AAL Programme

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AAL Programme

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1.Technological Club definition

Our concept of Technological Club resembles with Ba in terms of the platform for the resource concentration, collecting knowledge from the participants and integrates it for knowledge creation. If Ba is more specific towards creating new value and leveraging the knowledge work especially in the business field, Technological Club aims to develop a physical platform where to gather elders, caregivers and/or volunteers, and/or different new speakers on different domains and to support the following processes: socialization, internalization and self-assessment, as shown in Figure 1.

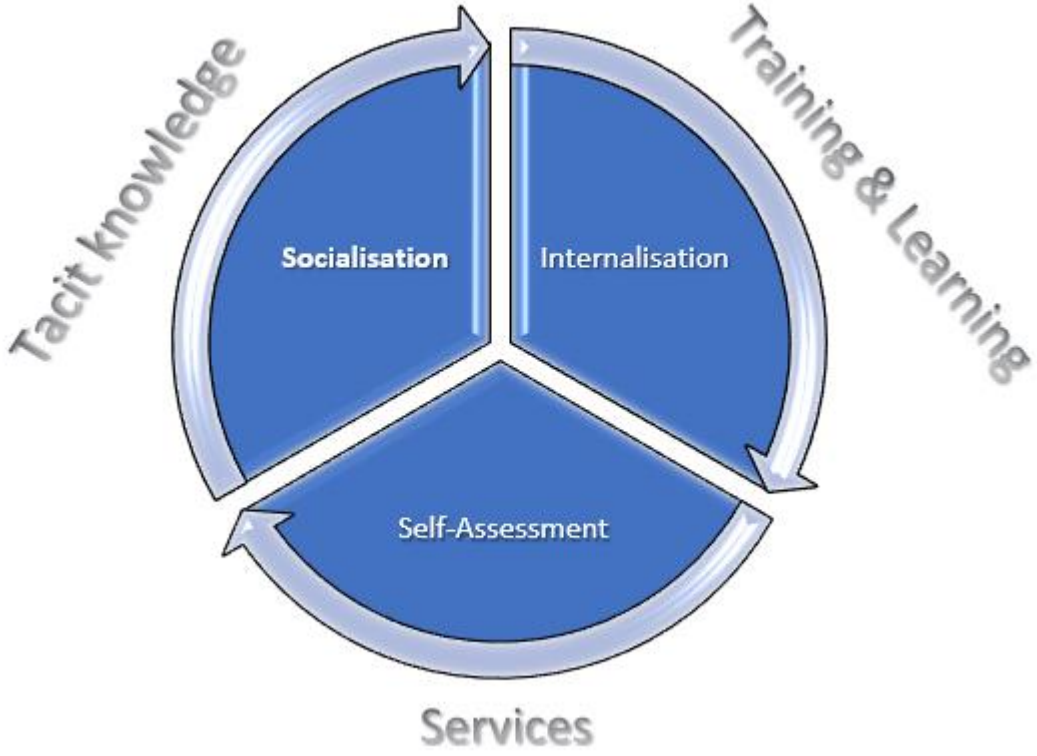

Figure 1. Technology Club processes: socialization, internalization and self-assessment

- ***Socialization*** is about sharing tacit knowledge between elders, through physical proximity, in terms of their daily activities, pure experiences, emotions, their own understandings about different aspects of life and society etc., by spending time together;
- ***Internalization***: is related to the knowledge provided by caregivers/volunteers/speakers about the technology to be used, benefits and training approaches for the accepted proposed Services. Hence, the knowledge provided by the

moderators is explicit knowledge and needs to be put in practice and action with the devices/equipment in order to be internalized by the elders, namely to be learned.

- ***Self-assessment***: the process where elders, practically used the services and devices, within the Technological Club Platform. In this regard, they could use for example:
  - the Choice Reaction Time device and epidermal stress ring to evaluate their reaction time with numerous implications useful for caregivers;
  - eHealth device for measuring biometric parameters in terms of blood pressure, temperature, heart rate, oxygen concentration etc.
  - etc.

2. Technology Club methodology

2.1 Methodology implementation

i. Shall utilize knowledge, not data or info.

ii. Even if each participant is unaware, they have their own style to share knowledge. To create Technological Club, it shall be selected domains where the participants' interest interchanges.

iii. The design of Ba shall create knowledge dynamics, therefore it is necessary to have a moderator or knowledge promoter, as a caregiver or volunteer to interview participants, to visualize their work and living style and conduct Ba design for stimulating knowledge sharing, knowledge internalization and self-assessment processes.

iv. The baseline of Technological Club is creation of socialization in order to provide with a relaxing atmosphere where elders will be comfortable to share knowledge and be attentive.

v. The involvement of moderators (e.g., speakers, volunteers, caregivers) on different fields and services to be embraced will provide with explicit knowledge and internalized (put in practice) by elders when tackling the physical devices.

vi. The possibility to let elders to self-assess while dealing physically on their own with the devices and equipment's (e.g., eHealth, Choice Reaction Time etc.)

vii. The 3 main processes (knowledge sharing, knowledge internalization and self-assessment processes) could take place as follows: successive; simultaneously the first two processes, and afterwards the third process; continuously the first process, while the second and the third successively)

Operational scenario:

Is Friday, 9:00 AM and Michael, Armand and Beatrice arrived at their weekly meeting at the Technological Club (TC). According to today schedule, the first part of the meeting involves ***socialization***. Beatrice shares with the others how happy she was yesterday, when she turned 68, and received an unexpected visit from her grandchildren who gave her a basket with 69 roses. Michael expresses his concern about the pandemic situation caused by the SARS cov-19 virus, and due to the fact that it has not yet been decided whether to be vaccinated, he would

like to receive more information from caregivers in order to help him to make a decision. Armand, who was an epidemiologist, now retired, explains to Michael what the risks are if he is not vaccinated and what are the properly majeures to protect himself from a possible infection with this virus.

