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Review

Requirements and Pitfalls in AAL Projects. Guide to Self-Criticism for Developers from Experience

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Abstract: Since 2012, several national and international projects on ambient assisted living (AAL) active and healthy ageing gave insight into the different steps of development processes where the requirements of the target group were not met or just failed to be realized. This article shall provide a summary of terms and requirements from the experience of practice and project work on the topic. This article is a reflection and guide for self-criticism for technical developers. Starting with some terms and how they are linked to each other gives an overview of the field of action for the projects, which our experience is based on. A mixture between literature and results of projects illustrates the requirement analysis as it was anticipated in recent years. The conclusion consists of recommendations for further research on requirements.

Keywords: ambient assisted living; requirements analysis; user needs

1. Introduction

Both the term and concept of ambient assisted living (AAL) have developed dynamically over time, as have the needs and requirements for products in AAL or mobile health (mHealth) technologies. The following article will therefore focus on describing these changes in terminologies, concepts, and developments on the market. Furthermore, previous experiences will be highlighted in order to define the steps or methods that are required in order to develop successful and marketable end products for the AAL and mHealth target groups.

Beside the changing concept of AAL and Active and Healthy Ageing (AHA) has become an increasingly used term for supporting good health. mHealth has developed as a particular niche in AAL, focusing on mobile applications. Wherever applications are concerned or data is required for devices to function (for example, to provide effective interventions), issues concerning data collection and data entry must be considered.

In a further step, user needs and requirements will be discussed in detail. End user support tries to encourage and improve adherence by monitoring data and even implementing alarms should an individual's behaviour counteract their individual age related interventions (such as taking medication as prescribed). While such supporting AAL or mHealth features have the ability to improve the quality of life of end users, the negative aspects perceived by the elderly often outweigh the perceived gains to using such systems.

2. Terms and Definitions

The concept of AAL has changed drastically over the years, the main change notably being the evolved understanding of AAL as "Ambient Assisted Living"—a device-oriented approach—towards AAL as "Active and Assisted Living"—an approach driven by the need to support the end users.

The European Union (EU) currently runs a funding instrument named AAL Europe where the concept of AAL is described by six aims [1]:

- extending the time people can live in their preferred environment by increasing their autonomy, self-confidence and mobility;
- supporting the preservation of health and functional capabilities of the elderly;
- promoting a better and healthier lifestyle for individuals at risk;
- enhancing security, preventing social isolation, and supporting the preservation of the multifunctional network around the individual;
- supporting carers, families and care organisations; and,
- increasing the efficiency and productivity of used resources in the ageing societies.

2.1. AHA

Active and Healthy Ageing (AHA) describes a set of interventions that support the health status of people that can be described as being a part of vulnerable target groups or are tend to be progressing towards a state of impairment, disability, or negative ageing. AHA was described by the WHO: "Active ageing is the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age. It applies to both individuals and population groups." [2]. Following this definition, "Active" focuses on integration and social inclusion, rather than solely on physical activity. The interrelation between both is obvious, to successfully apply the concept means focusing on all of the aforementioned aspects. Activity can be considered as an economic activity, a spiritual activity, a cultural or social activity, as well as participation in civic affairs. Health, as a holistic concept, is comprised of physical and mental wellbeing, as well as social wellbeing. AHA is a concept of quality of life that is supported by intergenerational solidarity and interdependence.

From a practical perspective, this concept has the same basis as AAL. Where AAL is technology-based, AHA is open to solutions from a broad range of disciplines and is less focused on information and communication technology (ICT) support.

2.2. Mobile Health

Mobile health (mHealth) summarises all technologies that are based on a mobile device and are related to health behaviour and monitoring. The mobile device can be a mobile phone/smartphone, wearable, or tablet. Furthermore, any mobile communication device can be used as a health related tool. mHealth is defined by the Foundation for National Institutes of Health as "the delivery of healthcare services via mobile communication" [3]. There are several benefits to using this technology, the most noteworthy from an economic perspective being that such technologies are less expensive compared to diagnostic machines. They also allow for more frequent measurements as the patient can add health data (for example blood pressure or blood sugar levels) at any time. This is particularly important for people with chronic diseases living in rural areas or in less economically developed countries where top diagnostic equipment may not be accessible to or affordable for everyone. Such mHealth technologies are already used by several organisations; the WHO and Médicins Sans Frontieres, for example, use mobile applications for eye diagnostics in third world countries where medical devices would be too expensive and the application delivers a level of accuracy close to that of the more expensive medical devices. This data may not be suitable for data collection and analysis as needed for a study, but fulfils the objective of helping people.

