Interreg CENTRAL EUROPE
European Union
European Regional Development Fund

niCE-life

VALORISATION OF EXISTING KNOWLEDGE AND SYNERGIES

niCE-life Project Overview

Brief description of the niCE-life project

The project focuses on the development of an integrated concept for the deployment of innovative technologies and services allowing independent living of frail elderly. More specifically, the aims of the project are:

- to foster social inclusion and care coordination of the elderly with focus on persons with cognitive medium-low deficits, including Alzheimer's, Parkinson's and other chronic diseases;
- to develop an innovative and transnationally applicable model of health and care services for frail elderly by using progressive technologies (such as sensor technologies, ICT and data analysis techniques) in order to enhance quality of care, to prevent frailty of the elderly, and support their independent living, social contacts and assistance after hospital discharges;
- to strengthen the capacities and competencies of public authorities and health and care providers through local action plans and provided targeted trainings regarding the developed tools, in order to efficiently address pressing social challenges and foster independent living of the elderly.

Short description of good practice from Bologna

The Ecare Network of Bologna, active since 2005 and created by CUP 2000 (now Lepida) on behalf of the Bologna Local Health Authority and 50 municipalities in its district with the support of the Emilia Romagna Fund for not self-sufficient people, has formed a network of social services and community groups (citizens, associations, public authorities and professionals) to support the frail elderly.

The **e-Care contact centre** talks to 1 500 frail elderly a year. Those people are over 75 years old, live alone and are considered frail because of health or social conditions. Contact centre operators call them every 7 or 10 days, depending on their frailty level. During the calls, operators collect information in order to check on the daily status of the patients and update their files.

The first contact of a senior with the e-Care contact centre is often suggested by social assistants, nurses, general practitioners and volunteers. During the first phone call with the senior, e-Care operators explain the services and interview the client in order to collect information not only about his/her health status, diets, medications, past hospitalizations and outpatient visits, but also about relatives, friends, personal interests, preferences and personal skills. This information is then recorded into the personal file of the "e-Care patient", so that the operators can later adjust each phone call according to the personal needs of a particular patient. They can provide help with transport, socialization, assistance, groceries, friendly visits, but also offer counselling in specific situations, e.g., abuse or mistreatment by relatives or neighbours.

Intelligent monitoring tool

Responsible partner: Brno University of Technology – Czech Republic

Brief description

The online sleep monitoring system is a web-based application for remote (in-home) and non-invasive sleep assessment and monitoring for patients suffering from a variety of neurodegenerative disorders such as Alzheimer's disease and/or Parkinson's disease and many others. It takes advantage of the state-of-the-art approach towards using wearable technologies for measuring human wellbeing and fitness. Specifically, the designed online sleep monitoring system uses the actigraphy bracelet device to record a set of body-level and other signals such as hand acceleration in 3D (x, y, and z axes), temperature, light level, etc. These signals are then safely stored and transferred to be processed and parametrised using specifically designed advanced digital signal processing algorithms to compute the hidden and possibly complex characteristics of the acquired data, and machine learning techniques to predict, assess, and monitor the presence of sleep disorders. The system is designed to provide clinicians with a convenient way of measuring and analysing sleep-related data.

Main added value for each end-user

There are two end-users of the system: doctors and patients. A patient wears a borrowed actigraph during sleep according to the instructions given by a doctor to collect sleep data for the consequent processing and analysis. After the data is collected, the patient will be able to upload the data into the system via his/her profile. After the data is uploaded, the doctor can apply trained machine learning models (e.g., to detect sleep stages, specific sleep disorders, etc.).

