South Austrian Seniors "vs." ICT for Healthcare in AAL Pilot Regions

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Keywords: AAL, Active and Assisted Living, Pilot Region, Support System, Smart Home, ICT for Healthcare.

Abstract: The two Austrian AAL pilot regions, RegionAAL in Styria and Smart VitAALity in Carinthia, developed and evaluated technology to empower older adults in their daily living routines. Different aspects like health, information and communication were considered and developed tools like fall detection as well as emergency call functions were designed to enable seniors to live a longer independent life at home. This paper displays first evaluation results of both pilots based on the usage of the user-interaction devices: tablet and smartwatch.

1 INTRODUCTION

1.1 Related Work – AAL Pilot Regions in Austria

The consequences of the demographic change are well-known topics for more than a decade now. To develop strategies to circumvent the given population development, various initiatives take place on (inter-)national level in Europe. From 2012 to 2018 in Austria, the AAL program benefit[1] has implemented seven test regions - three of them were also finished in this period (Ates et al., 2017).

This paper focuses on two of those regions: RegionAAL in Styria and Smart VitAALity in Carinthia. Both are aiming towards an independent and healthy life for elderly people. The approaches in both pilot regions are similar - as both are using integrated mobile technologies (tablets and smartwatches) in combination with user-oriented services. Nevertheless, differences exist in the settings, products used and services offered as compared in this paper.

1.2 Project RegionAAL

The major aims of the cooperative AAL research project RegionAAL are twofold: on the one hand, people shall be assisted by technology and services to be able to stay longer at home and on the other hand, information on these possibilities shall be made available to a broader audience. The project is mainly located around the urban areas of Graz (292.000+ inhabitants), Deutschlandsberg (approx. 11.600 inhabitants) and Leibnitz (12.600+ inhabitants). The prepared AAL package was tested and evaluated for one year with persons aged 60+ who have a care level from zero to four and no diagnosed dementia. Participants should be cared at least twice a week, attend a day clinic, or live in a supervised residence. A supporting person had to be willing to participate as well.

For the randomized controlled trial n=110 households in the intervention and n=111 in the control group were recruited. The evaluation investigates the quality of life for both groups. For the

[1] AAL funding by FFG benefit: https://www.ffg.at/

Ströckl, D., Majcen, K., Plattner, J., Krainer, D., Löffler, K., Schuster, E., Schaschl, P. and Oberzaucher, J.
South Austrian Seniors "vs." ICT for Healthcare in AAL Pilot Regions.
DOI: 10.5220/0007761400860093
In *International Conference on Finance, Economics, Management and IT Business (FEMIB 2019)*, pages 86-93
ISBN: 978-989-758-370-4

intervention, the group’s usage and acceptance of technology are analyzed as well.

1.3 Project Smart VitAALity

Smart VitAALity is implemented as a cooperative AAL research project with the aim of developing and evaluating with different perspectives a technical solution connected to a subset of integrated services. As project location the urban triangle of Klagenfurt (>100.000 citizens), Villach (>60.00 citizens) and Ferlach (>7.000 citizens) was selected. The developed AAL solution is tested and evaluated over 16 months by persons aged between 60-85 years with a level of care from zero to four, with one exception: if participants have a geriatric relevant diagnosis, they are allowed to participate with an age from 55-60 years. Participants have to live independently in their own homes and take an active part in their own life.

The controlled study within the project is realized with a total number of n=104 in intervention and n=123 in the control group. The evaluation strategy was designed as a multi-perspective approach including usage frequency, technology acceptance and user experience for the intervention group, defined domains of subjective quality of life and a socio-economical potential analysis for both groups. Furthermore, at project start, a user centered requirement analysis was realized, to meet the needs and requirements of the users with the developed system (Krainer et al., 2018a; Krainer et al., 2018b).

2 METHODS

2.1 Project RegionAAL

2.1.1 System Components

The test households in RegionAAL were equipped with identical sets of technologies as shown in Figure 1. This set shall assist in different areas, like health and wellbeing, information, communication, entertainment and safety. The set includes an automatic sensor-based stove shut down, light assistance with automatic night light and radio switched light, a smartwatch with fall detection and alert calls/messages, a tablet with a customized user interface (UI) as well as a wireless mobile doorbell.

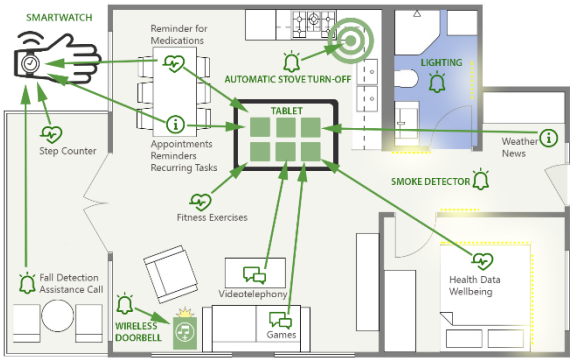

Figure 1: Technology used in RegionAAL test households.

Tablet. RegionAAL uses a Samsung Galaxy Tab A 10.1 LTE T585 (enhanced with a 32 GB memory card for the trainings videos). The tablet was equipped with a rubber case for better handling and a magnetic charge adapter for easier use than the standard micro-USB interface. The asina package[2] (launcher in kiosk mode with apps) was used on the tablet. Several apps were added to asina and some asina apps replaced. The APEX app launcher [3] replaced the asina app launcher. The functions provided on the tablet covered four areas:

Health and Wellbeing. Vital data at a glance, reminders (e.g. medication), training videos and live video streams.

Safety. This was assisted by the automated night light components and stove shutdown as well as the doorbell. Some functions on the tablet and the smartwatch also added to safety.

Information. Internet, weather, calendar and daily agenda.

Communication and Entertainment. Assistance calls, (video) phone calls, telephone, SMS, photos and games.

Smartwatch. A Finow X3plus (standard Android installation) was used and a self-developed fall detection with alerting calls was run on it beside the standard apps (step counter and reminders). Both, tablet and smartwatches, offer full phone and internet functionality and are operated with SIM cards (different phone numbers to be distinguish between normal calls on the tablet and fall alerts from the smartwatch).

2.1.2 Integrated Services

After the rollout of the equipment to the test households, participants were invited to monthly meetings by the involved care organizations. These

[2] asina package - www.asina.de

[3] Apex Launcher -https://play.google.com/store/apps/details?id=com.anddoes.launcher&hl=en

meetings helped to maintain motivation in using the application and learning how to use the technologies. The seniors had the opportunity to learn the usage step by step. Together they repeated the applications regularly and exchanged the experiences they made in the period before the meeting. Furthermore, the older people were shown how to use the technologies in their personal situation (i.e. which of their everyday problems can be solved or at least eased by the technology).

Fitness lessons, offered weekly at one of the care organizations, were also made available via a live video stream to people who could not directly attend. The video telephone also allowed direct interaction between participants and staff of the care organization.

For supporting participants, a telephone hotline with a personal contact person has proven very valuable. Problems were taken care of quickly and the elderly people did not feel left alone with using the applications and problems they experienced with them for whatever reason. The telephone center was busy weekdays from 8 a.m. to 3 p.m. in order to answer customer calls. For technical problems concerning the stove shutdown or the individual light solutions, employees of the project partner "Elektrotechnik Resch" permanently operated a hotline.

2.1.3 Usage Analysis

Different aspects of the devices regarding tablet (usage of apps) and smartwatch (detected falls) were of interest in RegionAAL.

The usage evaluation of the RegionAAL tablet was done on application level. For tracking the usage of apps, many apps exist, but in the project, the "App Usage Tracker"[4] was used. This app allows tracking user-app-interactions (i.e. date/time of starting the app and estimated duration of particular use, but without revealing app insights). The app produces log files, which were transferred for purpose of analysis. Participants also filled a paper-based survey regarding use of tablet-based applications and their acceptance.

The self-developed app for fall detection on the smartwatch is a constantly running application. Detected falls (including date/time of the event) are logged directly in the app together with information whether the user deactivated the consequential alerting call/message or not. Log files were exported and transferred for purpose of analysis. Participants in the intervention and control group documented falls on paper.

2.2 Project Smart VitAALity

2.2.1 System Components

In addition to the interaction components (tablet and smartwatch), the Smart VitAALity system contains hardware components like environmental sensors and vital parameter measurement devices. An overview of the whole system is shown in Figure 2.

Figure 2: Overview of functions and components of the Smart VitAALity system.

Tablet. In the project, an off-the-shelf Samsung Galaxy Tab A 10.1 LTE (2016) tablet equipped with a collapsible rubber case was used. Regarding the project approach of enhancing the multi-media knowledge of the users, the tablet offers unrestricted usage; no kiosk mode that restricts the user from using other functions/apps

The provided Smart VitAALity app has three main clusters with defined functionalities:

Health. A vital parameter measurement component (including a tele-monitoring service), a diary function, a medication reminder and a visualization of distinct activity levels (smartwatch step counter and environmental sensor data).

Information. Drugstore-opening hours, medical services during weekends, appointments for garbage collections, information regarding regional events and a personal calendar including moon and pollen information.

Communication. E-mails [5], WhatsApp [6] and FragNebenan[7], which is a digital neighborly help.

Smartwatch. The Omate SafeMotion S4 smartwatch of the project partner ilogs was used. Each device was equipped with a SIM card to be

[4] App Usage Tracker - https://play.google.com/store/apps/details?id=com.agrvaibhav.AppUsageTracking
[5] G-Mail - www.google.com/gmail
[6] WhatsApp - www.whatsapp.com
[7] FragNebenan - www.fragnebenan.com

geographically independent and provides the following functions: a regular watch functionality, a calendar, a step counter and an emergency call function with an optional call center (with a 24/7 accessibility).

2.2.2 Integrated Services

The Smart VitAALity system is designed to combine a technical system with accompanying services to create a comprehensive benefit for the users. In the design phase of the project, three key services were defined: The tele-monitoring component is complemented by a multilevel medical health coach approach. The participating users are provided with advices regarding their individual vital parameter curve as well as general feedback sessions on a regular base. They also have the possibility to get in contact with the medical experts via telephone hotline.

As addition to the Smart VitAALity watch, an emergency call service including a web-portal as backend was implemented. Users have the possibility to either create their individual emergency chain or to call a 24/7 call center in the case of an emergency.
Another service during the field trial was a technical hotline meant to provide assistance with problems or questions regarding technical components of the system. An associated ticket system was implemented to document the support effort during the whole trial. The tickets are categorized on a very detailed level to provide an insight into the status of the individual component/service for project partners. The gathered support data is used to figure out necessary improvements and to estimate the effort to operate the system beyond the project’s lifetime.

2.2.3 Usage Analysis Tools

For tracking the usage of the Smart VitAALity user interaction devices, tablet and smartwatch, a specific usage analysis strategy was implemented. For the usage of the Smart VitAALity app on the tablet, the software Matomo [8] is used in combination with project internal analysis tools. Therefore, any button tap and any site visit is logged with the specific identification of the interaction and a time stamp. This provides the opportunity to have a look if specific days and / or daytimes are typical for the usage of a particular function. Furthermore, it is possible to add data like geographical information, age groups (pre-defined by the project evaluation team) and sex. By combining this information, it is possible to investigate differences in these categories by using pseudonymized data. For privacy purposes, all data rows were assigned a GUID, which represents the connection to a specific user. To guarantee that it is not possible to identify the user itself, the additional data is aggregated; e.g., the level of detail of the geographical data is only the project location (Klagenfurt, Villach or Ferlach). The general usage of the tablet (beyond the Smart VitAAlity app) is not tracked according to privacy guidelines. Furthermore, at the end of the field trial, a short survey will be realized to gather the relevant information concerning the usage related to other applications (how often are other apps used, which kind of apps are used, are users able to use the tablet independently etc.).

The usage of the smartwatch is tracked by using an interface which logs taken steps and executed emergency calls in combination with time information (indicates that the watch is worn).

For both devices, specific usage groups, which indicate how often a user uses the systems, are implemented. The user groups are listed in Table 1 below. The tablet usage can be evaluated in all five categories by now, for the smartwatch, the daily user is not yet evaluable.

Table 1: Smart VitAALity user group categories and explanations.

Category	**Daily amount of device usage time**
Daily User	Uses the tablet once every day
Frequent User	Uses at least 5 days per week (tablet / smartwatch) once per counting day
Moderate User	Uses at least 2 days per week (tablet / smartwatch) once per counting day
Rare User	Uses at least 1 day per week (tablet / smartwatch) once per counting day
No User	Uses less than 1 day per week (tablet / smartwatch) once per counting day

For further evaluation, also four age-related groups are implemented: <=60 years, 61-70 years, 71-80 years and >80 years. Furthermore, female and male participants were evaluated separately.

[8] Matomo - www.matomo.org

3 RESULTS

3.1 Comparison of the System

In this section, the differences and similarities of the two introduced projects are confronted.

Components. In RegionAAL and Smart VitAALity, the same tablet model is used with the only difference that RegionAAL uses it with the asina software package in kiosk mode and Smart VitAALity uses it without any restrictions. Both pilot regions use a smartwatch, but different devices. RegionAAL uses a standard Finow X3plus with a self-developed fall detection and Smart VitAALity uses the provided self-implemented SafeMotion watch.

Functions. The functions regarding health issues are similar (although different in data acquisition and purpose with/without further services), RegionAAL provides additional physical training support via videos; Smart VitAALity provides a diary component instead. Calendar, internet and weather are provided by both projects. Smart VitAALity uses a large amount of already existing applications like WhatsApp or a regional garbage collection reminder. RegionAAL provides an additional safety component: a fall detection. Both smartwatches provide an emergency call functionality.

Handling. The tablet in RegionAAL is working with kiosk mode and the smartwatch is unrestricted regarding usage, in Smart VitAALity it is vice versa. The smartwatch from Smart VitAALity would have a camera functionality on board, but according acceptance and privacy issues it was switched off.

Support. Both projects provide a technical support hotline available on business days with the option that a technician supports the users via telephone or directly in their home environment.

Implementation. Here are the main differences between the two pilot regions. Regarding the tablet, RegionAAL used pre-selected asina platform apps and the web based asina backend for maintenance of asina clients on the tablets. The more flexible Apex launcher with a self-designed UI replaced the asina launcher. For usage tracking, the app "App Usage Tracker" was installed as well as a self-implementation of a web-based information portal in WordPress[9]. Smart VitAALity implemented an app, which is automatically updateable by the ilogs Agent based on ilogs' James[10] application. Additionally, a barrier free design approach – users can change font size, and color scheme according to their requirements (regular, night or high contrast mode) – was implemented. Interfaces to the ilogs backend for synchronization and updates, to the care center for communicating the vital parameters and to the Carinthia University of Applied Sciences FIWARE[11] server for logging the data were implemented.

Regarding the smartwatches, both projects use Android based watches; RegionAAL uses the watch as it is on the market with an additional fall detection and alarming app including logging facilities for detected falls. In Smart VitAALity, a customized Android version is used with the restriction that camera functionality is switched off. The smartwatch has an interface to the ilogs backend for emergency call logging and step counting as well as for updates.

3.2 General Usage of the System

RegionAAL. The two mobile devices in RegionAAL were adopted differently. The participants liked the tablet including installed software and additional hardware for easing its use. Many participants did not like the smartwatch. The major issue with the smartwatch was its short battery lifetime. This was a consequence of applications, which consume a lot of energy (e.g. GPS location and the fall detection), and phone and internet services did many re-connects. Nevertheless, the participants were very interested in the feature fall detection and would be happy to use it with a smartwatch if it is more comfortable to use. Those participants that used the smartwatch, experimented with available apps and changed the watch's settings like its available watch faces. In interviews participants mentioned that the smartwatch UI (smaller sized buttons and navigation) is more difficult to use than the tablet UI.

The use of the tablet varied between participants. Some of them used the tablet up to about 490 hours over the whole test period while others nearly not used it. A first analysis of app usage on the tablets showed that information (internet access via a web browser) was the most interesting item with 54%. Entertainment (the installed games "Sudoku" and "2048") added another 36%. Communication was following these two with 5%. Although interesting to participants, video telephoning was not heavily used. For video phoning, the Skype app was provided (contacts maintained by supporting persons), but it still seems to be too complicated to use as told by some participants in interviews.

[9] WordPress - www.wordpress.org
[10] James by ilogs - www.freedomjames.com
[11] FIWARE - www.fiware.org

The participants were allowed to keep the equipment after the one-year test phase. About 30% kept the tablet after the project for further private use. However, the participants wanted to have a standard UI rather than the customized UI in kiosk mode, thus having a device just like as their children and grandchildren have.

Smart VitAALity. The usage analysis is not yet finalized, because the field test ends in June 2019. An interim evaluation showed that the majority (>50%) uses tablet and smartwatch on a regular basis.

The functionalities that are of most interest are the health functions on the tablet, especially the monitoring component for blood pressure, blood sugar and body weight, the step counter monitoring per day and the diary to monitor the subjective perception of one’s own health condition. Functionalities in the information or communication cluster are used less often. This may correlate to the experience level of the users, because these functions are often third-party applications with a more complex UI. Furthermore, some users created short cuts on their tablet for WhatsApp or Internet, so that they do not need to open the Smart VitAALity application to reach these functions (result: no tracking). This fact will be evaluated at the end of the field test. Regarding to the requirement analysis, games play a major role for the users, but according the usage figures, just eight out of the 104 people in the intervention group are playing regularly.

3.3 Usage Analysis per User Group

RegionAAL. The tablet was used without additionally connected services and data sources (i.e. looking into data that were generated either by ambient sensors in the apartment or vital parameters collected by daily measurements with appropriate medical devices and transferred to a server and afterwards back again to the tablet). Such additional services may have created additional motivation for the participants to use the tablet.

Table 2: RegionAAL user group categories and explanations.

Category	Daily amount of tablet usage time
Power User	more than an hour per day
Regular Users	quarter to half an hour per day
Normal Users	5 to 10 minutes per day
From Time to Time Users	2 to 5 minutes per day
Rare Users	less than 2 minutes per day
Barely User	(nearly) not at all

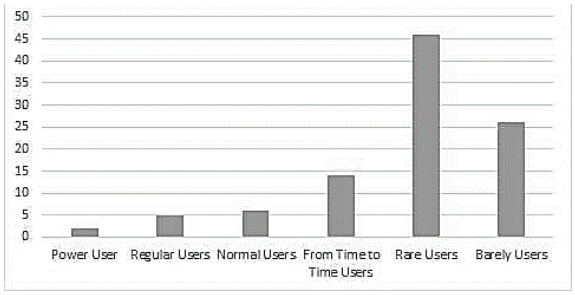

Figure 3: Distribution of user types for tablet usage in RegionAAL.

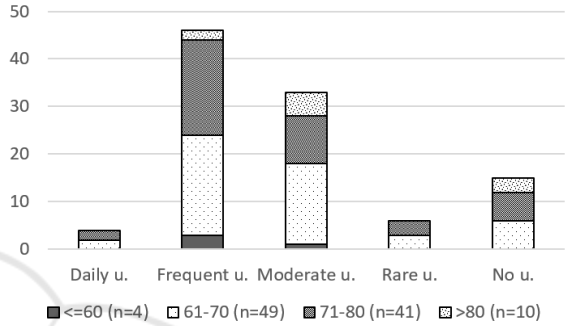

Figure 4: Smart VitAALity tablet usage divided in age groups.

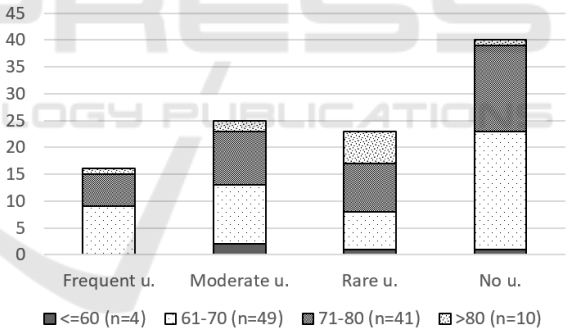

Figure 5: Smart VitAALity smartwatch usage divided in age groups.

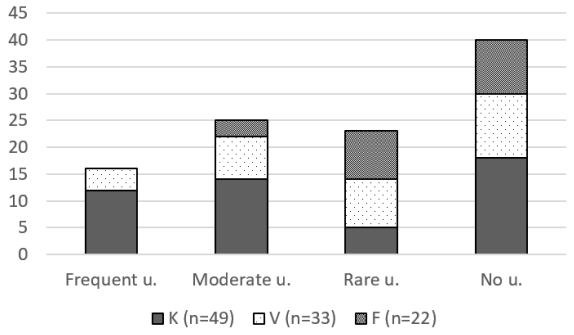

Figure 6: Smart VitAALity smartwatch usage grouped by geographical information.

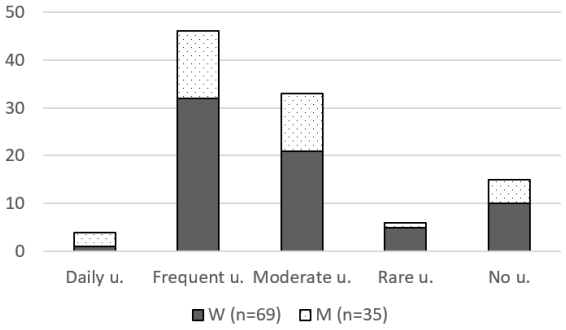

Figure 7: Smart VitAALity tablet usage grouped by sex.

Given the range from 0 to 489 hours of use of the tablet, grouping categories of usage times were introduced (calculated as average daily estimated hours) as shown in Table 2.

The distribution over these user categories is shown in Figure 3. Taking "from time to time" and more frequent usage as indication of some level of interest, this group includes 27% of all participants.

Smart VitAALity. The pre-evaluation of the usage shows first outcomes according the usage groups in relation with the evaluation categories geographical-data, age and sex.

As shown in the Figures (4-7), hypotheses like „people living in a city (Klagenfurt) are using the smartwatch more often than people living in the country side (Ferlach)", "men use the tablet more often than women" or "older people use the devices less often than younger ones" are answered. As shown in the figures, the total number of usage-days per category disproves the common stereotypes.

3.4 Support Effort

A crucial service for enjoying the use of AAL technologies for the seniors is a good introduction to the application and support during the pilot phase. This can be either a telephone hotline or regular personal meetings.

Supporting older people in using the AAL-technologies is time consuming and often underestimated. Offering a good introduction into the technologies can take up to 400 hours (for around 30 people). The regular support through hotlines, personal advices and group meetings for a one-year-period requires up to 1800 hours (for about 80 people). However, the effort of support significantly decreases over time.

Smart VitAALity. Also in the Smart VitAALity project, a good introduction to the functions and components and providing a comprehensive support was a key element of the provided services.The ratio

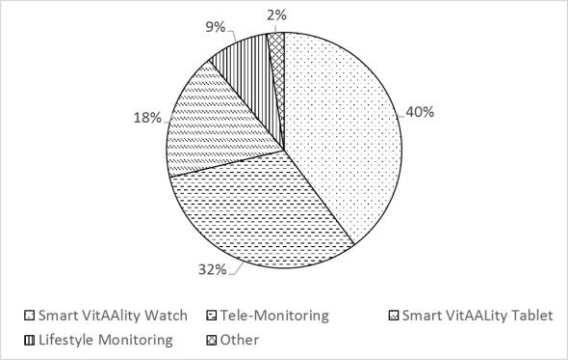

Figure 8: Ratio of overall support tickets per Smart VitAALity component.

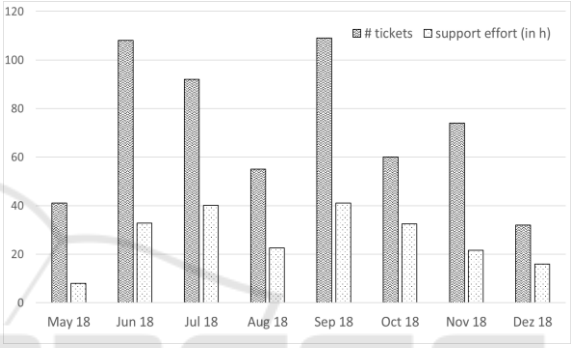

Figure 9: Monthly tickets and support effort in Smart VitAALity.

of support tickets per component is shown in Figure 8. 40% of all tickets were related to the Smart VitAALity watch, especially regarding hardware frailties and some general issues of the device itself.

The figure also shows that there was a very low number of tickets regarding the Smart VitAALity tablet which indicates that using the tablet with open access to all functions was not a problem for the user group. Figure 9 shows the ratio of tickets per month and the related support effort, including the time spent in the field and driving times. It can be seen that there is no significant trend regarding the monthly tickets but the support effort in the field constantly decreases over the last months. The number of overall tickets seems comparatively high, but this may be related to the extraordinary high usage of the Smart VitAALity system (or the unrestricted usage possibility of the technology) and will be subject to further analyses after the field trial is finished.

4 CONCLUSION

According to the different settings, the usage analysis is hardly comparable; the tablet with the health monitoring functionalities is a core component in Smart VitAALity; the users intensively consume especially the health monitoring functionality and regarding statements during the support activities, it is now part of their daily routine to monitor e.g. the blood pressure. In RegionAAL, health topics are not in focus and therefore, the usage of the tablet may be lower as in Smart VitAALity.

Regarding the smartwatch, the chosen watches influence the usage considerably. In RegionAAL, the chosen watch has a low battery lifetime and, therefore, the users refused the usage, but they liked the fall detection and emergency call function on the watch. In Smart VitAALity, the watch has similar problems in the first test phase but then it was constantly improved and people liked wearing it.

The results show, that the provided functionality and the device quality are important factors for the usage of AAL technology (Plattner et al., 2018).

Even if users are aware of the project frame and that the devices/software are more or less in a prototype status and that they have the task to use and evaluate them, they want the technologies to work without many failures and do not accept prototype-like issues. