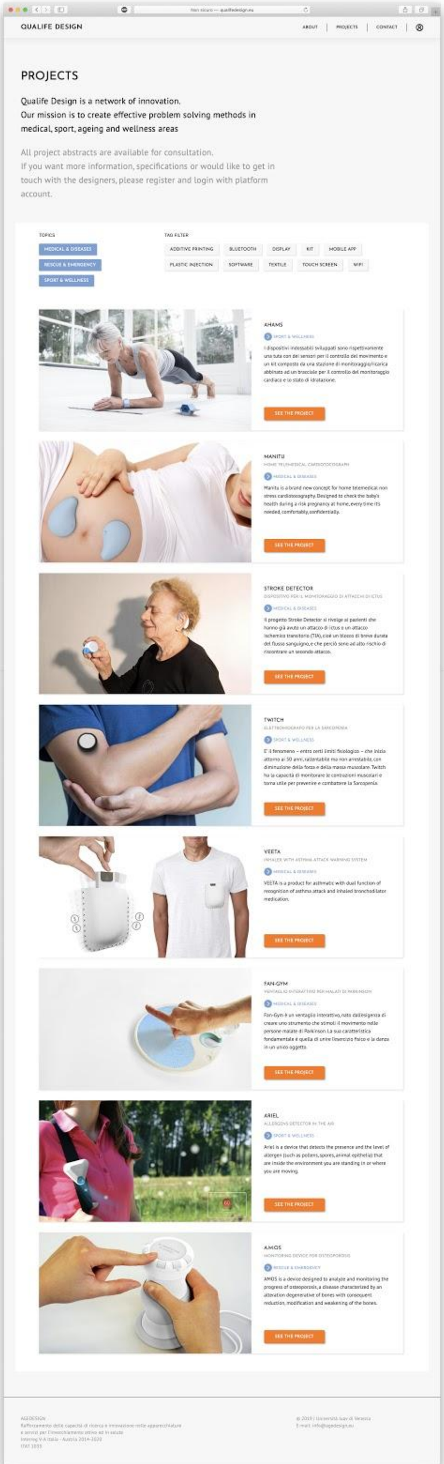


FIG. 55 - Overview of the list of projects

The pages of the individual projects can be consulted in two different ways, public or private (subject to registration). In the public view it's possible to see a photo of the project, a short descriptive text and the name of the designer.

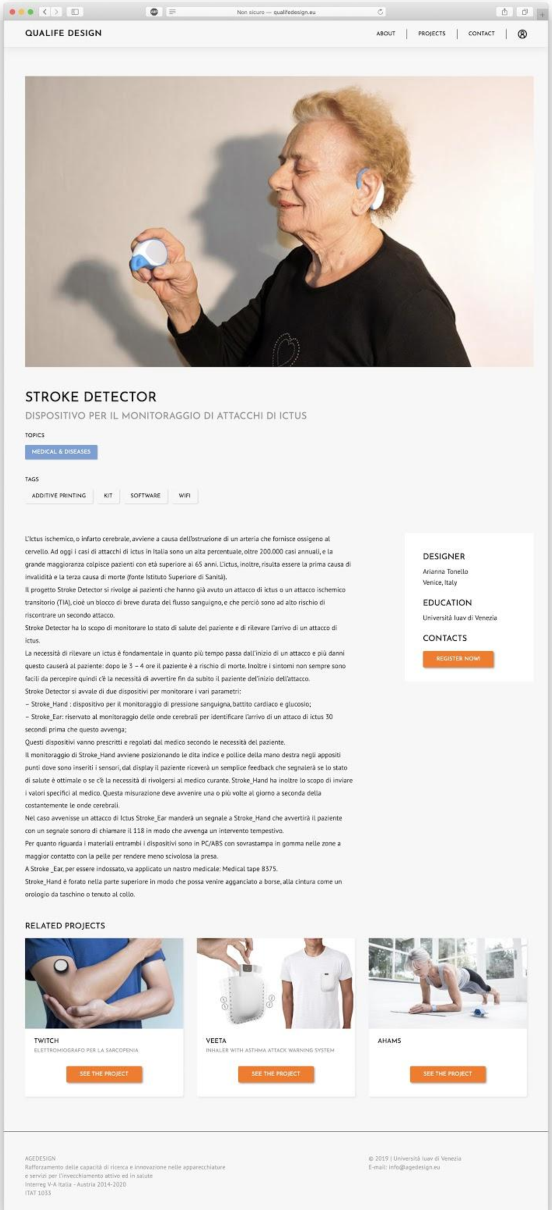


FIG. 56 - Example of a project's page

After registering the user will see much more information related to the individual project: other photographs, videos, technical drawings and the electronic components used. In this section a company can contact the designer to propose a collaboration for the development of the project (hardware or software).

