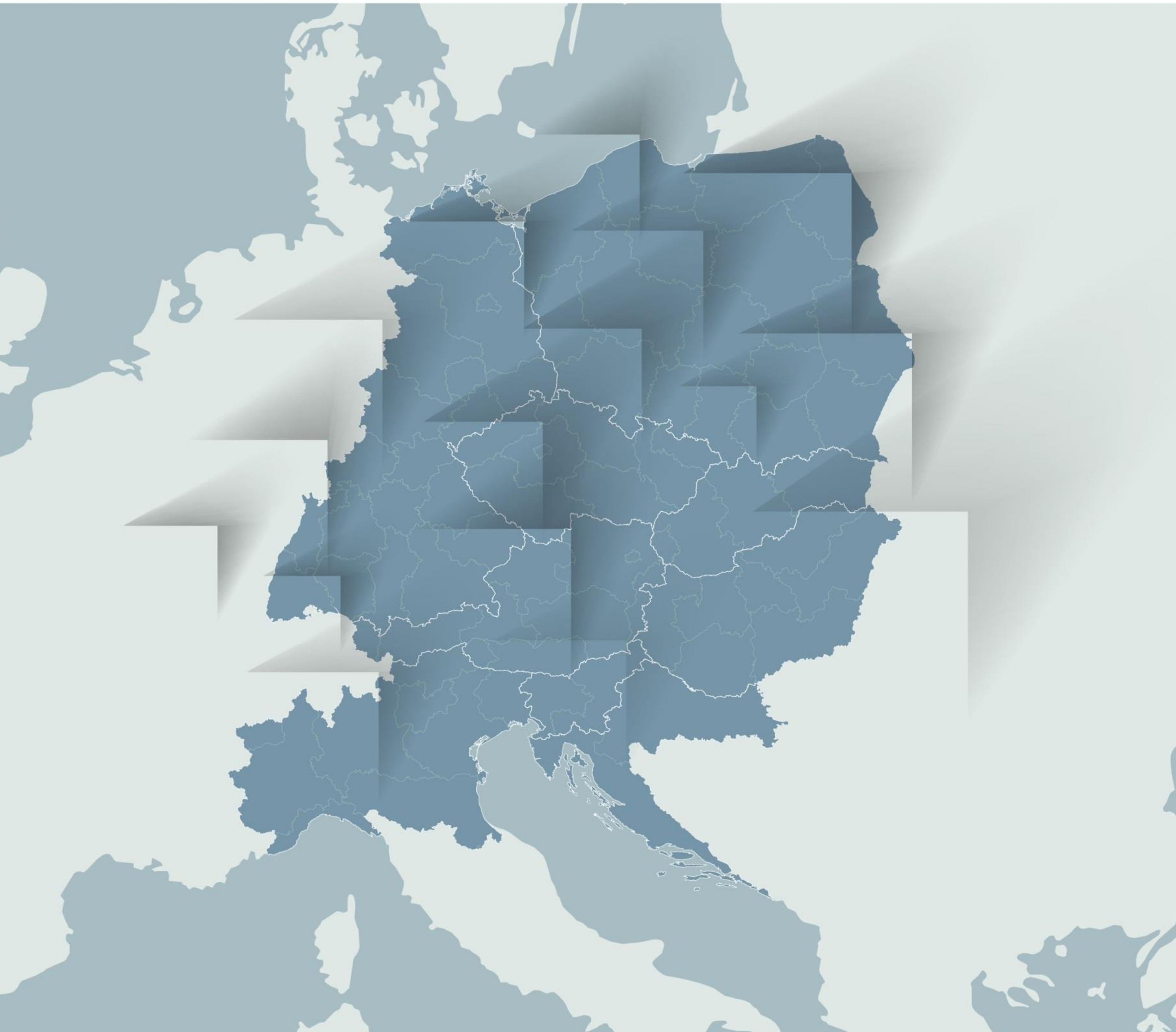
Interreg
CENTRAL EUROPE
European Union
European Regional Development Fund

CE 1581 niCE-life

Testing and finalisation of the tracking tool
(Deliverable DT.2.3.4)

12|2020
(version 1)



1. Introduction

This deliverable is dedicated to the testing, carried out in a controlled environment, of the GPS tracking device and its associated monitoring platform. This brief experimentation, conducted in December 2020, is preparatory to the pilot site activities that will continue throughout 2021. The experimentation in a controlled environment was necessary also because the technological solution will be proposed to frail elderly people, with cognitive disorders, and it was necessary to evaluate the possibility for the solution to respond to the needs of the target considered by the project.

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2. Testing characteristics

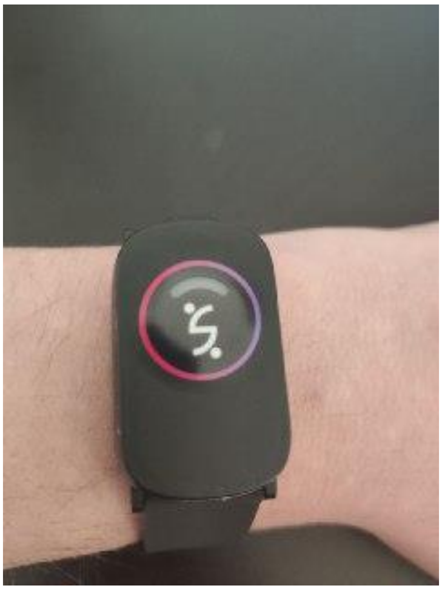
The main features of the testing carried out are as follows.

- The subject who wore the bracelet during the trial was a member of the ISRAA team and not a frail elderly person. The choice was dictated by the need to evaluate the effectiveness of the proposed functions before including frail persons;
- The trial lasted a week overall.
- Another member of the ISRAA team tested not only the wearable device, but also the monitoring platform. This part of the test was dedicated to verify that the usability of the platform was suitable for the skills of the health care professionals and caregivers who will use it every day to check for emergency situations. Furthermore, it was necessary to make sure that the information sent by the device was collected by the platform without any problems.
- The effectiveness of in-building tracking, through the use of tag BLE beacons, will be carried out directly in a nursing home and will start, together with the rest of the pilot, in early 2021.

3. First phase of bracelet testing

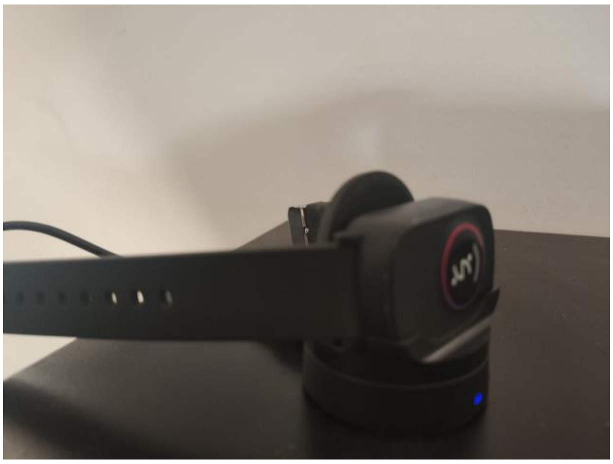
The testing of the monitoring platform and the gps tracking bracelet covered the following elements:

Firstly, the usability and characteristics of the wristband were tested. It is comfortable to wear, even while sleeping. The low weight and small size means that the device can be worn continuously for several days at a time.



the bracelet, unlike other solutions on the market, does not have a display showing the time. This choice is due to the need to reduce the energy consumption of the device as much as possible. The various sensors that allow the device to collect data are all located in the case. In addition to a SIM card soldered directly into the device by the manufacturers, the case also contains a heart rate sensor, a step counter and a gyroscope to detect falls.
The device has a single button on top. This button must be pressed by the elderly person in an emergency. The wristband straps are made of rubber and can be replaced or modified to meet the specific needs of people who will use this technology. In addition, there is also the possibility, depending on the characteristics of the person who will participate in the pilot, to make it impossible to remove the device independently.