The second part of the meeting involves ***internalisation***. Clara, a professional caregiver, tells to the elders that today she will present them a device that measures the biometric parameters in terms of blood pressure, temperature, heart rate, oxygen concentration. First, she projects on the TV screen a short film or suggestive animated images showing the easy to use the eHealth device and its components and then shows them the physical device. She explains to the elders, step-by-step, how to use the eHealth device according to the instructions received from the developer and what are the benefits of using it. After, Maria, a volunteer psychologist, presents to the elders a Choice Reaction Time (CRT) device capable to evaluate their reaction time and a smart ring that is able to monitor their stress level. Maria had the wonderful idea to explain to the elderly how to use the CRT device in the form of a game, which can relax them while using it.

The third part of the meeting involves ***self-assessment***. Beatrice is eager to use the CRT device, so she asks Maria to assist her. She is amazed of how easy it is to use the device and fun in the same time and, after a few tries she managed to use it without Maria's assistance. Armand and Michael start "playing" with the eHealth device and its components assisted by Clara. The two become familiar with the handling of the device and test its functionality by applying the sensors in order to monitor their biometric parameters.

Beatrice is very happy since she was involved in the Technology Club Community because she is not that lonely as before. The three of them are happy due to the fact that their health is monitored at the Technology Club and her doctor can analyze a detailed evolution of her biometric parameters. Also, Armand, Beatrice and Mihai appreciate that social exclusion was diminished.

2.2 Wellbeing evaluation

Integration and implementation of “Technology Club” well-being aspect - Technology Club development by: integration on existing fitness devices (COTS-Commercial Off The Shelf) and implementation of relevant existing methodologies for improving/maintaining well-being.
According[1] to Balakrishnan et al., choice reaction time is the deliberate and voluntary response to an external stimulus. It refers to the specific duration between the application of the stimulus and the subsequent motor response. This time interval, known as reaction time, represents the period from when the stimulus is presented to when the appropriate voluntary response is observed in an individual. Typically measured in milliseconds, reaction time indicates the speed at which neurophysiological, cognitive, and information processes occur as a result of the stimulus acting

[1] Balakrishnan G, Uppinakudru G, Girwar Singh G, Bangera S, Dutt Raghavendra A, Thangavel D. A comparative study on visual choice reaction time for different colors in females. Neurol Res Int. 2014;2014:301473. doi: 10.1155/2014/301473. Epub 2014 Dec 16. PMID: 25580294; PMCID: PMC4280496.

upon a person's sensory system. The sequence of events involved in reaction time includes receiving sensory information (visual or auditory), processing that information, making a decision, and finally, providing a response or executing a motor action. These interconnected processes collectively contribute to what we refer to as reaction time.
As stated in the project proposal, the envisioned WB solutions was tested with users and refined upon their evaluation. Consistent time was allocated to allow such a feedback loop to properly develop. Eventually, users' and stakeholder pilot experience drove the design of market exploitation strategies. In particular, the end-users will be involved, within pilot service implementation, in prototype service utilization sessions and will consequently provide feedback on the developed system. Certain users (keener on technology) were also trained in order to handle in the best and fastest way the interfaces of the system components and were involved in "peer-topeer" training of fellow end-users. The users' feedback will be gathered by the consortium developers in order to finalize/improve the pilot service, and as well to validate the service.
The well-being system, see Figure 2, scope consists in assessing intraindividual variability across reaction time (RT) tasks performance and the corresponding galvanic skin response (GSR).

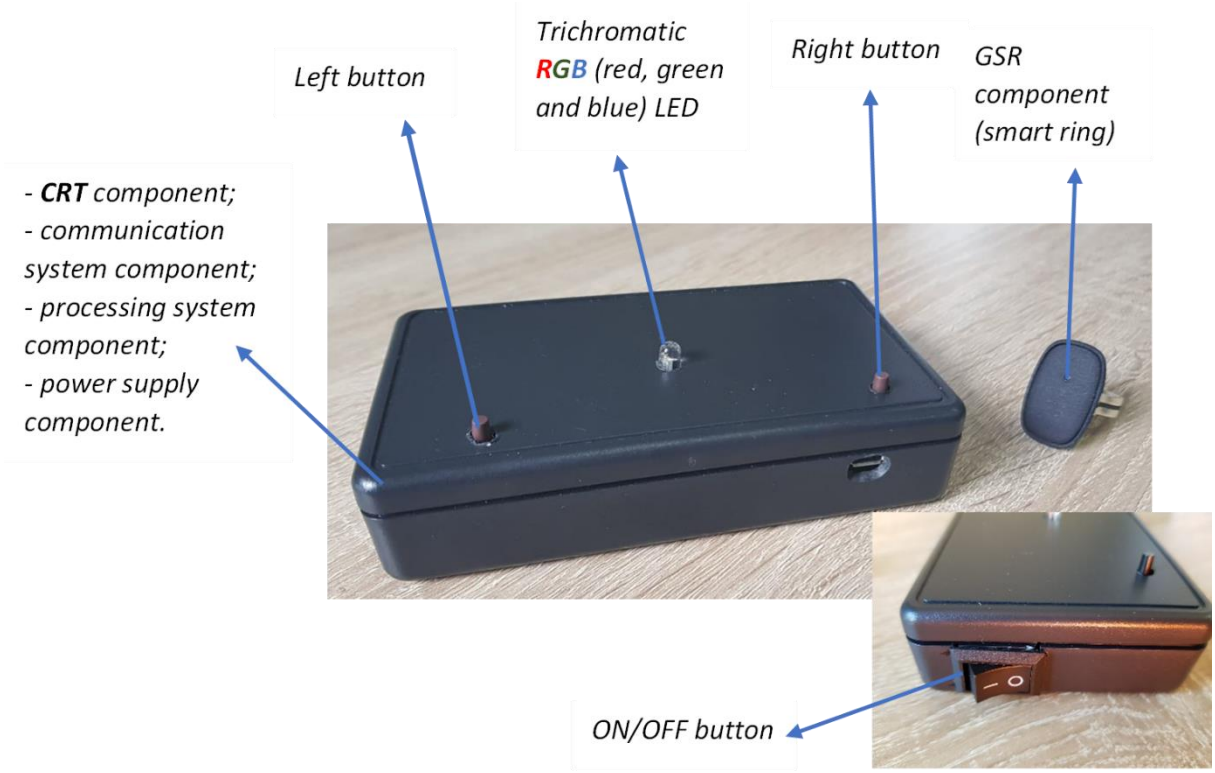

Figure 2. Wellbeing device

Intraindividual variability, according to literature, is considered a risk factor predictive of successful ageing, implicitly well-being, and it is significant in assessing individuals whose disorders are mild.

