Identifying the Needs of Older People for Personalized Assistive Solutions in Romanian Healthcare System

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Abstract: The new demographic perspectives lead to the necessity to develop new solutions based on the Internet of Things (IoT) technology, which is designed for the early identification of the health issues of the elderly people and for providing support to them so as to understand the factors that limit their Quality of Life (QoL). An adaptive technology, a personalized intervention and integrated wearable IoT devices have the potential to improve the national healthcare systems, especially the least developed ones, the efficacy of the provided services and thus, the QoL and the wellbeing of the elderly. This paper presents a user-oriented approach to the development of personalised assistive solutions in the field of elderly care, by identifying the needs and preferences of the older adults and translating them into development requirements of the vINCI platform, an ecosystem capable of providing a non-intrusive and personalised monitoring of physical and health parameters. In this regard, prior to the development of vINCI platform, two questionnaires were applied to a group of 62 participants aged 65 years or older without severe impairments, who were admitted as inpatients to "Ana Aslan" National Institute of Gerontology and Geriatrics in Bucharest and 62 formal and informal caregivers, with the purpose of identifying the needs of users. The vINCI technology aims to help the elderly people live independently and provides support for the implementation of preventive measures for healthcare.

Keywords: IoT technology, Smart sensors, Elderly needs, Personalized assistive solutions, vINCI technology.

1. Introduction

According to the World Health Organization (Word Health Organisation, 2011), the current demographic configuration will be profoundly reshaped in the near future. These major changes in the structure of the population are based on the fact that an increasing number of people over 65 reach extreme ages.

The elderly people represent the category which is most exposed to the risk of degradation of health parameters compared to any other population groups. Increased risk of the incidence of various age-related pathologies, such as cardiovascular or neurodegenerative diseases (De Bacquer et al., 2019), requires the use of health care services, and more specialized caregivers in the ageing process.

In this context of global population ageing and limited capacities to offer quality healthcare services, a recalibration of health and social care systems becomes necessary. To address this situation, it is necessary to develop applications and systems that take into account the needs of older adults (Bajenaru et al., 2020b).

Development of integrated assistive solutions with user-centred applications that provide services to promote active and independent living, is becoming a necessity more than ever.

In line with the spectacular development of information technology, the elderly centred healthcare model has changed the relationship between patients and healthcare professionals. Patients are no longer seen as the passive elements of this relationship, they become partners and deeply involved and responsible in the management of their conditions through ICT support.

Adaptive technologies, personalized interventions and integrating wearable and IoT devices for remote monitoring, have the potential to improve the quality of life and the well-being of the elderly.

Following this area of research and other approaches related to the Ambient Assisted Living (AAL), this paper proposes a user-oriented approach in development of assistive solutions for the elderly, by identifying the needs of older adults and translating them into development requirements of a remote monitoring and care platform.

The Clinically-validated INtegrated Support for Assistive Care and Lifestyle Improvement: the Human Link (vINCI) project is an example

of technological implementation of an assistive solution based on the needs of the elderly that could be adapted to the conditions of Romanian healthcare system. This implementation, which is part of the European research effort, has created a digital ecosystem based on smart sensors to ensure non-invasive remote monitoring and care for a better quality of life for older adults (Bajenaru et al., 2018).

As a person is growing old, bio-psycho-social changes start to occur, the most frequent and most visible are usually biological, among which one can mention sensory senescence (Rusu & Drăghici, 2019).

The biggest challenge of assistive technologies is to respond to the needs of older people, to adapt to their cognitive and perceptual declines, to support them in their daily activities and, last but not least, to provide them with independence and security (Drăghici et al., 2019).

In this regard, it was necessary to identify the user needs with regard to independently using the vINCI technology for assessing their daily physical activities, location, well-being and general health status as well as the potential benefits of technology for supporting medical and informal care. Two *User Needs Questionnaires* were applied to a group of patients and to a group of caregivers for self-completion. Each questionnaire comprises of two parts: demographic data, daily activities and interest in technology and a second group of specific questions about different aspects of vINCI technology such as acceptability, interaction, interface and functionality.

This article presents a summary of the preliminary results obtained for the Romanian pilot study, results that will be subsequently transformed into user requirements, which will be the basis for the design and development of the vINCI personalized assistive healthcare solution for elderly.