A second element of analysis, as far as hardware is concerned, is the battery life of the device and how it is charged. During the test, after the week of use, the device was deliberately left on in order to check the battery life. It basically depends on how often data is sent from the wearable device to the platform. This variable is adjustable directly from the platform, and the frequency of sending data can be adjusted for each element such as position, heart rate and guard zones. Regarding the crucial element of this experiment, the position detected by the GPS, a frequency of sending the position every two hours was set. This allowed the device's battery to last 21 days.

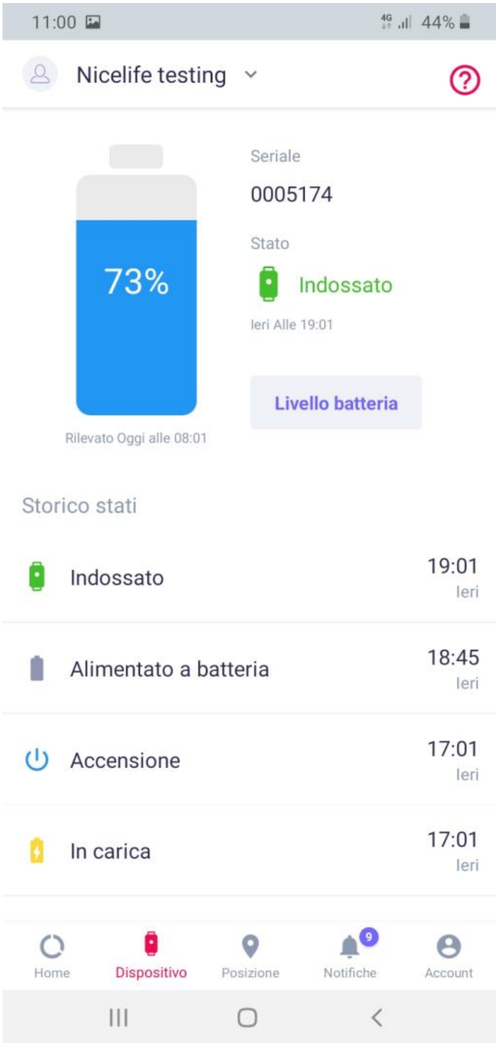


As far as charging is concerned, there is a magnetic base to which the bracelet can be simply placed. This implies a high degree of usability, as for elderly people it is often complicated to use the power cables commonly available on the market. The charging process takes several hours and the end of the charging process is indicated by the LED light in the charging base.
Finally, with regard to the functioning of the bracelet, the tests led to the evaluation of the importance of wearing the bracelet correctly in order to obtain the correct information in the monitoring platform. In particular, the useful information for the subsequent pilot site is:

- In order for the sensors to function correctly, it is necessary that the cuff worn DOES NOT MOVE on the wrist.
- It is therefore necessary to ensure that the strap is tight enough to prevent movement of the cuff.
- It must also be ensured that there is no space/light between the bottom of the cuff and the skin of the wrist on which the cuff rests.
- Care should therefore be taken to ensure that the bracelet fits snugly around the wrist and does NOT rest on the wrist bone.