The proposed well-being assessment system consists of two major components, as Choice Reaction Time (CRT) and Galvanic Skin Response (GSR) system components.

Visual choice reaction time (CRT) tasks performance has been widely analyzed to measure age-related declines in processing speed.

The Well-being system is using wireless and built-in sensor data acquisition, together with a cloud-based platform for both remote and on-site data monitoring.

Choice Reaction Time (CRT) methodology is based on several visual stimuli and two response buttons. In the Figure 1, a trichromatic RGB (red, green, and blue) light-emitting diode (LED) is emitting a stimulus with respect to the following procedure:

- The blue LED color represents the target, and when the blue stimulus lights up, the elder has to discriminate, select, and execute the right button (R);

- The red or green LED colors represent distractors and when the red or green stimulus lights up, the elder has to discriminate, select, and execute the left button (L).

Stress assessment Technologies are based on wearable devices measuring galvanic skin response (GSR) in order to evaluate specific changes and detect stress level and phase (excitement, stress and recovery). Stress assessment Technologies give a way to find a balance between work and free time in order to enhance the well-being state of the person.

The elder wears the stress assessment device, a ring in our case, that analyses the evolution of his stress level. The elder can be advised to stop working, relax and/or breathe in order to diminish stress level and thus, to enhance its well-being state.

Stress Assessment Services evaluate specific changes of stress level and/or stress phase (excitement, stress and recovery) and usually store the data in a cloud for further offline assessments.

The Moodmetric smart ring[2], see Figure 3, was developed for measuring electrodermal activity accurately in a convenient, wearable form able to provide data in real time.

Figure 3. Moodmetric smart ring

The Moodmetric measurement is related to the the sympathetic nervous system activation – the fight-or-flight response. High activation indicates positive or negative stress, low in turn relaxation and calmness. The Moodmetric measurement is intended for a long term and continuous follow-

[2] https://moodmetric.com/wp-content/uploads/sites/22/2020/04/Moodmetric-V7AC_2-user-guide-V1.7.pdf

up on stress and recovery levels and shows clearly the impact of emotional stress on the overall load.

The Moodmetric ring is not a medical device and should not be used to diagnose or treat any medical conditions. The device has an internal, non-removable, rechargeable Li-Ion battery. Normal device operating temperature is between -20º and 35º C / (-4º to 95º F). Charging temperature is between 5ºC and 35ºC (40º to 95º F).

A green indicator LED should blink once when inserting to finger: device is now working and recording and the battery is charged. When the device is removed from finger or when the contact with the skin is lost, the green indicator LED blinks twice. When the battery is low, the red indicator LED starts to blink periodically. If worn with a low battery for extended periods, corruption of recorded data may occur. When the battery is empty, the red indicator LED blinks twice and the ring will shut down. Charge before using. When the charge plug is inserted, an orange light will appear until battery is full. Take the charger off when the orange light shuts off. If the orange light does not light up when the power plug is inserted and the plug is powered, this means the battery is already full and no need to charge, or the temperature is outside the allowed charging temperature window 5ºC to 35ºC (40º to 95º F).

Moodmetric measures your alertness level. A simple reading tells whether you are experiencing stress/excitement or being calm. Note that the measurement can't tell whether your emotion positive or negative, only the intensity of it. The measurement is shown on a scale from 1 to 100, named the MM Level (the Moodmetric level). On the app´s main screen this number displays the stress level at a precise moment, and it updated continuously.

The MM level describes the load you are experiencing. Low electrodermal activity (EDA) means that your mind is at peace. The more intense the feeling, the higher the EDA. The Moodmetric smart ring captures this biosignal and shows the stress/excitement level with the Moodmetric number. The Moodmetric level ranges from 1 to 100. The in-built algorithm learns from the user and gives 100 to the highest experienced load and 1 to lowest. The MM level 100 means being extremely stressed, excited, anxious or frightened. At about 50 the mind is active while below 30 means being relaxed. Level 1 can be reached e.g. at deep sleep.

How to interpret the Moodmetric level:

0-20 Calm

21-40 Serene

41-60 Active

61-80 Worked up

81-100 Running high

Technical specifications

- The Moodmetric app is compatible with iOS and Android

- Contains Bluetooth Smart

- Operating range 5m

- Internal memory ~24 hours

- Battery lifetime ~ 4 days

- Lithium polymer battery, typical charging time approximately 2.5 hours

- Charging from the included USB cable

- Splash proof

- Laser cut stainless steel bands with copper and silver coating

- The Moodmetric ring comes in five sizes (inner diameter indicated in millimeters):

XS / 16mm / US5.5, S / 17mm / US6.5, M /18.5mm / US8.5, L / 20mm / US10, XL /

21.5mm / US12

3. Wellbeing system architecture

Following the design and interaction with users, new functional requirements have emerged for improving the Wellbeing system.

a) The following two operating modes exist:
- regime 1 (UPGRADE version for research purposes) for scientific research with large-scale data extraction: the CRT subsystem should provide response time for each button press, along with the correct/incorrect verdict. In the case of an incorrect press, the reaction time until the correct button press should be monitored. The GSR subsystem should continuously monitor electrodermal activity (3 samples per minute), particularly during CRT activity.
- regime 2 (EXISTING version for caregiver information) for monitoring the elderly by tutors/volunteers on various cloud and mobile platforms using data extracted from the existing version (without upgrade): the CRT subsystem should provide the number of incorrect and correct button presses, minimum and maximum response times, average time, and standard deviation. The GSR subsystem should provide an epidermal stress score.

b) Both operating modes should be able to function simultaneously as follows:

Regime 1 (UPGRADE version) needs to be adapted to the specific requirements of the Technology Club pilot, displaying on-site data through a USB connection to a PC within the Technology Club infrastructure. The displayed data should be exclusively intended for the research team.