The remainder of this paper is as follows. Section 2 refers to the latest implementations of intelligent IoT-based systems presented in the literature, with emphasis on their advantages and contribution to improving the quality of life of elderly and their health. Section 3 presents the benefits of smart, personalized assistive solutions based IoT technology, embedded into digital ecosystem that aim to remotely monitor the elderly

patients. Section 4 emphasizes the importance of integrating user requirements and preferences at the very beginning of the development process of personalized assistance solutions. In this sense, a generic methodology was proposed for gathering and analysing user needs and requirements. A summary of the preliminary results of this study is described in section 5 and section 6 presents the conclusions of this paper.

2. Related Work

A personalised assistive solution for healthcare involves remote monitoring of a patient's vital functions through appropriate IoT devices and appropriate techniques (Kotwal & Prabhakar, 2009).

Efforts in this regard have been made at European level since the beginning of the last decade. Among the first completed projects is Health Early Alarm Recognition and Tele monitoring (HEARTS), initiated in 2002 and completed in 2004 in Lazio, Rome whose goal was to introduce a new generation of open healthcare systems, with patient surveillance focused predominantly on cardiovascular diseases (Kropp, 2005).

Another example is the Universal Remote Signal Acquisition for Health (UR-SAFE) project carried out between 2002 and 2004 in France, which proposed a personalized healthcare system, which allowed convalescents and the elderly to lead a normal life, as it guaranteed the same safety as in a hospital structure (Castanié at al., 2003).

The Enhanced Personal, Intelligent and Mobile System for Early Detection and Interpretation of Cardiological Syndromes (EPI-MEDICS), developed in collaboration with researchers from France, Italy and Sweden between 2001 and 2004, aimed to develop a device for telemonitoring the ECG signal called Personal ECG Monitor (PEM) for the detection of various heart conditions (Rubel et al., 2005).

Another project, I-DON'T-FALL, provided an integrated platform to help guarantee the physical safety of older people. The project also focused on tailoring technological solutions related to fall detection (Barban et al., 2015).

To prevent frailty, a new model for early detection of pre-frail older adults' symptoms was proposed by PERSSILAA project. Based on this model a

training support offered to the elderly was built in order to improve health services and prevent frailty.

Within this project, the main causes of the fragility syndrome for the elderly were highlighted. These are often insufficient mental stimulation or physical activity, as well as nutritional insufficiencies. (Cataldi et al., 2019).

According to (Larsen, 2019), 21 studies were performed on 2704 participants to investigate the effect of an intervention based on physical activity monitoring. These studies were randomized controlled trials and randomized cross-over trials which involved people over 65 years of age. These studies showed that physical activity monitoring interventions appeared to be safe and effective in increasing physical activity (Larsen et al., 2019).

In 2016, a larger project funded through the Vinnova Grant investigated the perceptions of older people and health care professionals about the contributions and qualities of medical technology related to the physical activity of the elderly. Both the elderly and the caregivers expressed their views in focus groups where it emerged that both groups of participants believed that digital technology should support and make physical activity more enjoyable (Ehn et al., 2019).

According to the country profile (European Commission, 2019), the Romanian health system, despite numerous investments, continues to be characterized by substantial deficiencies in the provision of medical services. This situation is due to factors such as: health spending in Romania is the lowest in the EU (5% of GDP compared to a European average of 9.8%); a growing share of the population over 65 (17.8%), an increased incidence of chronic diseases among the elderly and a massive departure of specialists from the system. Despite the growing interest shown at European and global level in the use of systems based on innovative technologies in the provision of remote healthcare services focused on the elderly, in Romania, the implementation of such solutions remains extremely limited.

3. Personalized Assistive Solutions for the Elderly

Currently, at a global level there is an obvious trend towards changing the current paradigm on the provision of healthcare services, by moving from the *"late illness" model* where the focus is mainly on diagnosis and treatment, to the model based on *"early health systems"* where the emphasis is on prevention and early detection of the symptoms of certain diseases. This new approach is determined by two main factors: the acceleration of the global ageing process, and the emergence of a new generation of medical applications.

In this context, the development of systems that link and interconnect several areas of healthcare, patient-centred perspectives and technologies is still an open issue (Elissen et al., 2016; Bajenaru et al., 2018). The personalized healthcare services involve finding solutions to meet the following challenges: a) implementation of non-invasive ways to monitor the user; b) promoting a user-centred design; c) ensuring emotional comfort by offering personalized services, increasing communication, as well as providing new forms of relaxing environments, ensuring an active ageing process (Marcelino et al., 2018).