4. Phase 2: Testing the functioning of the platform connected to the bracelet

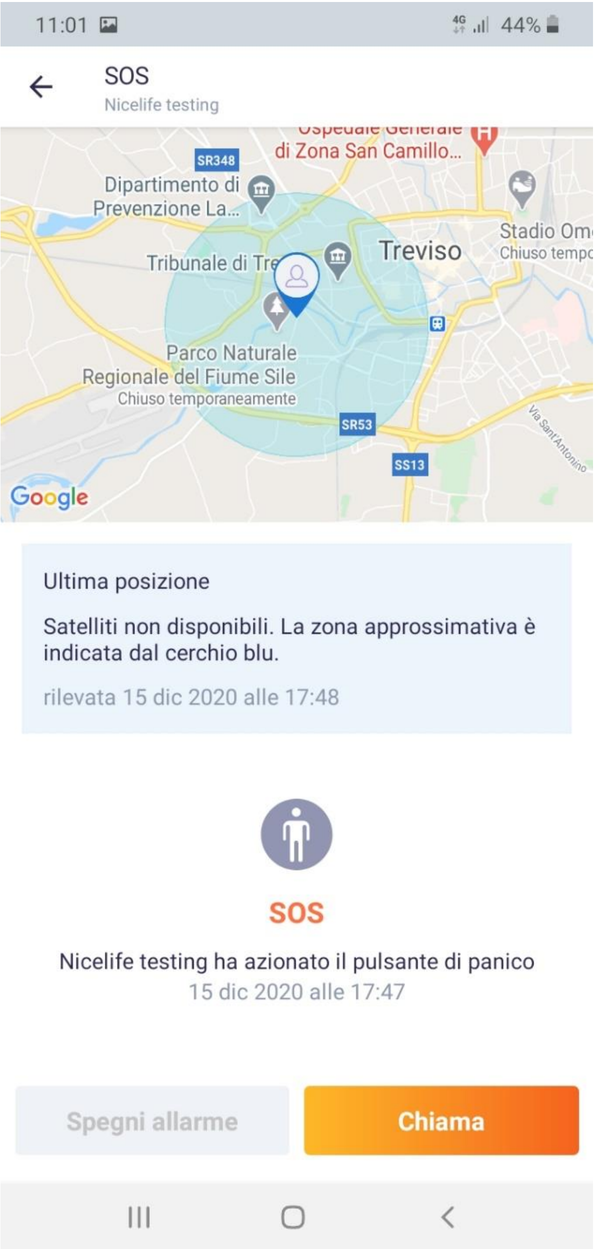
In the first testing phase the focus was on the characteristics of the wristband and the usability related to the specific target group of the project. In the second testing phase, the focus was on the iteration of the wearable device with the monitoring platform. This is crucial as the wristband alone, without the support of the platform, is of no use.



The first element investigated by the test was the association of the device with the specific user, through the monitoring platform. Each device has a specific code that must be connected to the personal data of the person in charge. The steps to perform this operation are simple and allow to quickly associate the user not only to the device, but also to formal and informal caregivers. It is also possible to provide informal carers with a qr code to scan with their personal smartphone, so that they can associate their own contact with their relative's bracelet. This ease of use is expected to be crucial in enhancing the role of the informal carer in supporting their family member.

After the process of associating the device to the user, the test focused on the most relevant functionalities.

First of all, we tested through the platform the possibility to know some crucial information about the use of the device, i.e. the charge level, if the device is worn or not and if the device is turned on. The testing activity also verified the possibility that the system automatically sends alerts if the elderly person removes the wristband and if it runs out of power. This allows the care manager or familiar to intervene promptly to support the elderly person, reducing the overall risk level as much as possible.



GPS tracking and emergency button

Turning the attention to the main functionalities offered by the device and the digital ecosystem as a whole, the ISRAA team focused first of all on the GPS tracking function. It should be noted in this regard that between the two ways of accessing the platform, the team chose the mobile application, because it is closer to the mode that will be implemented during the pilot site. Therefore, through the app, we easily verified the position of the subject wearing the bracelet. In light of the chosen settings, i.e. the updating of the position every 2 hours, we also wanted to check the reliability of the tracking in case of an emergency.

We pressed the emergency button on the wearable. This immediately triggered the vibration of the wristband, the activation of the emergency light and the immediate sending of the support request.

The support request arrived at the platform in about two minutes, triggering the appropriate audible alarm (we verified that it starts in both the mobile application and the web-based platform). The alarm continues to sound until an authorised user takes charge of the emergency. Once the alarm has been taken over, it is first of all possible to call directly the person who raised the alarm. In addition, the position of the person in need can be identified in real time. During testing, it was verified that the accuracy of the bracelet's position was not always accurate, due to two basic elements - the presence of available satellites; - the type of building in which the person is present. These problems can be overcome through the use of BLE beacon tags, which guarantee maximum accuracy even when the person is inside a building. In addition, even in cases where it is not possible to precisely define the position of the subject, the platform identifies the maximum perimeter within which the subject is present (the area in blue in the image).