Regime 2 (EXISTING version) operates with remote data display through the cloud or a mobile web application for tutors/volunteers.

In accordance with Model Based Systems Engineering (MBSE), the architecture of the Wellbeing system was developed using the Object Process Methodology (OPM) methodology, employing the specific software OPCAT. Thus, the system diagram, which represents the highest level of architecture, is described in Figure 4:

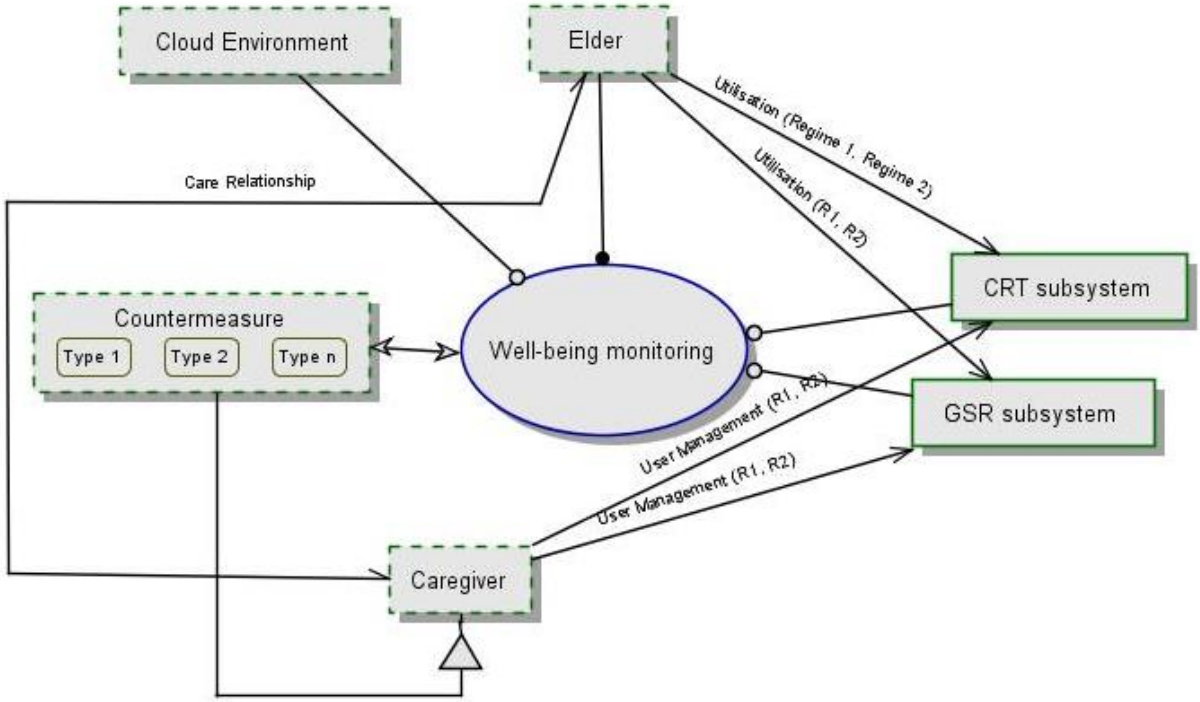

Figure 4. System Diagram (SD) – well-being system. Source: ISS Partener.

The specifications for the SD - Wellbeing, according to the Object Process Language, are as follows::

CRT subsystem is physical.
GSR subsystem is physical.
Cloud Environment is environmental and physical.
Elder is environmental and physical.
Elder Utilisation (Regime 1, Regime 2) CRT subsystem.
Elder Utilisation (R1, R2) GSR subsystem.
Elder and Caregiver are Care Relationship.
Elder handles Well-being monitoring.
Caregiver is environmental and physical.
Caregiver User Management (R1, R2) CRT subsystem.
Caregiver User Management (R1, R2) GSR subsystem.
Countermeasure is environmental and physical.
Countermeasure is a Caregiver.
Countermeasure can be Type 1 by default , Type 2, or Type n.
Well-being monitoring is physical.
Well-being monitoring requires Cloud Environment, GSR subsystem, and CRT subsystem.
Well-being monitoring affects Countermeasure.

The Wellbeing system diagram at level 1.1, as shown in Figure 5, provides a detailed overview of the Wellbeing monitoring process:

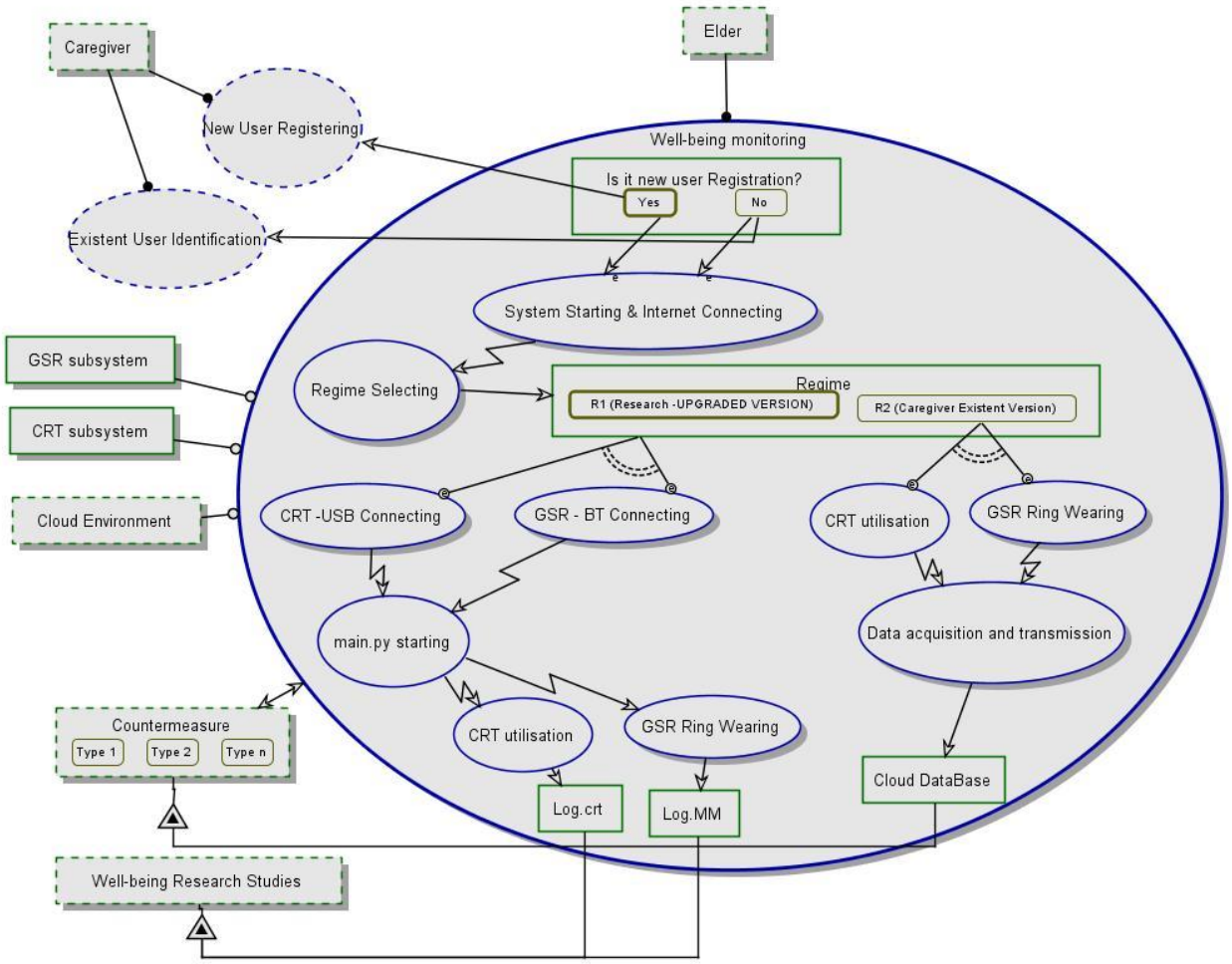

Figure 5. System Diagram (SD) 1.1 – well-being system. Source: ISS Partener.

Specifications SD 1.1 – well-being, conform Object Process Language are the following:

CRT subsystem is physical.
GSR subsystem is physical.
Cloud Environment is environmental and physical.
Elder is environmental and physical.
Elder handles Well-being monitoring.
Countermeasure is environmental and physical.
Countermeasure can be Type 1 by default , Type 2, or Type n.
Countermeasure exhibits Cloud DataBase.
Caregiver is environmental and physical.
Caregiver handles Existent User Identification and New User Registering.
Well-being Research Studies is environmental and physical.
Well-being Research Studies exhibits Log.crt and Log.MM.
New User Registering is environmental.
New User Registering consumes Yes Is it new user Registration?.

Existent User Identification is environmental.
Existent User Identification consumes No Is it new user Registration?.
Well-being monitoring is physical.
Well-being monitoring exhibits Is it new user Registration?, Regime, Log.crt, Log.MM, and Cloud DataBase.
Well-being monitoring consists of System Starting & Internet Connecting, Regime Selecting, CRT -USB Connecting, GSR - BT Connecting, main.py starting, CRT utilization, GSR Ring Wearing, and Data acquisition and transmission.
Well-being monitoring requires Cloud Environment, GSR subsystem, and CRT subsystem.
Well-being monitoring affects Countermeasure.
Well-being monitoring zooms into System Starting & Internet Connecting, Regime Selecting, CRT -USB Connecting, GSR - BT Connecting, Data acquisition and transmission, main.py starting, GSR Ring Wearing, GSR Ring Wearing, CRT utilization, and CRT utilization, as well as Cloud DataBase, Log.MM, Log.crt, Regime, and Is it new user Registration?.

Regime can be R1 (Research -UPGRADED VERSION) or R2 (Caregiver Existent Version).

R1 (Research -UPGRADED VERSION) is initial.

Regime triggers GSR - BT Connecting or CRT -USB Connecting when its state changes.

Regime triggers GSR Ring Wearing or CRT utilization when it enters R2 (Caregiver Existent Version).

Is it new user Registration? can be Yes or No.

Yes is initial.

Is it new user Registration? triggers System Starting & Internet Connecting when it enters Yes.

Is it new user Registration? triggers System Starting & Internet Connecting when it enters No.

System Starting & Internet Connecting is physical.

System Starting & Internet Connecting consumes No Is it new user Registration? and Yes Is it new user Registration?.

System Starting & Internet Connecting invokes Regime Selecting.

Regime Selecting is physical.

Regime Selecting yields Regime.

CRT -USB Connecting is physical.

CRT -USB Connecting requires Regime.

CRT -USB Connecting invokes main.py starting.

GSR - BT Connecting is physical.

GSR - BT Connecting requires Regime.

GSR - BT Connecting invokes main.py starting.

Data acquisition and transmission is physical.

Data acquisition and transmission yields Cloud DataBase.

main.py starting invokes GSR Ring Wearing and CRT utilisation.

GSR Ring Wearing is physical.

GSR Ring Wearing requires R2 (Caregiver Existent Version) Regime.

GSR Ring Wearing yields Log.MM.

GSR Ring Wearing invokes Data acquisition and transmission.

CRT utilisation requires R2 (Caregiver Existent Version) Regime.

CRT utilisation yields Log.crt.
CRT utilisation invokes Data acquisition and transmission.

4. Wellbeing system data acquisition

For the real-time/on-site visualization of the data acquired during the measurements made with the CRT (Choice Reaction Time) and Moodmetric Smart Ring devices, access the main py.exe file, see Figure 6, developed and configured by the partner Institute of Space Science.

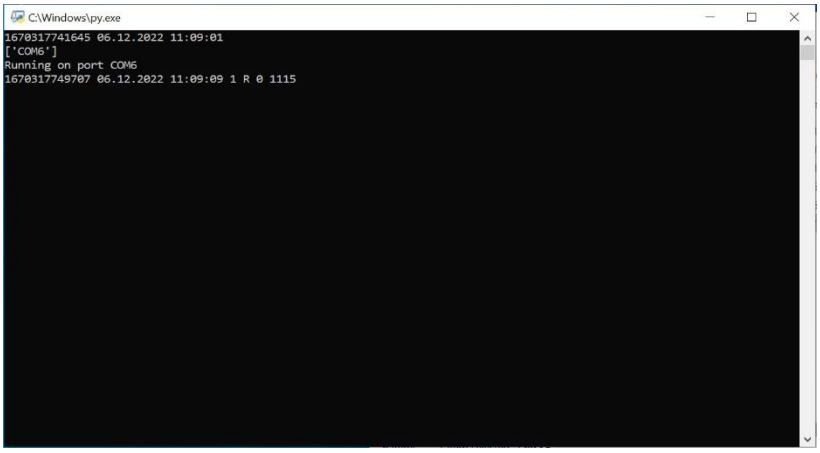

Figure 6. py.exe script in Command Prompt

The connection of the CRT device with the laptop/computer is done via USB cable, as can be seen in Figure 7.

Figure 7. CRT Connection via laptop

During the acquisition/measurements using the CRT device, each choice reaction time will be displayed, as shown in Figure 8, this is a novel improvement of the Wellbeing service.

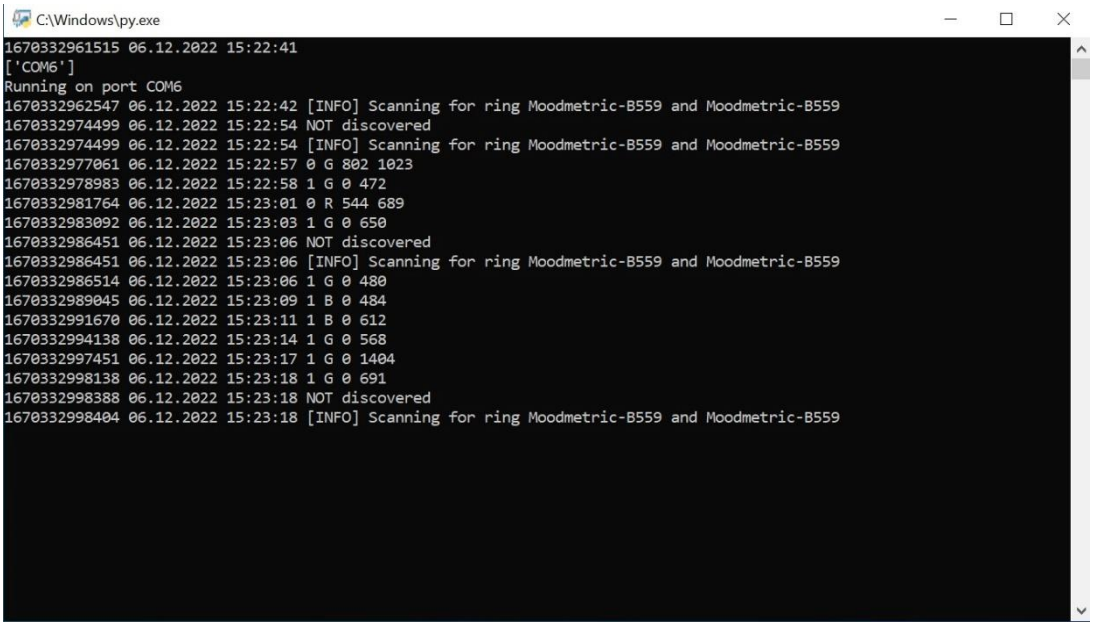

Figure 8. Displaying real-time acquired data

At the end of the measurement, two files will be automatically created, namely: logCRT and logMR, as shown in Figure 6, which contain all the acquired data during the measurement. When the measurement is completed, two files will be automatically created, namely: *logCRT.txt* and *logMR.txt*, as shown in Figure 9, which contain all the data acquired during the measurement.

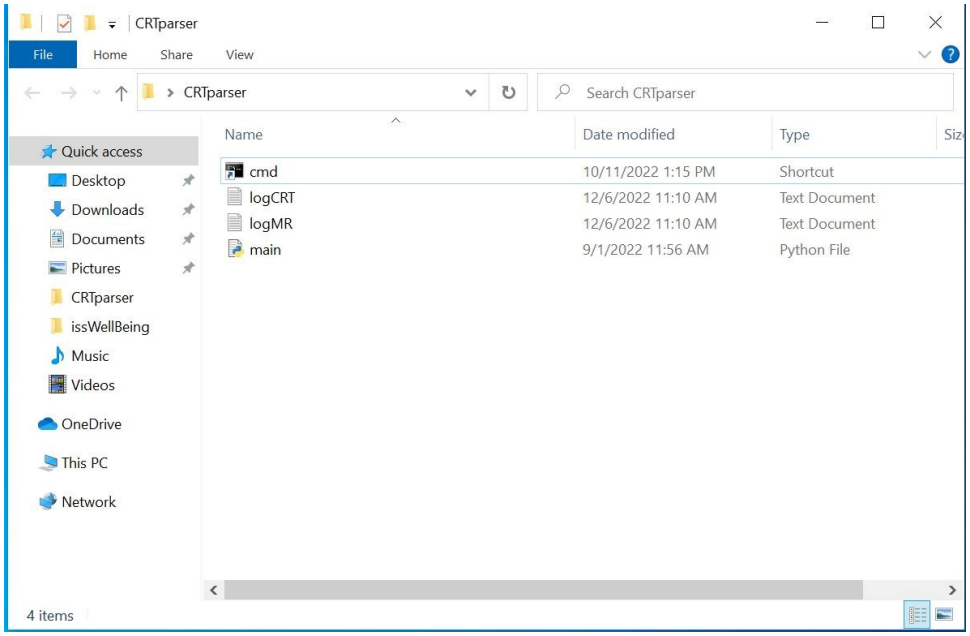

Figure 9. Files logCRT and logMR

The logCRT file, as shown in Figure 10, contains 7 columns representing: column 1 - epoch timestamp, column 2 - acquisition date, column 3 – button pressing time, column 4 - displays 1 if the response is correct and 0 if the response is incorrect, column 5 – the color of the lit LED,

columns 6 and 7 – the time in ms between the led lighting and the response; if response is incorrect, CRT device will wait for correct response and will display it in column 7.