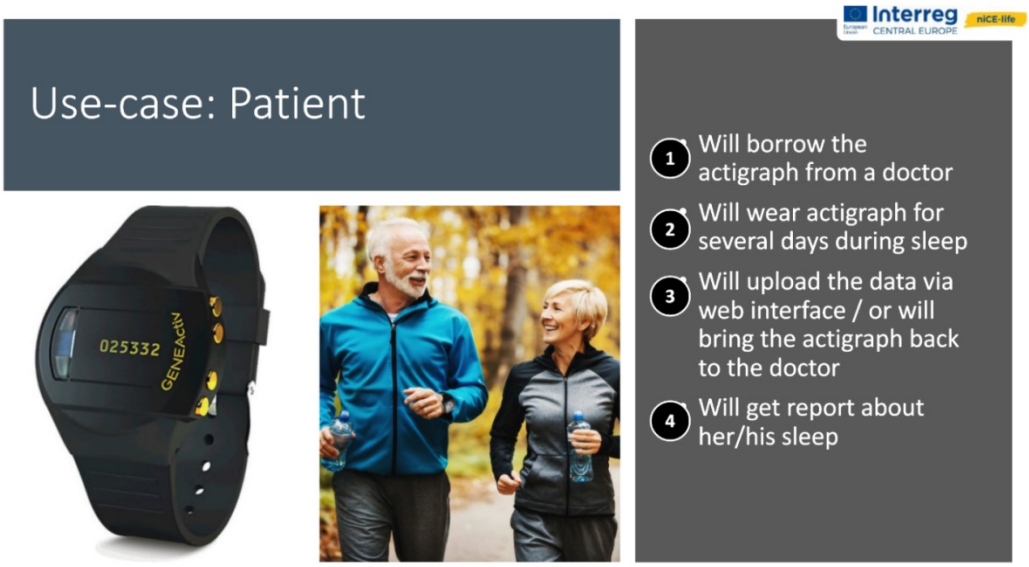


Figure 1: Patient's point of view

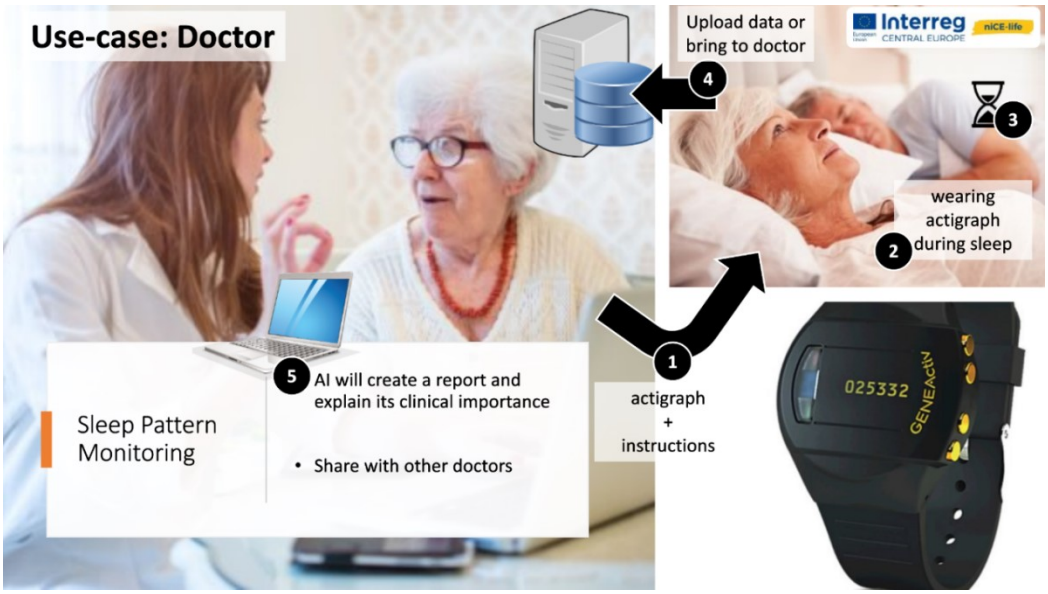


Figure 2: Doctor's point of view

Used technologies

The online sleep monitoring system will be designed as a client-server web application. The front-end part of the system serves as a gate into the system itself (used by all parties involved, e.g., patients, doctors, administrators), and it is also used for the presentation of results to the patient (and other people involved in the process). The back-end part of the system is used for data storage, data processing, data analysis, data/user/access/rights, management, results generation, communication with the front-end part, etc.

Evaluation method - data, organizational

According to the original time plan, the monitoring tool was to be presented and tested with project partners and target groups during targeted meetings at the local level (6 meetings). Due to COVID-19 situation the meetings will be held online.

Data analysis

The Intelligent monitoring tool will use machine learning algorithms in order to use long term signal monitoring from wearable devices and prediction of brain diseases in its prodromal stages, i.e., when the person still feels well, there are no significant symptoms apparent, yet, the disease has the highest potential for development. The prodromal stage in case of brain diseases can last up to 10 years. Unfortunately, once the symptoms are apparent, it is too late, since the disease has already caused extensive brain damage.