The emergency signal from the device is not the only action that causes the automatic creation of notifications that reach formal and informal carers through the monitoring platform. They are also generated in other situations. For example, alerts are generated when the battery drops to an excessively low level or when communication between the device and the platform is interrupted.

Fall detection

Emergencies can also be generated by other factors, such as falls. A specific test has been carried out in this respect. The bracelet is able to :

- automatically detect "serious" falls with a significant impact on the ground

- send an alarm when the person is immobile for a few seconds after the fall and is therefore unable to press the SOS button

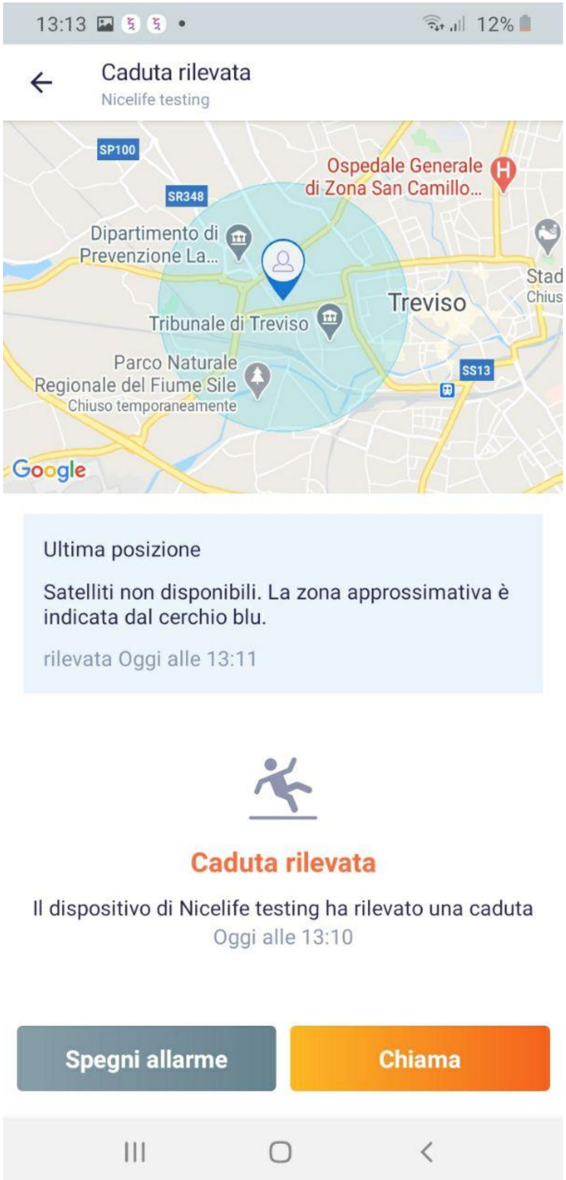
- If the fall is slight (slipping) or movement is detected after the fall, then the device does not generate an alarm automatically, because the person can press the SOS button independently to call for help.

Very occasionally it can happen that some daily action is detected as a fall and therefore a false alarm is generated.

The automatic fall detection is very sophisticated to be able to distinguish a real fall from an everyday situation.

To simulate a fall and generate an alarm we followed these steps:

1. Wear the bracelet for at least 5 minutes
2. Stand on a carpet of a certain thickness.
3. With arm outstretched in front of you and the bracelet held by the buckle.
4. Count to 15 (seconds)
5. Dropping the bracelet
6. Count up to 15 (seconds) WITHOUT MOVING the cuff.
7. It will begin to vibrate, flash and beep if it has detected the drop.



At the end of the test the behaviour of the device and the platform was perfectly in line with what was assumed.

Data transmission and localisation

With regard to these important elements, the test resulted in the following information.

When first turned on, a SOS REQUEST test was performed immediately by pressing the main "S" button for 2 seconds until a RED flash was seen. After a few minutes an alarm was sent to the paired smartphone.