Therefore, the research effort is currently directed towards the creation of systems focused on well-being of the elderly, able to provide various *personalised assistive solutions and services*, such as customized care, real-time monitoring, health data and information processing, in accordance with needs and expectations of the ageing population (Ianculescu & Alexandru, 2020).

An elderly-friendly digital ecosystem represents a reliable support designed for delivering *personalised healthcare assistive solutions* for the elderly and other stakeholders. This type of ecosystem, which aims to monitor the elderly patients, is represented by medical professionals, providers of health services and products, organizations they belong to, direct or indirect beneficiaries of healthcare and digital media. (Bajenaru at al., 2018).

New digital technologies play an important role in terms of personal involvement in health management, helping older people to avoid accelerated degradation of their main physical, physical, and health parameters (Larsen et al., 2020). In a digital ecosystem focused on the elderly, they should be able to have real-time access to healthcare and monitoring services in a familiar and personalized setting, with positive
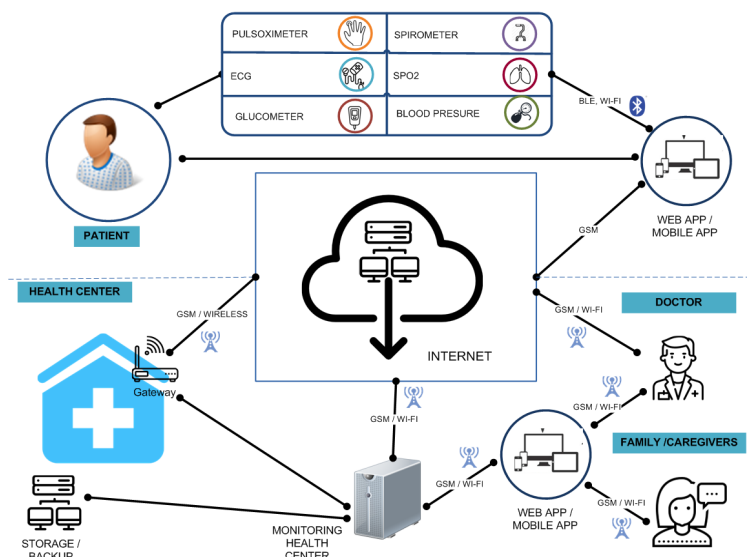
Figure 1. Personalized care system (Bujnowska-Fedak & Grata-Borkowska, 2015)

effects on their QoL. A schematic diagram of the digital ecosystem for elderly monitoring is presented in Figure 1.

Based on the information obtained from daily activities and from the data collected with the help of different devices, a patient profile model can be obtained. The needs and requirements of the elderly represent a basic component of this model (Bajenaru et al., 2018).

vINCI - the Human Link

As part of the European research effort, vINCI project, aims to enhance the QoL of older people by developing an IoT-based ecosystem, capable of proving non-intrusive and personalised monitoring of physical and health parameters according to the general needs and requirements of the elderly (Bajenaru et al., 2018).

The vINCI project developed an integrated platform that discreetly monitors the elderly using extensible technologies. The collected data are stored securely and are analysed to provide the well-being of patients, respectively to detect the early symptoms of age-related deficiencies.

Technologies resulting from this study should meet the needs of older adults, offering support in their daily activities, and give them independence.

The vINCI platform has the following components: a static patient profile; the results of a questionnaire on their quality of life (The World Health Organization Quality of Life

Instrument, Short Form, WHOQOL-BREF) and a questionnaire on the level of physical activity (International Physical Activity Questionnaire, IPAQ); data from smart devices (smartwatch, smart insoles, depth camera). All these data define a model for a person based on the study that will be validated in clinical conditions by the Romanian medical staff ("Ana Aslan" NIGG - National Institute of Gerontology and Geriatrics, Romanian pilot study).

This platform connects devices equipped with high-performance sensors and collects information, compares it with an ideal model to determine anomalies, and may provide to healthcare professionals a complete profile of the patient.

The microservice-based architecture abstracts the hardware architecture of the platform because each device communicates through an interface with a microservice that processes the received data.

Real-time data is added to the static profile of the patient, which is collected from a camera that has a depth sensor, through which the subject is monitored for activity recognition, along with a pair of smart insoles, in order to determine the number of steps taken.