2.3. Health Data

Classically, health data describes data collected in order to provide information about the health status of a society. It usually deals with larger populations and allows for comparisons over one or more years in order to provide insight into the health behaviour of nations or social groups. In recent years, personal health data was integrated into this concept by using and analysing health data on

an individual level. By giving patients the chance to collect data themselves, personalized data sets were gathered, analysed, and used to provide better insight into the health situation of individuals, although issues did arise during data collection. The most prominent issue was the self-measurement of blood pressure, largely because the procedure with analogue devices requires proper implementation (requires good coordination and some practice), and most automatic devices are considerably more inaccurate so that the resulting data should be used with caution.

In 2015, Aumayr proposed categories for health data according to the use and processing of the available data following the classes of typical data structures [4]:

- Basic data: heart rate, SpO_2, blood sugar, breathing frequency, etc.
- Processed data: heartrate variability, HbA1C, stress level, etc.
- Interpreted data: diagnosis of disease
- Class of understanding data: therapy design

This allows for a classification and relation between different data sets, as well as the hierarchical integration of data sets in software engineering. Data from questionnaires and assessment instruments (e.g., MMSE—mini-mental state examination, GDS—geriatric depression scale, etc.) represent basic data at the questionnaire level. When evaluated and compared against thresholds, they become processed data. If a diagnosis is made based on these data, this diagnosis is then considered "interpreted data".

3. User Needs and Requirements

The target group of AAL is senior citizens with certain functional disabilities that will be covered by AAL or mHealth solutions, so that they can remain in their known living conditions for a longer period. As these people shall be the ones using the technologies, they are considered as "end users". This includes several forms of functional disabilities from cognitive to social to physical symptoms and syndromes that have an influence on the requirements.

3.1. End User Groups

The definition of the end user group has broadened over the years, including not only the primary end users, but also the secondary and tertiary end users, meaning that the target groups now include family members and care organisations as well [5].

A primary end user is the individual—the elder person—who is going to use the AAL product or service in the future and should therefore be considered as the most important end user group in terms of integration and definition of requirements. Secondary end users include family members, formal or informal carers, friends, and neighbours—people or organisations that are directly connected to the primary end user. Institutions and further organisations, which are indirectly connected to the primary end user, are defined as the tertiary end user group [6]. To examine these groups and to consider their integration has shown to be essential to develop business plans and handle exploitation beyond the defined project durations. Commonly used methods are stakeholder analyses as well as value proposition canvases and business model canvases [7]. The emphasis on the detection of requirements varies from project to project. Therefore, careful consideration must be given to clearly define which end user group is participating in which project part to gain high level outputs.

Primary end users are often seen as persons who are excluded from the digital world and reject technical innovation as a whole. This is partly because of a heuristic that arises when thinking of elderly people. The main impression or image that springs to mind is a person about 80–85 with no use for a tablet. Also, the target of AAL is producing a bias in the estimation of the chances of elderly people being able to catch up with technology developments. To erase or at least reduce this bias, it is necessary to rely on empirical data of real life situations of older people. In Austria for example, 52.5% of people between 65 and 74 years were connected to the internet in 2016, 40.0% have used devices such as mobile phones, smartphones, laptops or tablets to access the internet. Elderly people

in this age category mainly used the internet to search for health related topics, for online news, and internet banking. Online shopping, videos, and social networks were also named. Statistics show that the next generation is a more advanced internet user: 72.8% of people aged 55 to 64 years have stated having used the internet in 2016 and every other younger category showed higher participation numbers [8]. German statistics prove an increase of importance of internet use for people aged 60 and above: in 2012, 21.0% of survey participants stated that living without internet is something that they cannot imagine—this opinion was shared by 29.0% in 2015. 27.0% wanted to participate on the internet in general in 2012, in 2015, 38.0% of survey participants made that statement [9]. Seniors lifestyles vary and are tending to become more individualized in future older generations [6]. House et al. (1990) demonstrated that the relation of age to health varies with the socio-economic status of people [10]. This adds a further dimension. When considering the change of living situation, income situation when retired, health changes, and the increased, age-related risks for frailty, the target group becomes very diverse in its requirements.