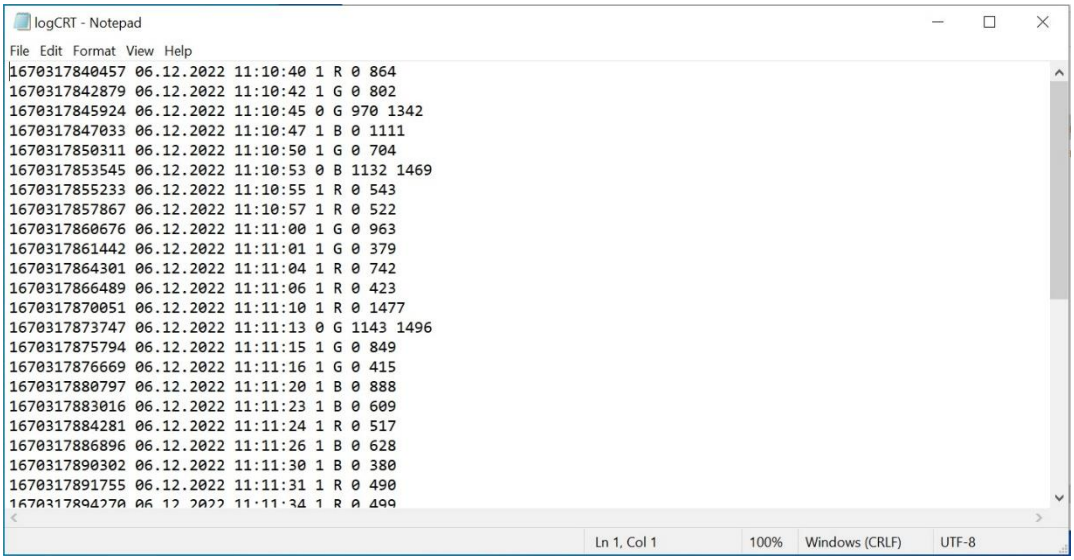

Figure 10. The logCRT file and acquired data format

The logMR file, shown in Figure 11, contains the data acquired during measurements from the Moodmetric smart ring. Similar to logCRT, data is displayed in bits and KOhm and also more info about ring connection are displayed during data acquisition process.

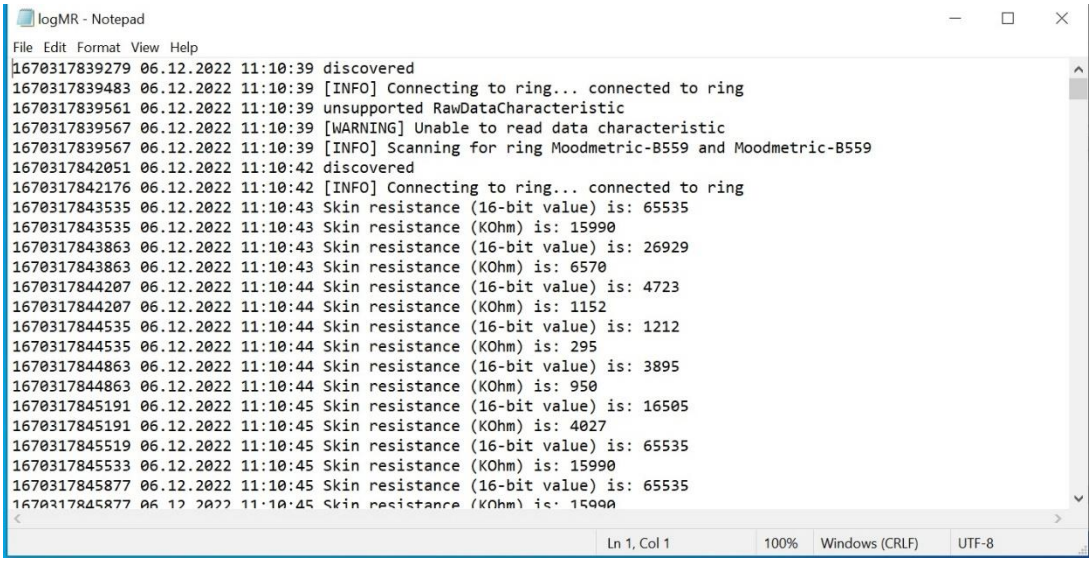

Figure 11. The logMR file and acquired data format

5. Wellbeing user manual

Steps for using the Wellbeing device

A) Steps for using the Wellbeing device in USB mode with data saving to a .txt file:

1. Connect the CRT (Choice Reaction Time) device to the computer via USB.
2. Turn on the CRT device shown in Figure 11 by pressing the button on the right for 5-10 seconds. The CRT measurement session is indicated by the blinking GREEN LED and a series of beeps.
3. Open the Python script main.py, which displays the response time on the screen for each button press, as well as the data from the MR ring (Figure 6).
4. The MR ring (MoodmetricRing) automatically connects to the CRT device via Bluetooth.
5. During the measurement session, the subject should press the left button if the LED turns RED or GREEN, and the right button if the LED turns BLUE. Each measurement session lasts for 2 minutes.
6. If the subject presses the wrong button, a low-frequency sound will notify the user. If there is no reaction from the subject for 2 minutes during the measurement, the measurement is invalidated, and the system restarts.
7. The end of the measurement session is indicated by the blinking BLUE LED and a low-frequency audio signal.
8. The data is automatically saved in 2 separate .txt files, one for CRT and one for MR (as shown in Figure 6).
9. The resulting files are renamed with the subject's ID who performed the procedure. Otherwise, the data will be lost upon the next use of the device..