Monitoring grid

Responsible partner: Samaritan Burgenland Department of Home Care – Austria

The Monitoring Grid, which was developed within the framework of the niCE-life project, is based on the Monitoring Grid, which is part of the Bologna e-Care network.

Brief description

The Monitoring Grid **aims to monitor the state of health** (both physical and mental) of elderly people over a longer period of time and on a regular basis. In this way, any deterioration should be recognized in good time, targeted measures initiated and complicated long-term consequences avoided. This should enable older people to live an independent life at home for as long as possible. To achieve this goal, the Monitoring Grid was developed as a basis for weekly telephone calls, which should work as follows: Trained staff call the elderly every week and enter the answers in the Monitoring Grid. The web application analyses the answers and shows the health status development in a line and in a spider diagram. To be able to collect and evaluate the acquired data effectively, there are five distinct categories: 1/ Personal data; 2/ Medical history; 3/ Clinical factors; 4/ Functional factors; 5/ Social factors.

In order to give the elderly an opportunity to contact the monitoring team, the Monitoring Grid will be extended by the **home emergency call**.

During the implementation of WP T1 it turned out that the residents not only want to be called, but they also want to be able to call the nursing staff themselves. To make this possible, the home emergency call already in use will be extended by another button, namely the **"service button"**.
Therefore, the home emergency call offered by the Samaritan Burgenland Department of Home Care will have 2 functions:

- Call for rescue in the event of an emergency.
- Call a caregiver to ask essential questions.

Main added value for each end-user

The target group of the Monitoring Grid are people, who

- live in Burgenland,
- are over 75 years old and
- have a home emergency call (in the event that they also want to contact the monitoring team)

The third criterion is not mandatory.

One of the most important advantages of the Monitoring Grid is that it can help elderly people to live independently at home. This can be made possible by:

- **Having more information about the patient** - Fluctuations in the client's state of health and risk factors are observed and documented over a long-term period. This means that interventions and future measures can be planned and implemented in a targeted and timely manner. Consequential damage (e.g., lengthy hospital stays) can be avoided (e.g., relieve loneliness before it turns into depression). The Monitoring Grid enables inexpensive action versus cost-intensive response.
- **Having more information for the patient -** Personal responsibility and self-management of elderly people can be strengthened by pointing out the need for certain activities, e.g., taking medication, measuring high blood pressure, etc.
- **Contribution to social participation -** Regular calls themselves already represent added value for the interviewee: the elderly "feel heard" and experience social participation. This alone can improve their quality of life. Furthermore, patients have the opportunity to turn to someone if they need to talk. Social isolation can be reduced by intensifying "neighbourly help" and social contacts. In addition, regular calls provide the elderly with more security.

Used technologies

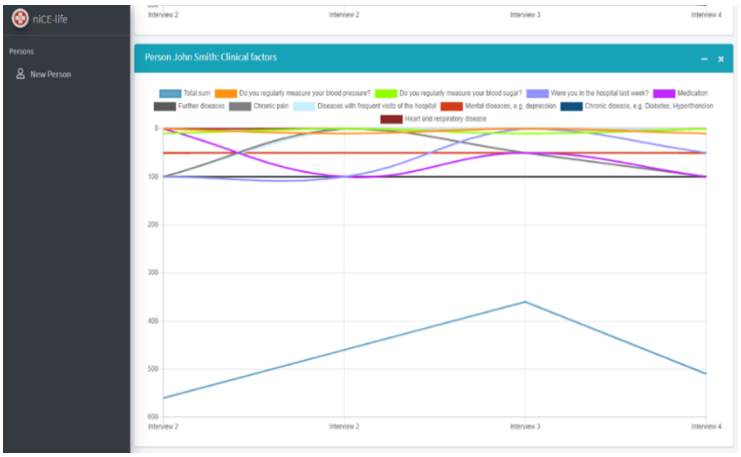
The technical realization of the proposed solution is based on the JAVA platform where the so-called thin client is being used. Spring Framework is a Java platform that provides comprehensive infrastructure support for developing Java applications. The ORM module provides integration layers for object-relational mapping APIs, including Hibernate, which was used in our case. The Web layer consists of the Spring-MVC framework and is based on the Model-View-Controller framework. The application is secured over a set of protocols, so the data is protected.