In general, the end user group of elderly people has more specific requirements on usability of devices and services than other groups. Several scenarios can be desirable for primary end users—most common desired outputs are improvement of health status, support of everyday activities, enhanced comfort, saving costs and energy, as well as prevention of risks (e.g., falls). People want to keep their integrity and independence. This forms the drive for both requirements and acceptance. Secondary end users might have other preferences, such as monitoring functions, communication facilities, and support for administrative tasks [6].

Taking into account user requirements will help to improve technology acceptance. Davis' (1985) technology acceptance model focuses on two specific constructs that determine a user's acceptance of technology:

Ease-of-use (Is the system easy to use?): simple and intuitive design
Usefulness (Is it useful to use the system?): type and number of functions [11]

These two constructs are mostly influenced by the system design; individual user situation and abilities also play an important role. According to Davis, the impact of usefulness is about four times higher on actual use than the impact of ease-of-use. This encourages a high emphasis on beneficial functions for primary end users [6].

The following factors that affect technology use have been defined by Flick in 2012 [6]:

Factors which influence technology acceptance: costs, individual needs, personal technological experience, and other barriers (such as physiological, cognitive)
Factors that influence the need for technology: generation of the user, lifestyle, family status, and personal attitude on technology

Even when keeping in mind all of these factors for acceptance, several barriers have to be considered in terms of AAL service or product development [6] and respecting or considering these has proved to be crucial in the successful implementation of projects:

Data protection/surveillance/violated privacy
Scepticism towards technological innovations
Fear of stigmatisation
Interference with daily routines
Language (for example, Anglicisms in German language)
Fear of damaging devices
Aesthetic aspects of devices
Financial aspects and costs
Vision, hearing and motoric abilities
Consumer behaviour

3.2. Experiences, Trial Designs and Project Results

During two projects called AHEAD (Augmented Hearing Experience and Assistance for Daily Life, which was funded by the EU in the AAL Joint Programme [12]) and My-AHA (My active and healthy ageing, funded by the EU in the Horizon 2020 program [13]), stakeholder analyses showed that the above named factors are relevant to care organizations, although the perspective is slightly different. In principle, for care organizations, the economic aspects are the main drive and are reflected in decisions for the integration of new systems. During the stakeholder analysis in both projects, it was highlighted that the interference with daily routines, the fear of damaging devices (both by care staff and the elderlies), and financial aspects were the dominant factors. The consumer behaviour for the observed care organisations was based on the intuition of the department chiefs or financial officers and not related to demographics, statistics, and objective data. In general, the evaluation of new technology is mainly done by heuristics by the relevant positions.

The financial aspects and costs are also extremely important for the considerations of the creation of business models and have to be taken into consideration as a co-founding element. During a trial, the evaluation of products and developments will be much more positive and participants of trial sites (primary end-users) are much more forgiving as they do not have to pay for devices and services (in general). In the projects AHEAD, SOCIALCARE (funded by the EU in the AAL Joint Programme [14]), and My-AHA, several qualitative and quantitative methods have been used to analyse usability, usage patterns, benefits, and impediments of users. In the project AHEAD, a pre-field trial and a field trial were conducted including ten participants over a five weeks period. Qualitative interviews were conducted to gain relevant feedback. The project SOCIALCARE involved 25 end-users in Austria over a period of ten weeks for the first trial period, and 25 end-user for another ten weeks for the second trial period. In the Netherlands, the same trial design was used. Studies involved quantitative surveys at the beginning and the end of trial phases, as well as focus groups at the end of the study to collect qualitative feedback. Core part of My-AHA will be a randomized control trial over a period of 18 months, involving over 600 participants in several European countries, as well as in Australia and Asia. Surveys involve validated questionnaires for quantitative data collection to measure effects on the prevention or reduction of frailty, as well as several qualitative methods to examine changes in attitudes and behavior. Trials will start in 2018.

So far, results show that participants were happy about the provided systems and support. The acceptance of devices was good; nevertheless, none of the developments were valued high enough that the participants would be willing to pay to use them. A common participant reaction from all of the projects was: "If someone else needed it, then it would be worth some money. But not for me". Systems and applications are mostly evaluated much more positively than reality would allow. As one example the personal emergency alert system of Johanniter in Austria was compared to the newly developed AHEAD system with integrated help call. The price for the full functionality in AHEAD was considered to be about 20% higher than the 15 year old personal emergency alert wristband. Additional functionality and outdoor location did not balance the 20% increased costs. The costs between 26 Euro and 30 Euro per month were considered too much for a smartphone, hearing aid, activity tracker, and outdoor functionality of emergency and support calls in total. The single landline connected device with a radio connected wristband with a range of 30 meters was considered the more appreciated device.

This short overview illustrates the situation in AAL in considering the requirements and challenges for acceptance. Although the definition of AAL has shifted from Ambient to Active and Assisted Living, in early 2017 the wish of unobtrusiveness was brought up again and the "Ambient" aspect will likely be more present again in future. This does not mean that the activity aspect will be reduced, but will allow for a humble integration into the daily routines of the elderly—taking the leap from technic to magic.

4. The Magic of Transformation

This transformation needs a social shell as a construct to incorporate the system. The impact of these developments will have an effect on the relationships between the actors in the field of health and care. Wearables opened the stage for mHealth as a part of health care that shows how the social system is influenced and what self-measurement is capable of.

4.1. Transformation of the Social Relationship

Health trackers of all sorts have become ever more interesting and popular to the lifestyle target group over the past five years. This includes step counters, mobile pulse oxymeters, wireless blood sugar measuring devices, 24/7 heartrate monitoring, as well as shirts with woven in ECGs (electrocardiogram). These sensors are also becoming increasingly accurate due to improvements in technology and can therefore be considered an additional potential source of data. This was the dawning of the age of mobile health (mHealth).

Alongside these technological developments, a strategic aim for Europe was launched in order to catch up the spirit of health as a lifestyle component and the term Active and Healthy Ageing (AHA) became popular. This concept aims at maintaining the idea that keeping up a good level of health is a positive experience for as long as possible. Keeping people in mind who run marathons at the age of 80 and beyond, fighting lifestyle related diseases like diabetes or hypertension, the AHA movement developed from an economic need as well. Costs started to explode with better health treatment and better chances for acute interventions in hospitals. The better such medical treatment becomes, the more expensive the follow up costs appear to become. To re-balance this in an ethical way, active and healthy ageing is the hope of many.

Alongside these developments, the interaction system between medical staff and their clients is also changing. In (European) Health Care, the medical doctor is the main authority in therapy, the patient's role consists of following the prescriptions. Health Care is currently a hierarchical system, which demands compliance. New sensor technology allowing patients to collect their own data through wearables could however lead to a change in the patient's role, thus allowing them to take on a stronger position within the health care hierarchy. This change is powered by the availability of information from the patient. Whereas, in the classical situation a "knowledge-cascade" from the physician down to the patient defines the hierarchy, the patient becomes expert for his or her own health by means of the available self-assessed data and the experience of self-efficacy. This equalizes the academic knowledge of the physician with the expertise on own health of the patient. In this ideal situation, a consolidation for therapy design would be possible and responsibility is shared between physician and patient.

4.2. Transformation within the Patient

A major challenge arises when dealing with patients suffering from neurodegenerative diseases, as the expectation of these patients is to be accepted as an equal, but they potentially lack the cognitive resources to fully understand the situation.

The concept of using sensors to support therapy can help in such situations, as well providing instant data and the option to instantly report on the situation. This probably makes it easier for people with mild cognitive impairments (MCI) to understand their own changing state of mental health. Already with the visualization of movement data, it is easy to show a normal structured day in comparison to scattered movement behaviour over the day of a person with severe MCI. This provides a clear statement.