Also, a smart watch, attached to the hand, measures the degree of sedentary lifestyle and a tablet running an Android application, provides support for completing questionnaires, in order to collect additional information about the patient's condition.

vINCI will provide technologies to support more independent living, helping older adults feel more secure when taking a walk in the park, doing daily activities at home, or enjoying an independent life style.

The technology will blend in with their surroundings, putting little pressure on the older adults' experience. At the same time, the caregiver (or assisting personnel) will not need to accompany the older adult, thereby giving them an advanced sense of freedom.

4. Elderly's Specific Needs and Requirements

The needs and requirements of the elderly in relation to health care services are essential for accepting the help provided (Bajenaru et al., 2020b). They largely depend on individual characteristics such as age, health and social status. In works such as (Kotwal & Prabhakar, 2009) these needs are presented, which can be classified as: physical needs, emotional needs and social needs. In order to take into account these needs of the elderly, the developers of personalized assistance solutions must integrate their preferences in the process of technology development.

4.1 Methodology Description

vINCI project consortium has chosen to follow a user-centred methodology to gain an understanding of what the user really wants and needs, and which features can be accepted by end users. The proposed generic methodology for gathering user needs and requirements is divided over three main phases (Figure 2):
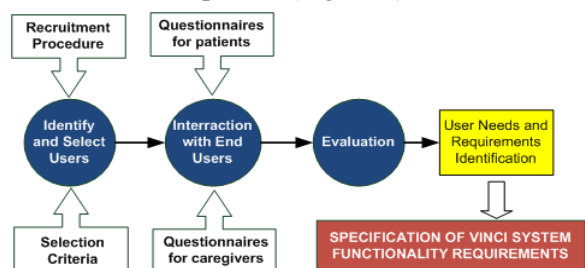

Figure 2. Methodology for identifying user needs and requirements

1) *Identify and select users*: The first phase aims to identify and select users for clinical validation of vINCI technologies.

2) *Interaction with end users*: two different questionnaires were developed for both categories of users: elderly and caregivers. These questionnaires are available in Romanian languages, in electronic and paper version.

3) *The evaluation phase* transforms the user needs into vINCI final requirements for architecture definition.

4.2 Categories of Users

a) The target users

The Target User Groups involved in this study consists of two main categories. The first category includes primary end-users namely older adults aged 65+ without severe impairments who live alone or in a day care centre and who understand the advantages of non-intrusive technology-based remote monitoring of various physical, mental and social parameters, for early detection of symptoms related to impairments associated with old age, and for triggering alerts related to possible incidents. The second category includes formal and informal caregivers for the elderly.

b) Pilot study description

The group of participants included 62 participants, aged 65+, who were admitted as inpatients at the "Ana Aslan" National Institute of Gerontology and Geriatrics in Bucharest. The group of caregivers included 62 persons - 43 formal (medical doctors specialized in various medical fields, nurses specialized in elderly care) and 19 informal (family and friends) caregivers.

c) Recruitment procedure

All patients 65+ years old admitted to NIGG - Geriatrics and Gerontology Inpatient and Outpatients Department, without severe impairments, are the potential subjects for the pilot study. They will be evaluated based on inclusion and exclusion criteria and also based on computer digital skills until the sample target number is reached. The selection of the elderly participants in this study was based on the following inclusion and exclusion criteria:

Inclusion criteria: age over 65 years old; to sign an Informed Consent Form; independently functioning/ living; have compliance with study protocol. All persons from the target group will complete a Digital Skills Questionnaire (DSQ) in order to evaluate their computer skills and technological knowledge, and at the end the elderly with average and high score will be accepted.

Exclusion criteria: acute medical conditions; if they had surgeries within the last 3 months; diagnosis of a major neurocognitive disorder (Mini-Mental State Examination, MMSE≤20) (Petersen, 2004); presence of moderate and severe depression (Geriatric Depression Scale – Short Form GDS-SF >10) (D'Ath et al., 1994); physical disability (Activities of Daily Living ADL - needs human help in one or more basic activities of daily living); problems that might limit mobility; visual impairment; elderly with low DSQ score; for elderly who did not sign the Informed Consent Form. Exclusion criteria were based on medical examination, anamnesis and on patients' medical charts and documented medical history.