Data analyses

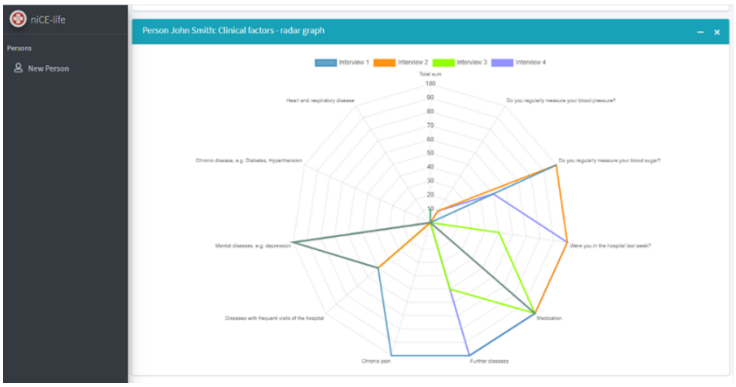
The results of the interview are evaluated and visualized using three types of charts:

- A complete overview shows the overall development of all three factors (clinical, functional, social) and the development combined in a total curve.

- Line charts of the individual factors: The development of individual topics in the different groups of factors is shown in a separate line chart:



- Radar charts of the individual factors: The development of individual topics in the different groups of factors is shown in a separate radar chart.



Care for frail

Responsible partner: University hospital Olomouc - Czech Republic

Brief description

The **aim of this digital tool is to create software supporting processes that take place when patients are discharged from hospital** because in CZ and SK the coordination, communication and information flow from one actor to another in the process is currently not digitalized, is inefficient in terms of fast sharing of critical information and is very challenging regarding the human resources in the involved institutions.

Main added value for each end-user

Added value for a patient is more care and time dedicated to him/her by home caregiver instead of the time dedicated to dealing with processes (e.g., handling medical documentation). The patient is also safer at home instead of travelling to his/her practitioner and spending time in waiting rooms. In the Czech Republic, there is a lack of electronic health records and it is very difficult to share the data between providers of health care. The system is based on simple communication between patients and providers to ensure appropriate care. The new platform will enable secure and credible management of each case of relevant patients discharged from hospitals (frail, comorbidities, injury, older, alone, poor, mental illness) and data exchange between follow-up care providers either in care institutions or homes of the patients (formal or informal home care).

Used technologies

The new tool is a SW platform able to support faster and efficient coordination of demands and available capacities and pertinent administration of health and social care providers in the whole region, namely, between hospitals, general practitioners, patients and their families and home care providers. The platform runs on computers with implemented security measures. One of its functions allows for effective stratification of seniors' frailty index. Additional solution that can be used to further enhance care of these patients will be based on a digital tool for video consultations between care specialists and chronically ill patients, combined with a telemedicine system that allows data collection about patient's health (e.g., blood pressure, body weight, fluid intake, etc.) and make it available to healthcare professionals involved in the care of the particular patients.

Evaluation method – data, organizational

The whole service will be evaluated by MAST (Model for assessment of telemedicine tool) or KPI (Key Performance Indicators) and by evaluation methods from Bologna and compared with methods used in CZ and SK for evaluation of care. To measure the impact of care and its contributions to the quality of the patient and family experience, a combination of two evaluation methods will be used: KPI for social and healthcare and questionnaires on quality of life and how the end users adopted the whole platform.

Data analysis

The platform will collect and share data about the health status of end users/patients and the documentation after discharge from hospitals. For chronically ill patients there is a possibility to measure their health status by blood pressure, heart rate, weight, etc. Telemedicine data is analysed within the platform and an alert signal is sent to the provider/case manager. The platform will allow prediction based on the frailty index used in the monitoring grid tool.

AP-NURSE

Responsible partner: Slovak University of Technology in Bratislava - Slovakia

Description of the AP-NURSE system

AP-NURSE is a simple modular monitoring tool used for home and medical application in case of patients suffering from Alzheimer's and Parkinson's disease. It encompasses ambient sensors, which can monitor activity patterns, gas, temperature and sound aspects. Its aim is to support independent living of frail elderly and simplify the work of home caregivers or nurses by monitoring basic interactions of patients with their environment during day or night job duties and provide fast alerts about possible dangers.