In 2016, several articles about behaviour monitoring and behavioural changes and how they could be visualized were published in the scientific community. In the Johanniter Research and Innovation Department in Vienna, Austria, a small evaluation in order to follow up on such results was conducted. Movement data of a mentally healthy person was recorded from a family member over the course

of three weeks. During this time, certain patterns became noticeable. Sleeping times, night mobility at certain times, certain appointments, and general activity levels could be easily separated. On the *y*-axis activity levels between 0 (no activity) to 10 (high activity) were distinguished. Especially the sleeping time and breaks during the day were very clear in the visualization as can be seen in Figure 1.

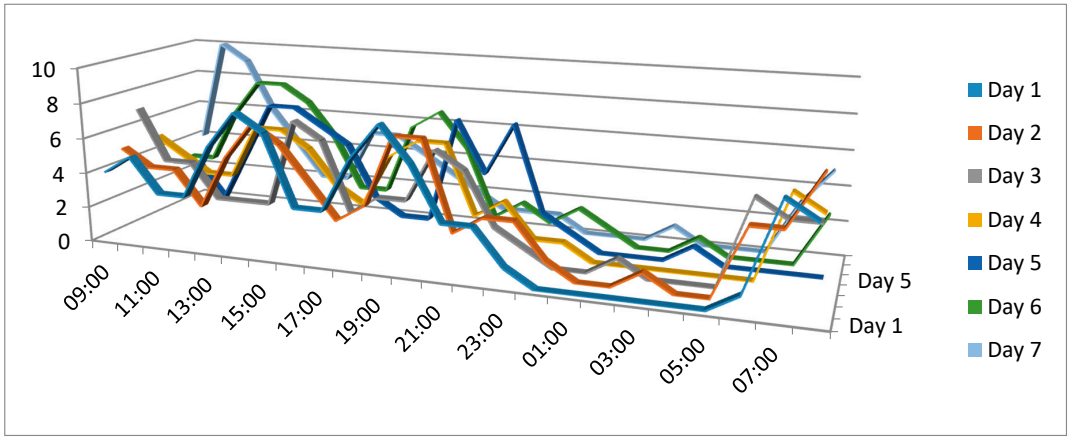

Figure 1. Overview of normal week's activity levels (*y*-axis) per time.

After these three weeks, movement data of a person with Alzheimers Disease has been tracked from the same family for the same time period. In comparison, the activity phases were completely scattered. Sleeping times were spread across the day and during night phases of high activity were recorded. As Figure 2 shows, there was hardly a visible structure in the days recorded.

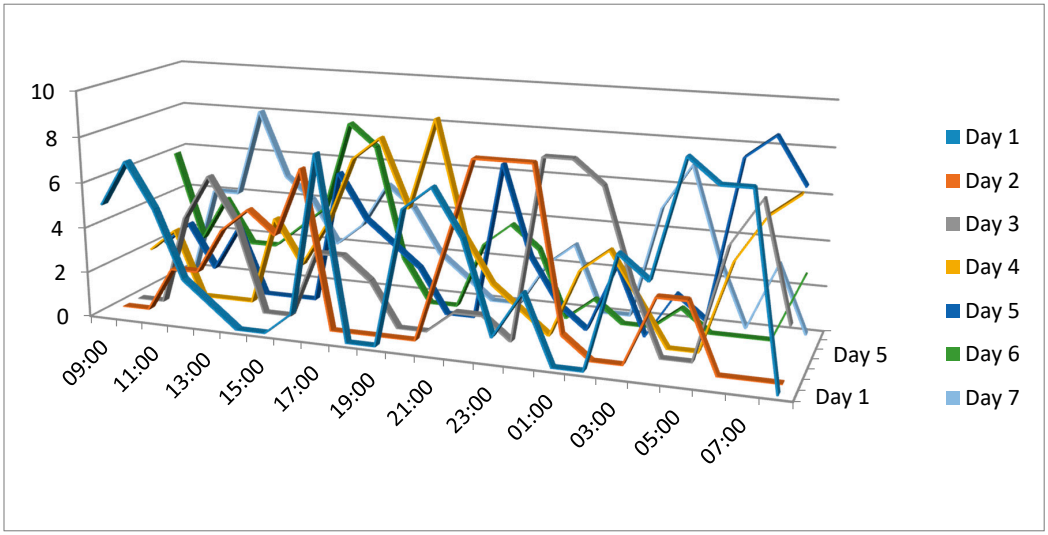

Figure 2. Overview of a CI week's activity levels (*y*-axis) per time.