Ethical Issues: The Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects; EU regulation on Clinical Trials will be followed, in particular the ones regarding the following issues: 1) obtaining informed consent and 2) ethics committee approval; the European Consultation on the Rights of Patients will be used for establishing grounds in terms of patients' rights.

No research will be carried out without the approval of the NIGG's Ethics Committee. Informed consent from older adults will be obtained before any information is used. They will be informed that they can withdraw that permission at any time during the project. Before informed consent was obtained, the elderly patient is given ample time and opportunity to ask questions about details of the study and decide whether to participate in it. Participation is therefore fully voluntary. Refusal to participate will have no consequences. The person may discontinue participation at any time. Prior to adult participation, the written informed consent form should be signed and personally dated by the individual and by the person who conducted the discussion on the informed consent (the researcher) who may be contacted at any time for further questions and/or clarifications.

4.3 Procedure

The requirements, needs and wishes of end users, represent the backbone of the design and development of the vINCI platform. In this sense, a bottom-up approach will be implemented, with end-users being involved from the very beginning of the design process. They will be involved in three distinct phases throughout the whole project implementation. In the first phase, needs collection,

the end users will be involved in a study whose results will allow identifying their needs, which will be later transformed into requirements and ideas regarding the functionalities of the vINCI platform, as well as the guidelines concerning the appearance of the user interfaces. In the next phases, users will be invited to evaluate the first implementation and final version regarding the usability and acceptance of the technologies available within the vINCI platform.

For the first phase two questionnaires are developed, together with the input of user-related partners. During the second phase, the data collected in the first phase (needs collection) will be evaluated with low-fi prototypes with the participation of target user groups and necessary amendments will be carried out, depending on the results. In the final phase, the interaction of users with the final prototype will be evaluated and the usability and acceptance of the technology will be studied. Users' opinions on aspects that may be improved will be gathered.

4.4 Methods of Data Gathering

In the context of designing the VINCI platform, questionnaires are the chosen method of data gathering that will support the process of identifying the requirements and needs of end users. Questionnaires are an instrument designed to gather quantitative and qualitative data about the participants' usage of assistive technologies and their preferences concerning the future Vinci environment. This method uses specific questions for collecting the opinions of targeted group that can easily be analysed.

The questionnaires (for the elderly and their informal/formal caregivers) are developed based on partners' experience, the objectives of the vINCI project, and also, on the results extracted on the basis of a review of the relevant literature. Based on the particularities of the vINCI project, two questionnaires, divided in two parts (A - Demographic data, Daily Activity, Interest in New Technologies; B - User preferences, Needs and Requirements regarding the VINCI environment), were developed.

The first questionnaire is addressed to older people and is aimed at how they perceive new assistive technologies in the context of their daily activities, needs and expectations with regard to their interaction with the vINCI platform. The questionnaire is implemented both in

print and electronic version within the mobile application vINCI. For the Romanian pilot study, the questionnaire will be applied through a face-to-face interview with the patient, the experts (medical staff within the NIGG) being the ones who will register the answers received. The questionnaire consists of 12 demographic questions and matrix questions for Part A and 13 matrix questions for Part B.

The second questionnaire was provided to the formal and informal caregivers of the elders in order to get their point of view with regard to what the system should provide for improving elderly care and their perception of certain requirements regarding a continuous, intelligent, non-invasive monitoring environment focused on the physical, mental and social state of the elderly. Formal (i.e., Physiotherapist) and informal (i.e., family members of the elderly) caregivers, are also involved in the data analysis along with the designer and developers of Vinci platform, for gathering and identifying more realistic and effective requirements that will assist in promoting active ageing, as well as enhancing the independence and the efficiency of care monitoring for the older people.

5. Summary of Preliminary Results

5.1 Demographic Data

The study is conducted on a group of 124 participants (62 patients of 65 years of age and older, who were admitted to "Ana Aslan" NIGG and 62 caregivers) from Romania. The mean age is 71.6 for the elderly and 45 for caregivers. In the study dedicated to the elderly, the majority of participants are women (79.03%), have a high level of education, 19,35% pursued higher education and 45.16% upper secondary education and are not single (51.61% are married). Within the group dedicated to caregivers, the gender distribution is 91.93% for women and 8.06% for men, 69.35% of them being formal caregivers and 30.65% informal caregivers. From among the formal caregivers, 41.86% are doctors, 41.86% nurses, 4.65% Physiotherapists, 6.98% Psychologists, 2.33% Social workers and 2.33% Others. Distribution for Informal caregivers is as follows: 1 st-degree relative: 16 (84.21%), other degrees of kinship: 2 (10.53%), Friend: 0 (0%), Neighbour: 0 (0%), Voluntary: 0 (0%), Others: 1 (5.26%). Most of the formal caregivers work

in Geriatric clinics/ Institutes of gerontology and geriatrics: 42 (97.67%), in senior care centres with permanent program: 0 (0%), in day centres for the elderly: 0 (0%) and other places: 1 (2.33%).