When fully operational, the bracelet sends data with different frequencies depending on the type of data:

- URGENT: Notifications of all alarms (SOS, FALL, ALARM) are INSTANT and arrive within 2/3 minutes of the event.
- NON-URGENT: Data on heart rate, sleep, steps, battery etc. arrive every 2/3 hours to save battery power.

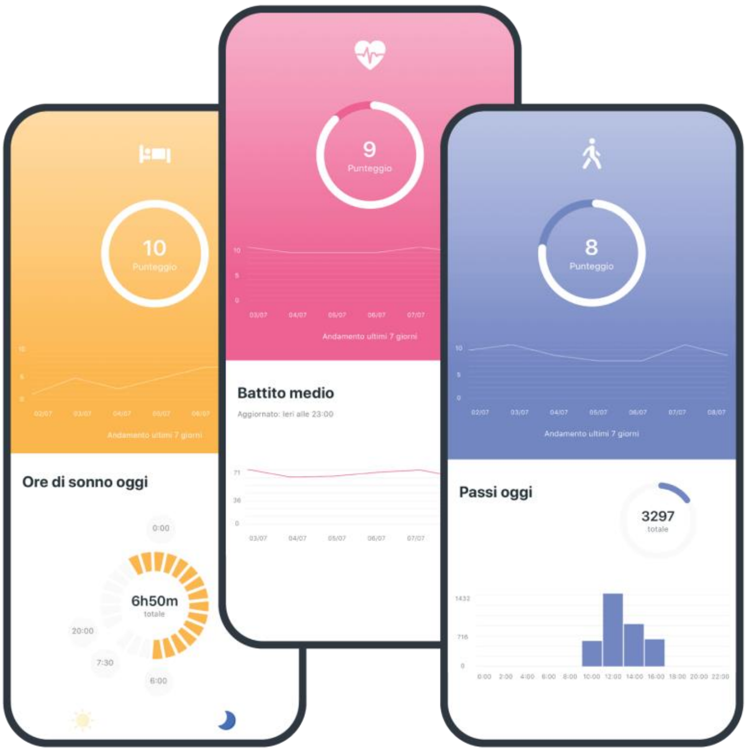
After the first few hours after switching on the data was not yet available, as the bracelet, when worn for the first time, requires at least 24 hours of data acquisition in order to display the well-being parameters: cardio, steps etc.

As far as localisation is concerned, the bracelet is able to locate the position of the person wearing the bracelet in various ways and scenarios:

- OUTDOOR: The location is very precise (<50m) thanks to the integrated GPS.
- AT HOME: Inside the home, the satellite signal is often masked. The wristband is however able to detect the position with an approximate accuracy of up to 2km indicated by the blue circle.

Wellness-related functions

The wristband and the monitoring platform also provide for the collection of other data necessary to support the health of the elderly person.



The three types of wellbeing data sent to the monitoring platform are:

- Heart rate to intercept dangerous peaks;
- Checks quantity and quality of sleep at night and during the day;
- It measures the level of physical activity and steps taken daily and during the week;

The platform automatically generates ratings based on the data generated by the bracelet.

This information can help the person wearing the bracelet to improve their health by intervening in their lifestyle. Finally, it is worth noting that it is possible to set thresholds for cardiac activity, which if exceeded generate automatic alarms that activate the rescue chain.

5. Conclusions

At a general level, the experiment respected the hypotheses that had been developed. The solution proved to be extremely user-friendly and therefore in line with the characteristics of the target group. Usability characterises both the device and the monitoring platform. The latter was tested both in terms of the application and the web-based programme. Both solutions seem to be suitable, but the mobile application certainly succeeds in representing more effectively and clearly the condition of the user wearing the bracelet.

Both the safety and well-being dimensions can be adequately supported by the device in question. In the first instance, however, the gps tracking and security dimension is central to the functionality of the device.

From a reliability point of view, the device has a very long battery life and the information sent has a good level of accuracy. The pilot site phase with senior citizens and a large number of participants will confirm the information gathered in the testing phases, which is positive from the first analysis.