B) Steps for using the Wellbeing device wirelessly with data transmission to the cloud:

B.1) For new user:

1. Open page http://saveaal.eu:4200/web/#/tc.
2. Fill in all the fields with the correct user information (name, surname, country, etc.), see Figure 12.

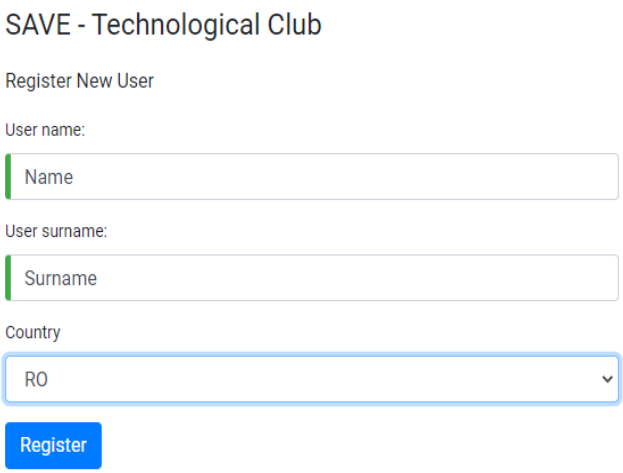

Figure 12. New user interface

3. Push Register button for finalization.
4. Open page http://saveaal.eu:4200/web/#/club.
5. Select the country, the devices used, and the user, see Figure 13. (If the country is not selected correctly, the user will not appear in the list).

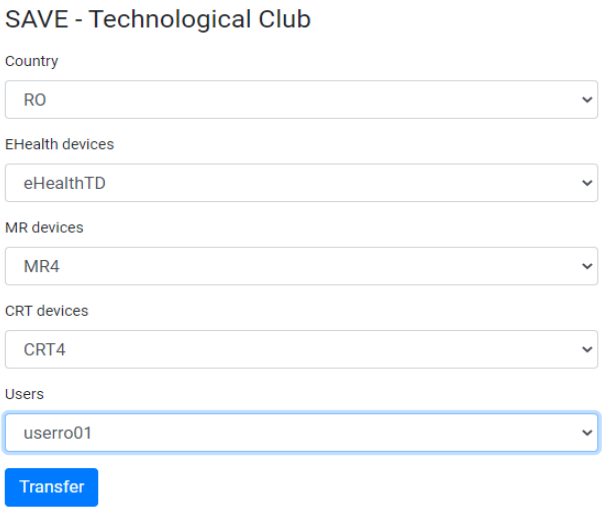

Figure 13. The device assignment interface

6. Press the Transfer button to assign the devices to the user.

B.2) For an existing user, start the procedure from step 4!

Steps for data acquisition:

1. Press the ON/OFF button.

2. Connect the device to a wireless network using the following access details: SSID: issEhealth Password: 1q2w3e4r
3. Position the smart ring, see Figure 11, (GSR - Galvanic Skin Response module) on your finger.
4. Turn on the CRT (Choice Reaction Time) device shown in Figure 14 by pressing the right button for 5-10 seconds. The CRT measurement session is indicated by the flashing GREEN LED and a series of beeps.
5. The end of the measurement session is signaled by the flashing BLUE LED and a low-frequency audio signal.
6. During the measurement session, the subject should press the left button if the LED lights up RED or GREEN, and the right button if the LED lights up BLUE. Each measurement session lasts for 2 minutes. If the subject presses the wrong button, a low-frequency sound will notify the user. If there is no reaction from the subject for 2 minutes during the measurement, the measurement is invalidated, and the system restarts.

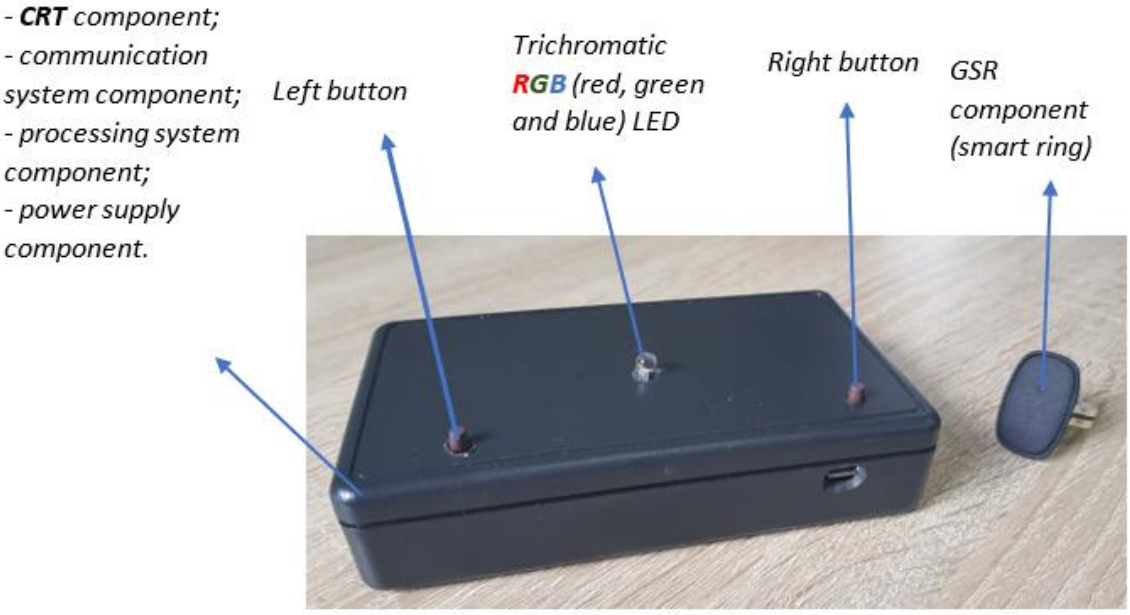

Figure 14. CRT device and Moodmetric ring.

7. The acquired data can be accessed from the cloud:

Link: http://saveaal.eu:4200/admincentre

User: admin

Password: admin