A more in-depth study was conducted on this topic. The structure of daily life was organized into sleeping phases, activity phases, relaxation, and daily routines. A normal day therefore tends to be rather structured with little variation. When monitoring a patient suffering from Alzheimers, the structure becomes disrupted. DOMO Safety is a provider of behaviour-based data analytics. With the DOMO Safety system, a visualization of this structure was possible and, again, impressively shows the effect of a disease on behaviour as well as highlighting the potential of behaviour monitoring for early detection (Figures 3 and 4):

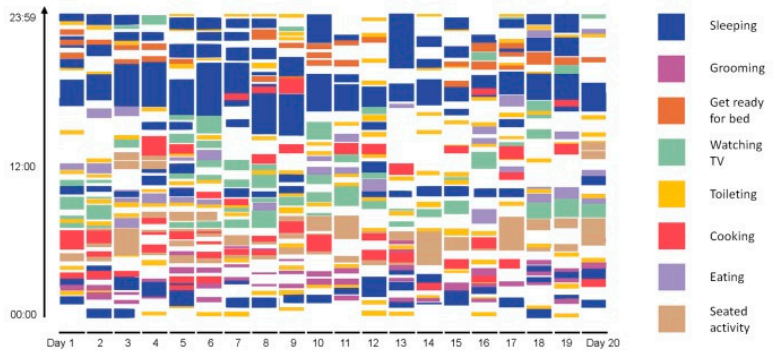

Figure 3. Activity map of a 84-year-old female Alzheimer patient [15].

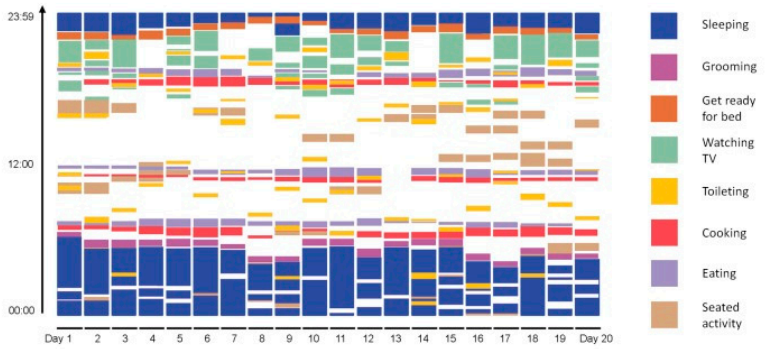

Figure 4. Activity map of a healthy 79-year-old female [15].

5. Health as a Construct

As mentioned before, health can be considered as a combination of three aspects, namely: "social aspects", "cognitive and psychological aspects", and "physical aspects". Spiritual aspects could also be considered, but little to no research has been done in this area (no RCT-like evidence). Instead, spiritual aspects can be summarized under the cognitive and psychological aspects. All of the factors are interrelated in one way or another so that they are hardly assessable without an understanding of the others. Therefore, we focused on a three-folded system of health of body, mind, and social network.

5.1. Physical Aspects

The physical aspects of health are related to the metabolism, cardiac system, neurological system, and others. These aspects include diagnostic processes with blood samples, tissue samples, MRT, EEG, ECG etc. Through the last years our understanding of genes, epigenetic, neurology, new medications for chronic diseases and surgery methods has changed and improved, this is particularly true in the area of chronic disease management where the interrelation between the health aspects has become clearer. Neurodegenerative diseases can be considered chronic diseases as they are defined through a decline in (mental) health over time with no hope for improvement. This produces a special dynamic in the health system.

5.2. Cognitive and Psychological Aspects

Cognitive and psychological aspects deal with mild cognitive impairments (MCI) and include Alzheimers disease and depression. A previous research project (IMPETUS, running from 2015 to 2016, funded by benefit program, FFG, and BMVIT, Austria [16]) has shown that while depression was a standard diagnosis in senior care it was rarely treated as such. The impact of depression on health and compliance however, is dramatic. The relation between the cognitive and physical aspect is very

strong. Moussavi et al. showed that depression has an effect on comorbidities to a much larger extent than other comorbidities would. One example is that if a patient is suffering from a lack of motivation and has lost his or her personal meaning of life, then why should this person take any medication to prolong their life? This example may be extreme but also clearly shows the dynamic between the two aspects [17]. A study by Ciechanowski et al. (2000) indicated that people with depression have a lower compliance in dietary recommendation and medication intake for their diabetes treatment than people with low or no depression [18]. Also, the positive effect of a collaborative care model (a model which includes psychological care) was demonstrated in a study by Unützer et al. (2002). This study proved that the effectiveness of the Improving Mood-Promoting to Access to Collaborative Treatment (IMPACT) had a significant impact on quality of life, depression, and satisfaction with care [19].

5.3. Social Aspects

The social aspects of health are related to inclusion of people in a working and positive social environment. The two main negative aspects are loneliness and isolation. Loneliness can be defined as the perception of the individual of his or her social inclusion and depends on the psychological state as well, whereas isolation is something that is experienced as coming from outside of the patient (e.g., stigmatisation, avoidance, etc.). Both aspects focus on the loss of the social role and social bindings in a community. Loneliness and isolation are strongly related to worsening health problems (for depression [20]); for cardiovascular risk [21]), the interrelation between social aspects and cognitive, as well as physical aspects was shown in 2009 by Cornwell and Waite. The effect was mainly visible in the self-perceived health status. They see social disconnectedness and perceived isolation as something working together and inflicting problems to health [22].

House et al. showed that mortality risk is decreased if social integration is high [23]. Social aspects are therefore strongly related to mental and physical wellbeing, the health care sector should therefore consider social aspects more strongly and as a vital component towards maintaining a good quality of life.

In order to effectively identify these interrelations between the progressions of a chronic or neurodegenerative disease, a systematic analysis should be conducted by identifying the potential effects on each aspect of health. This should combine health, behaviour, and the personal evaluation of the patient (concerning all three aforementioned aspects) with regards to their individual situation.

5.4. Summary of Project Experiences

The proposed construct of health is used in the project My-AHA for an approach against frailty. My-AHA is trying to find personalized interventions for people at the stage of pre-frailty. In theory, this should allow for the assessment of the process of decline at an early stage and should reduce, or even annihilate, the effects of frailty through tailored support. During an 18 month long randomized controlled trial, starting in January 2018, this thesis will be evaluated.

During the project SOCIALCARE the social aspects were supported by a digital neighbourhood platform to exchange support and services for seniors. This focus proved to be interesting to access care organizations. The feedback from the organizations, however, was the suggestion to focus more on the care aspects of the platform where a pre-form of semi-automate documentation was introduced. Major benefits for case management were identified.

This revelation played into the first results of pre-tests of My-AHA, where it is especially interesting (in terms of data collection) to see effects and motivate participants from the beginning on. Together with case management, this is a good chance for increasing adherence and keeping participants motivated.

The results of AHEAD showed that using speech as an interface for seniors is a very promising way of interaction as it comes naturally to them and overcomes certain barriers they might have, such as neuropathic disorders or tremor. The measuring of vital parameters is interesting for people with certain problems (e.g., hypertension, diabetes etc.) and people with a controlled lifestyle. Even then,

the data is more valuable for care givers than patients. The reason for this is the business model in the background. The automated collection of health related data has the potential to reduce time needed for documentation and leaves more quality time for care. This greatly reduces the huge burden for care givers, as well as reducing errors that may occur during the documentation process. This reduces overhead costs for accounting and quality assurance.