The AP-NURSE digital tool is designed for multiple areas of application. Therefore, two versions of the system are being developed - AP-NURSE Home and AP NURSE Care. AP-NURSE Home is designed for home use and the AP-NURSE Care for care centres. AP-NURSE Home is a set of simple and inexpensive small monitoring devices that monitor several environmental factors of patient surroundings and are placed at home of a frail elderly or a patient to ease the everyday life of caregivers, who are usually family members. AP-NURSE Care as a multi-patient platform represents a set of small monitoring devices that monitor several environmental factors of patient surroundings, placed at a care centre to ease the job duties of the caregiving personnel.

The flowcharts of AP-NURSE Home and Care are shown in Figures 3 and 4. In case of any emergency detected by AP-NURSE Home, a caregiver is notified by a simple rubber watch/bracelet. It is assumed that the patient lives together with the caregiver (likely a family member) in one household, therefore to minimize disturbance of the caregiver's partner (a husband/a wife) at night, the bracelet warns the caregiver by vibrating pattern (RF433MHz module with hard encoded addresses is used). In the case of AP-NURSE Care, the caregiving personnel monitoring the conditions of the patients from the nursing room is notified on the computer or mobile app. The conditions of the monitored patients are evaluated using simple traffic light logic - the green light represents normal condition; the orange light represents abnormal condition; and the red light represents critical condition requiring action.

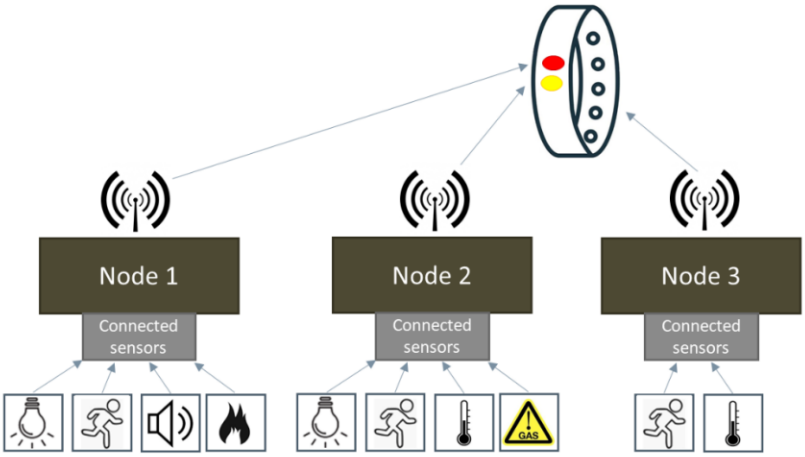


Figure 3: AP-NURSE Home flowchart

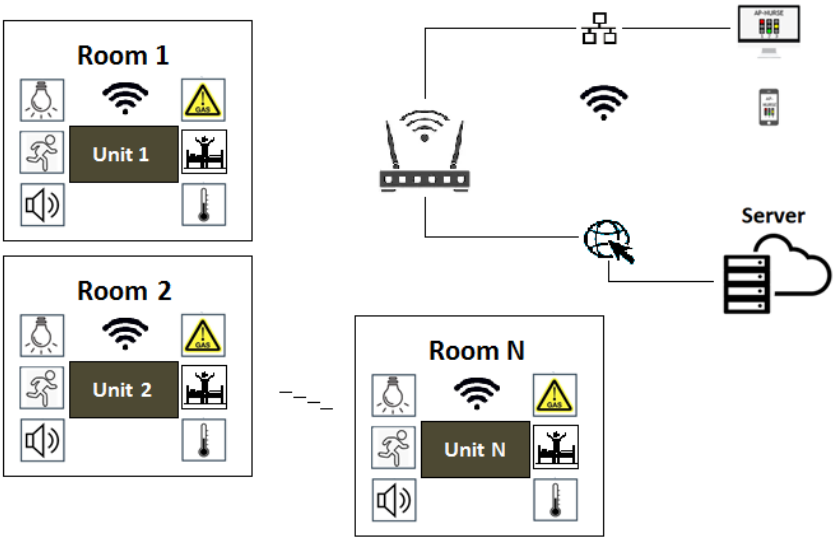


Figure 4: AP-NURSE Care flowchart

Main added value for each end-user

The main mission of the AP-NURSE solutions is to increase the quality of life on both sides; care givers and clients. For the care-giving personnel, the AP-NURSE provides important information regarding the conditions in the clients' rooms, standard conditions or conditions leading to dangerous events, which can optimize work duties of the caregiving personnel and decrease stress conditions. The benefits for the clients include a decrease in the response time of the caregiver, thereby preventing or decreasing the consequences of harmful events, which routinely occur, due to the progress of their diseases. The proposed traffic-light logic, based on the foreseen event tree, provides simple information, which can be