5.2 Social Behaviour

The group of elderly have a good level of social interaction (64.52%) but most of them are not so familiar with ICT technologies and applications. However, for 36.47% of the total respondents, there was a tendency of isolation, with no regular interaction with other people. Thus, the lack of social interaction is most often correlated with the lack of physical activity, or a poor emotional state, with negative consequences on the health and quality of life of the elderly. A poor interaction with others can be avoided by early detection of lack of physical activity or other deficiencies associated with older age, sending alerts to carers / family / other people involved via a single dashboard and performing personalized interventions leading towards sustaining an active social life.

5.3 Communication Profile

The lack of technology expertise among the elderly, is an issue that should be highly considered during the design of the overall system and moreover for the user interfaces, by addressing the issues of usability, learnability, and user's satisfaction, factors that are very important for the success and adoption of the vINCI system. 64.52% of the respondents selected a single communication option, indicating a certain reluctance to use alternative means. Only 21.62% of the elderly use smart devices and applications. The obtained results indicate very clearly a difficult transition to modern means of communication. To reverse this tendency, a minimalist user interface must be implemented, for a smooth transition to smart communication devices within the platform (e.g. smart applications on tablet). Also, continuous training in the use of digital devices used for communication within the platform will be required. This training can be differentiated, depending on the profile of each user.

5.4 Safety and Interaction with Technology

An important issue for older people is related to the degree of safety they perceive when living alone. A low degree of personal safety can contribute to the isolation of older people, may induce fear

of carrying out certain daily activities alone and may create a permanent need for long-term care. The majority of the elderly participating in this study (53.23%), consider frequent interaction with the caregiver an important factor in ensuring an increased level of personal safety. Technology can create a permanent bridge of communication between the two actors, thus replacing the lack of physical presence of the caregiver (formal / informal) near the patient. In this regard, the developers of the vINCI platform must provide secure channels of communication and appropriate tools to connect the patient and the caregiver whenever necessary.

Obtaining a more complete picture of how the elderly perform their daily activities, identifying the difficulties encountered in performing certain tasks, in correlation with other parameters, such as location, may represent important information which, interpreted in a medical or elderly care context, can contribute decisively to establishing a diagnosis or to identifying early signals regarding certain pathologies specific to the elderly. 48.39% of the users agree to share information about their daily activities and location, while 37.10% totally agree with this possibility.

The emergence of intelligent mobile devices has made it possible to popularize communication through specific applications via Internet, their model being successfully implemented at the level of the doctor / caregiver-patient interaction. Most of the study participants aim to interact online with the medical staff. Thus, 32.26% of the respondents agree and 24.19% totally agree with this facility. For the successful adoption of the vINCI platform, developers must provide tools, protocols and technical support, so that the audio / video / data communication between patients and doctors / caregivers can take place in good and intuitive conditions.

5.5 Users' Preferences Regarding vINCI Environment

Monitoring the health parameters through intelligent technologies (wearable sensors, IoT, etc.) is an important step in the early detection of health problems. Thus, the patients' health parameters are automatically monitored at home without influencing their daily activities. Early detection of health problems is the key to promoting health and independence for the elderly. Data from sensors can be automatically

analysed on a daily basis, looking for changes in an individual's data patterns. If a change is detected, an alert can be sent to clinicians, caregivers, family, etc. The implementation of such technologies (sensors, smart devices, wireless communication methods) is considered very useful by 43.55% of the participants in the Romanian pilot study.

Online access to the data collected within a health monitoring platform is the easiest way to check different health parameters. Access to data is possible for the doctor / caregiver and the patient. Although seniors consistently have lower rates of technology adoption than the general public, this group is more digitally connected than ever. Thus, allowing older people to consult online their own data collected within a medical or healthcare platform is a feature that contributes substantially to increasing the rate of adoption for such a system. 32.26% of the participants found this function very useful. Another specific function refers to notifying users about possible changes detected in daily behaviour (eg: increasing sedentariness). The study participants were asked about the usefulness of such functionality. 27.42% of the participants consider it very useful.