MARKET APPEAL

Silver economy

The Silver economy is a new great cross-sectoral ecosystem: healthcare, social assistance, insurance, transport, construction, communications, food, tourism, culture and leisure.

A recent study by Oxford Economics and AARP Real Possibilities "The longevity Economy: How People Over 50 Are Driving Economic and Social Value in the US" shows how this economy in the United States amounts to 7,600 billion dollars, with an employment impact equal to 89.4 million jobs.

The analyses carried out by the European Commission on the silver economy indicate that consumption attributable to the elderly in the European Union amounts to € 3,700 billion, capable of supporting over 78 million jobs.

Market appeal

During the project there have been many presentations of the project results to companies and start-ups. New cooperation with the private sector are arising. Hereunder there are some insights of the discussions during market appeal meetings that are relevant for further research.

a) In general there has been an interest for motion detection systems that are simple to wear and use, which can be used for a variety of exercises and which, in addition to being functional to programs for maintaining physical efficiency, communicate with more complex protocols of care and rehabilitation.

b) The presentation of AGEDESIGN project to the owners and employees of the Outpatient Rehab Center for Cardiovascular Diseases https://www.ambulatoriumnord.at/ in Salzburg shows how the concepts AGEDESIGN integrated with other sensors, could help the patient to continue the training program after the rehabilitation phase (the rehabilitation program aims to restore the health and fitness of patients to the best possible extent in the 1-6 month intervention period). An important step that indicates possible directions for AGEDESIGN concepts application.

c) There was great interest regarding the exercise data recording. Some manufacturers considered how to connect the IMU-based sensor technology directly to the screens of fitness equipment instead of an additional app (cell phone/tablet). Some exhibitors during the exposition, in which AGEDESIGN motion capture and recording system was showed, were amazed at how inexpensive, miniaturized, and equipped with high storage capacities these sensors are. There was enthusiasm for easy integration into clothing without impairing the movement requirements, but still capturing relevant movement properties.

d) The measurement of dehydration remains an open chapter, especially for the elderly. Up to now there is still no measurement and alert system that is easy to wear and use and which, at the same time, ensures acceptable levels of accuracy and reliability. The concept developed with AGEDESIGN certainly places itself in a sector of high demand for solutions for the elderly and its configuration distinguishes by responding to the most significant needs that have been found on the market.

e) A good interest has emerged for the platform, developed by the IUAV University of Venice, for the control of human health parameters, which communicates with mobile APPs connected to the monitoring sensors worn by the user and with a small easy-to-use domestic HUB, that physically allows to expand the physiological measurements that can be made at home, in addition to those provided with the bracelet.

f) There is a world of applications of the measures of physiological parameters and of movement, different from the medical one of rehabilitation and personal care, that are less stringent as regards the parameters of acceptability and requirements for the recognition of their normal use. These can be widely contaminated by findings developed with medical research. These are the fields of ergonomics and human-machine interaction, which belong to different sectors, such as manufacturing, logistics, maintenance, heavy mechanics, to name a few. AGEDESIGN findings can be interesting for these sectors both in the monitoring of physical effort and in the study of solutions aimed at reducing fatigue and the risk resulting from out of limit physical effort.

g) During the meetings, the importance that AGEDESIGN concepts can have in the life insurance world also emerged, in the sense that their application for monitoring the physical state of the person could be a condition for lower insurance expenses. The equivalent of the black box for a car insurance. Of course, this requires the development of service organizations, which support the use of these wearable concepts in a widespread and reliable way, in co-branding with well-known insurance companies. This aspect also emerged from the meetings of the Austrian partners with organizations interested in the care and guarantee of life of the person. The thoughts regarding the possibility to monitor the physic exercises of an elderly often went in the direction of the collaboration with the insurance companies. For example, the amount of the self-contribution for various medical expenses could be linked to the compliance of the given exercise programs. The project would allow with few extensions of the collection of such personal data additional interesting results.