quickly evaluated by the caregivers and, based on their experience, may provide accurate timeframe for necessary actions. Based on that, whether the caregivers are engaged in the patients´ homes or in care-centres, they can more effectively take a rest or take care of other clients. Special effort will be given to the evaluation of the feedback from the testing sites, where on-site experience will be transformed to the optimization of the AP-NURSE solutions to bring them closer to real life applications.

Used technologies

The development of the AP-NURSE units is divided into two branches based on the proposed systems (Home and Care). AP-NURSE HOME is based on the *NodeMcu* ESP8266 microcontroller paired with rubber bracelet via radio communication. The monitoring device includes the *NodeMcu* ESP8266 core unit with peripheral sensors and RF433 MHz transmitter encapsulated in an appropriate casing, maintaining damage and vibration resistance. The bracelet includes warning signal lights, battery indicator, vibration module and the RF433 MHz receiver.

Since the AP-NURSE Care system aims to be used in social homes and care-centres, where patients suffering from Alzheimer's and Parkinson's diseases are treated, it encompasses multiple modules able to monitor several environmental indicators at the same time. The client solution consists of one or multiple sensor units (SU), a central unit (CU), and a communication gateway. It uses the M5STACK platform, which is a modular stackable product development toolkit based on ESP32 (The world's most popular Wi-Fi SoC, upgrade of ESP8266). The M5 ecosystem consists of main controller "core", stackable modules and bases, grove compatible sensors "units" and different applications. M5Stack is committed to providing easy-to-develop and cost-effective IoT devices.

Evaluation method – data gathering

The AP-Nurse Home unit is fitted with a custom-built firmware based on the ESP8266 Arduino core. It is capable of handling data acquisition with the use of a variety of supported sensors. Its firmware supports configurable multi-level alert warnings triggered by external or internal events. In case of user demand, the firmware also supports data collection and remote alert notification using HTTPS requests.

The AP-NURSE Care sensor unit and central unit are fitted with a modified version of the M5STACK UIFlow firmware based on the MicroPython 1.11 operating system supporting OTAP (over the air programming) for convenient unit software upgrades. The AP-NURSE Care sensor unit is capable of handling data acquisition with the use of a variety of supported sensors. Its firmware supports configurable multi-level alert warnings triggered by external or internal events.

Data analysis

Both AP-NURSE solutions support collection and remote alert notification using HTTPS requests sent to a remote server dedicated to further simple data analysis and evaluation by artificial intelligence. However, simple data analysis is needed, because the alerts are not only sensor-based, but rather event-based, i.e.,

movement, force, noise, light gas and temperature sensor. More detailed logic can be seen in the project deliverables related to the AP-NURSE development. Moreover, on a request basis, anonymized data acquired during test phase may be provided to the other project partner for analysis, where the possible patterns for the specific combination of event and type of monitored patient may be identified. Any deviation in these patterns may indicate the change of the patient health status and may bring relevant quantitative and qualitative data about the progress of disease.

Digital tool for frail elderly - YouBOS

Responsible partner: LEPIDA SCPA Bologna - Italy

Brief description

YouBOS is a web platform (mobile-optimized) for frail seniors, often isolated, who have not used digital tools before and for their families/caregivers. The new communication system is based on technological/informatics networks and on local social resources. Its aim is to improve the quality of life and health conditions of senior citizens (frail/alone or affected by pathologies); to promote healthy lifestyle; to keep seniors living at home for as long as possible and, thus, keeping them active; to reduce digital gap and users' social isolation; and to guarantee the correct use of the social and health services in order to limit welfare costs.

In the province of Bologna there are about 880.0000 citizens. Seniors aged 65 and over represent almost 30% of the population in some areas. Most of them are women (without relatives or friends living nearby). One-person households are > 51%, of which 33% are inhabited by people over 65 (about 10.000 men and 25.000 women).