From a medical point of view, the evaluation of health parameters represents the main investigation that leads to establishing a diagnosis and a treatment/ intervention plan for the patient. Therefore, the accuracy of this data is one of the main challenges related to the doctor-patient relationship. Until recently, data from patients could only be collected in medical or senior care centres. With the advancement of smart devices, it has become possible to collect data from a distance, the patient being permanently monitored, which does not affect his/her habitudes or comfort. One of the main advantages of using ICT technologies is the long-term monitoring of the patient, which allows one to obtain more accurate results regarding his/ her health or activity status. Another advantage is the increased comfort of the patient, but also of the caregiver who can obtain most accurate data in this way. Within an automatic monitoring system based on intelligent technologies it is possible to observe an extensive range of parameters that could characterize: health status (pulse, heart rate, etc.), physical activities (number of steps, location, distances, etc.) and social interaction. 59.68% of the caregivers considered very useful the existence of a system that allows monitoring the parameters described above in the case of elderly people. Early

signs of age-specific disorders can be observed by analysing posture and mobility during physical activity. A system that could identify changes of the two parameters is considered very useful by 50.00% of caregivers/doctors and useful by 45.16% of them.

Stimulating older people to increase their mobility and to perform an appropriate physical activity in relation to their age is one of the main goals pursued by medical staff or caregivers. One such example is the use of intelligent technologies in detecting longer periods of sedentary life and triggering alerts whereby the elderly person is invited to perform a series of physical exercises, and the caregiver to receive a report on failing to perform the proposed tasks. Following the evaluation of the answers received, 56.45% of the participants considered the possibility of stimulating the physical activities to be very useful, while 38.71% considered it only useful. Monitoring the time spent by the patient sitting without doing any other movements or engaging into physical activity, contributes to the sketching of patient profile, based on which various interventions or solutions for stimulating the physical activities can be proposed. Thus, 61.29% found it very useful, while 37.10% considered it useful. For being able to provide personalized interventions, caregivers need to be notified periodically about any changes of daily activities that may affect the patient's health. 66.13% of the caregivers find it very useful.

Some features selected to be implemented within the vINCI platform are based, to a certain extent, on the caregivers' previous experiences in the use of monitoring devices. The caregivers show a high level of familiarity with a series of monitoring devices, frequently used within the remote medical platforms. Thus, 87.10% of the study participants are familiar with mobile devices (phone / tablet / health monitoring applications), 41.94% are familiar with the use of a depth camera, 50.00% intent to use or have had the opportunity to observe how wearable devices work, and just 29.03% of them are familiar with body sensors and 22.58% with other types of devices.

In older age the functional reserves are limited, thus seniors are more vulnerable to health risk factors but they also represent that segment of the population who benefit the most from correcting the modifiable risk factors. Increasing the level of physical activity in older age has many direct

and indirect benefits such as lower morbidity and mortality rates, increased social interaction, improved mood and quality of sleep, preserved functional independence and improved quality of life. It is important not only to increase the level of physical activity but also to avoid sedentary behaviour patterns. The vINCI technological platform enables seniors to independently monitor and adjust their physical activity levels in the comfort of their own environment without direct contact with medical care services. The integrated features of this platform quantify the users' behaviour with regard to physical activity and health-related quality of life, by collecting both subjective data and objective parameters. The vINCI platform is able to analyse this data and provide a direct individualised feedback to the user.

6. Conclusion

This paper proposes a user-oriented approach to the development of senior care solutions, by identifying the needs and preferences of the elderly, which will translate into development requirements for vINCI, the non-invasive care platform. This study involved two different groups of users (elderly and caregivers) from the Romanian pilot study, in the early stages of the design process. The results of this study highlight one of the main features that should define the vINCI application, namely to grant a certain independence, a degree of freedom and security to users. More than half of the elderly and caregivers considered the possibility of stimulating physical activity to be very useful.

Increasing the level of physical activity in old age has many direct and indirect benefits, such as lower morbidity and mortality rates, increased social interaction, an improved mood and sleep quality, preserved functional independence and a better quality of life.

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