Program of further actions and possible developments

The interest in the dissemination and further development of the functionality of the AGEDESIGN concepts does not stop with the end of the project but continues with a view to maximizing the results achieved with the project.

The AGEDESIGN themes are fully included in the objectives of the new BIOMEDICAL cluster that the IUAV University of Venice is about to start in 2020. Within the Cluster, companies interested in forming a RIR - Regional Innovation Network- are currently being identified, capable to present projects on biomedical topics and in particular on the development of devices for active and healthy aging on the basis of the AGEDESIGN results.
An opportunity to involve Veneto Region companies in the development of new applications, that can capitalize on the know-how and results, achieved with the AGEDESIGN project, is represented by the publication of calls for the financing of research and development projects. One of the funding option sponsored by Veneto Region is represented by the line "1.1.4 - Research and development projects by regional innovative networks of enterprises or by clusters of Veneto enterprises" under the POR FESR 2014-2020 funds. The related Call will be published not before February 2020.
In this regard it should be emphasized that in Veneto there is a RIR, called RIBES - INNOVATIVE NETWORK FOR THE HEALTH ECOSYSTEM AND THE SMART FOOD, which brings together companies that develop product for the health chain, from food to personal care. Contacts and discussions are being opened with members of the RIR board by University IUAV - Industrial Design and Multimedia and CPV Foundation.
Another opportunity, to be carefully evaluated, will be represented by the forthcoming release, in the first half of 2020, of the Veneto Region call for tenders, that funds the use of researchers in companies, by drawing on the 2014-2020 ERDF POR funds. Being able to involve private companies in the continuation of the development of the AGEDESIGN discoveries through the funding of researchers who could work at the IUAV Industrial Design and Multimedia University, would truly represent a great chance for SMEs in the VENETO Region.

Two other POR FESR financing lines in the Veneto region to finance further developments of AGEDESIGN, also looking at the possibility of creating a start-up to enhance the AGEDESIGN concepts, could be “3.5.1 A -

Creation of manufacturing SMEs and Services" and the "2.2. Digitization of the P.A.", foreseen the last POR FESR 2014-2020 calls.
In fact, an important sector for the application of services based on the AGEDESIGN concepts is represented by equivalent public and public organizations, which deal with the care of the elderly by providing food, accommodation and medical assistance. Contacts are in progress with these organizations, in particular ISRAA of Treviso, to decline the use of the AGEDESIGN concepts in relation to specific new services for elderly guests.

Collaboration between universities and between universities and industrial districts is also bearing fruit. In fact, it emerged the opportunity to give a thesis by Prof Rovati of the University of Modena with the collaboration of the IUAV University of Venice and the Re: Lab company of Reggio Emilia, with the aim of investigating and finalizing possible solutions regarding some of the problems that arose during the development of the AGEDESIGN concept for dehydration measurements with sensors placed on a wrist strap. The possibility of presenting the results of the AGEDESIGN project in one of the next events scheduled in the Biomedical district of Mirandola in Emilia Romagna for 2020 was also taken into consideration.

Following the numerous one-to-one discussions held by Salzburg Research during the Salzburg Sportphysio Therapy Symposium with representatives of companies such as SüssMed https://www.suessmed.com/, Storz Medical Alliance https://www.storzmedical-alliance.de/, Synaptos https://synaptos.at/ and others, further single meetings are foreseen with someone of such companies in the first part of 2020 year, to go into more details concerning AgeDesign suit and sensor technologies for recording motion parameters during selected training exercises.

The network and the network of international contacts that emerged with the development of the AGEDESIGN project, is making it possible to expand the spectrum of AGEDESIGN concepts through EU-funded projects, such as H2020, Life and AAL. The related calls are under consideration by the project partners, in particular the CPV Foundation and the IUAV University of Venice. Contacts are also underway with the University of Modena and The European Platform for Sport Innovation (EPSI) through Prof Medardo Chiapponi of IUAV University in Venice.