Main added value for each end-user

YouBOS has the answer to the following needs of elderly people:

- home support in order to prevent the elderly from unnecessary movements;
- entertainment in order to avoid loneliness;
- contact with other elderly people in order to promote socialisation;
- information in order to assist in the socio-sanitary "map of services";
- ensuring continuity in the healthcare of elderly people.

The services offered by YouBOS are numerous, e.g., broadcasting events/conferences taking place in the city of Bologna; organizing activities in line with the elderly people health programme promoting healthy lifestyle; creating a connecting Blog with an editor-users interaction, etc.

The YouBOS platform connects the following end-users:

- frail seniors - they can access the YouBOS platform, create an account and participate in the different activities offered in the content;
- animators/volunteers - they play the role of connecting territorial resources virtually, involving experts in different domains (health, food, culture, sport & exercise);
- system administrators - management of user profiles, roles and authorisations.

Used technologies

Installing the development environment for the YouBOS solution consists of several steps:

- creation of the domain "testyoubos.net", accessible only to developers from the internal network of LepidaScpA (for Lepida developers/designers/testers), or via VPN (for other partners)
- installation of the Drupal CMS, adopting version 9 (released with "stable" certification on June 3) and MySQL database
- installation of version 4.X of the Bootstrap graphical framework
- installation of the "minimum" required modules for a “plain vanilla” Drupal configuration
- creation of categories of users necessary for project management, and subsequent creation of a test user for each category.

YouBOS will allow integration among different technologies in order to guarantee access to a broad audience with equal access opportunity. E.g., the video transmission delivered through Facebook or YouTube will be made available directly on the YouBOS platform for seniors who do not have any account on the mentioned social media.

In order to access the YouBOS platform, seniors will need a username and a password. The registration will require creating a new user profile. Data will be treated according to the GDPR rules.

GPS tracking

Responsible partner: ISRAA Institute for elderly care and shelter - Italy

Brief description

GPS tracking is among the emerging technologies that seek to provide answers to the problems related to dementia from a non-pharmacological perspective. In the framework of the niCE-life project, the implementation of a GPS tracking system will be an important tool to provide older people, who are at risk of developing dementia, with a higher level of safety and a better quality of life.

The implementation of this technology in the Treviso pilot site will involve three main actors - the care provider organisation, elderly people and informal caregivers. An elderly person will have to wear the bracelet all day long and periodically recharge the battery of the device through a magnetic base. The senior will be able to use the SOS button of the device to ask for support from family members or the care provider. The care provider will be able to receive alerts from the devices worn by the seniors. The alerts will be triggered following events defined ex ante, such as the use of the SOS button or the exceeding of health thresholds defined specifically for the user. Through remote monitoring, the care provider will be able to verify the position of the subject. Informal caregivers will also be able to access a dedicated app which will provide the position of their relatives, as well as the parameters indicating their state of health evolution. The informal caregiver will, therefore, be included in the alarm chain that will be triggered if the elderly person presses the SOS button.

Main added value for each end-user

The main added value of the innovative care model with GPS tracking is:

- Increasing the safety of the person with MCI and at the risk of developing dementia, while supporting the formal and informal caregiver in the care activity;
- Supporting orientation, not the surveillance of the clients, but the possibility to reach the clients in case of emergency and the possibility to offer help, if necessary;
- Preventing dangerous situations, reducing the risk of people getting lost and reducing those methods of restraint that limit people's freedom;
- Reducing caregivers' anxiety. In fact, concern about the safety of one's relative is a variable that can produce an increase in the level of stress, leading, among other things, to a worsening of the quality of life of the informal caregiver.

Used technologies

The technologies that will be used in the experimentation of GPS tracking in Treviso are the following:

- A bracelet wearable by the elderly person – it sends SOS requests at the touch of a button, automatically detects falls and locates the position; counts steps; monitors heartbeat, sleep quality and physical activity level; it has an integrated sim card;
- Indoor tracking through the use of BLE proximity TAGs - the 100% wireless BLE/Bluetooth Low Energy sensors are easy to install thanks to the standardised, non-proprietary protocol;
- A monitoring platform dedicated to formal and informal caregivers - it will be accessible through a web-based application and a specific mobile app; the data will be accessible from the platform through a specific cloud architecture, based in the European territory.