6. Ethical Aspects

In order to prepare the stage and give a few first impressions as to why ethical aspects are so important, a few statements from interviews from the aforementioned projects will be portrayed. The following statements were detected multiple times during qualitative interviews in the different projects during requirements analysis concerning the use of AAL and mHealth technologies:

- Fear of damaging devices
- Fear of failing
- Fear of being alone
- Intervening with lifestyle
- Intervening with health
- Compromising personal privacy

These statements should make clear why ethical debates are not just idyll discussions. The proper integration of ethics in the development process, for coders, as well as system architects, helps to increase the chances for a successful project or product dramatically. Methodologies are available that can support in integrating ethics in the design and development process.

In order to analyse ethical aspects, the multidimensional approach MEESTAR (model for ethical evaluation of socio-technological arrangements) can be used. Ethically problematic effects can be identified and ways of resolving them can be found by employing workshops involving project partners of all disciplines. The instrument covers one neutral and three negative levels in order to effectively define the minimum ethical requirements from several points of view. Along three axes (individual, organizational, societal), seven ethical dimensions (x-axis) are defined and problems on those issues are categorized and assessed in a four level scheme (y-axis), which evaluates the ethical sensitivity of the defined problem or issue. Ethical dimensions involve care, autonomy, safety, justice, privacy, participation, and self-conception [24].

Using MEESTAR might help to detect ethically doubtful parts of systems, as well as ethical challenges from its use. Due to the categorization, a clear picture of arising ethical issues can be found and defining viable solutions is encouraged from an early project stage. Revisions of this approach are possible during the project runtime, allowing for upcoming ethical difficulties to be analysed and managed adequately.

7. Conclusions

To provide reliable data, the most important points are to cross-check financial viability, social network, and status of people, and to keep in mind that the elderly hardly have the need to adapt to new technologies if they provide no intrinsic value for them.

The support of a system is mandatory for its regular use. The target group's requirements until 2017 are not linked to ICT systems, but rather to social support actions. ICT is a topic of interest that brings the generation of the elderly and the young adults together, and through this, conquers one of the main problems of ageing: Social Isolation. Developers have to be aware that they are confronting their target group with a new world to which the target group has little or no access. This means that the target group is confronted with potential isolation. The use of ICT Systems can be a tautology of social isolation. The support given during testing times counteracts the isolation, as there is constant interaction between human beings. But after the testing, when a system should run on its own, the system is likely to fail.

The methodology of user acceptance is scientifically correct and sufficient for the general requirements analysis, but fails to analyse the problems of the target group. The financial situation is troublesome as well. For the same price of an AAL system, a human can come to visit the elderly twice a week for one hour each where the elderly person can converse directly with a human being and get the support they need. If a person must decide between an AAL system and a real person to support their daily life, the decision is clear for the second option.

The need for adaptation to new systems is a need induced by social isolation. Within the target group, people with no or low technology use are not isolated because of this. They still have their non-ICT infrastructure to communicate and this usually works fine. It is a generational problem where the elderly are being isolated by their lacking capacity to use technology and the arrogance of a young generation who isolate the elderly by their (technological) developments and related language, as such isolation already starts with the IT-language and terms used. Already in the design of new developments, most of these considerations can be taken into account and a potential system can be tailored to the real needs of the target group rather than to the needs or visions of the developers.

Summed up, the authors recommend to:

- Use understandable and explanatory language, ensuring that all of the end users understand and are comfortable with the IT-jargon used.
- Developments must be evaluated in terms of their potential price before developments are started. If the price is above 10% of the mean income of a retired person, it is too expensive and should be considered for reevaluation.
- When starting field trials, the intensity of support must be considered when evaluating the results for acceptance. This is a strong influence factor.
- Social Isolation is also powered by technological developments. People will try to overcome this with kindness, openness, and forgiveness. This, however, does not reflect their real use of a product. Social Isolation should be a standard measurement for evaluation.
- Needs and requirements of the elderly are not the same as those of young people or developers. Communication needs of elderly in 2017 do not rely on ICT. They rely on pen and paper, face to face interaction, telephone (not smartphone), radio, and TV. They do not rely on the internet, smartphones, projectors, or emails.
- The target group is very heterogeneous because of their life time experience.
- This was a guide to self-criticism for developers.

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