Evaluation method – data, organizational

The following data gathered will be evaluated: the client's position (safe area location); the client's health status and symptoms (e.g., heart rate); the client's sleep patterns and physical activity level (number of steps) and early warnings of brain disease risk; experimental monitoring of the client's status according to ICHOM scale (www.icom.org).

Data analysis

The data analysis will use information from wearable sensors and will be used to assess person status according to ICHOM scale (www.icom.org).

Pilot design

Responsible partner: Miasto Stołeczne Warszawa - Poland

The main goal of the WP T3, starting at the beginning of 2021, is to conduct pilot testing of the developed technical solutions at the regional level within health and care centres. The developed technological tools will be tested in partner facilities (e.g., care centres, hospitals) by actively involving the frail elderly and people released from hospitals. The Intelligent monitoring platform will be separately tested by volunteers with IT skills. Based on the results of the pilot actions the Model of health and care services for frail elderly will be refined and amended.

Each of the partner regions will be conducting different activities aimed at testing the following tools:

- **Intelligent monitoring platform** (Brno University of Technology, Czech Republic)
- **AP nurse** – for persons suffering from Parkinson's disease in Care Centre in Bratislava, Slovakia (Slovak University of Technology + Petržalka Municipal District of Bratislava) and for persons suffering from Alzheimer's disease in Social Care Home in Warsaw, Poland (Slovak University of Technology + City of Warsaw)
- **GPS tracking** - Treviso, Italy (Institute for elderly care and shelter, ISRAA + Brno University of Technology)
- **Digital tool for frails** – Bologna, Italy (Local Health Authority of Bologna + Lepida SCPA)
- **Monitoring grid** - for the management of frail persons in Mittelburgenland, Austria (Samaritan Burgenland Department of Home Care + Brno University of Technology)
- **Care methods of frail persons discharged from hospitals** in Olomouc, Czech Republic (The University Hospital Olomouc + Petržalka Municipal District of Bratislava) and from hospitals in Bratislava, Slovakia (Petržalka Municipal District of Bratislava + Slovak University of Technology, Lepida SCPA, Local Health Authority of Bologna).

The relevant testing phase will take place in May-October 2021. It will focus on the following factors: quality of life of seniors and formal/informal caregivers, social isolation acceptance of services and user satisfaction, using selected measurement tools - EQ-5D-3L, Zarit Burden Inventory, UCLA loneliness scale and UT-AUT tests.

During the evaluation process, the following criteria will be examined:

- ease of use (usability on the part of a senior and a care giver),

- feeling of security through regular contact with carers or through a monitoring tool (senior's satisfaction with the tool),
- prevention of social isolation (the number of social contacts),
- possibility of early detection of health deterioration,
- quality of life and work of caregivers (response time reduction).

The results of the pilot actions, based on the collected feedback through questionnaires and personal/phone contacts with test persons and staff, will be synthesised in the summary report prepared by the project partners under coordination of Lepida SCPA in October 2021. The report will represent a basis for the development of local action plans and targeted training.

Action plans

Responsible partner: Samaritan Burgenland Department of Home Care – Austria

The project partners will draft 6 local action plans in national languages with English summary. These action plans customized for the partner countries will provide a detailed road map for the implementation of the transnationally applicable Model of health and care services for frail elderly. They will define:

- necessary steps to be taken by relevant authorities towards introduction into local strategies,
- technical requirements,
- financial and personal resources to be allocated,
- stakeholders from the public and private sectors to be involved,
- timeframe to be followed in the process of introduction of health and care model,
- indicators necessary for documenting the success factors for the deployment of the model.

The action plans will be aimed at spreading the knowledge developed during the project implementation and ensuring the sustainability of the developed tools.

Furthermore, an English **guidebook** will be prepared for local authorities to allow transnational transfer of knowledge to the municipalities and regions not involved in the project. It will provide an overview of the best practice tested solutions for the improvement of health and care for the frail elderly and offer a detailed roadmap for the introduction of the health and care model and supporting technical solutions.

The action plans and the guidebook will be rounded off by **trainings** for representatives of public authorities responsible for healthcare, care centre operators but also family members of frail elderly in order to acquire new skills and competences necessary for introducing new health and care models, as well as for using the newly developed technical solutions.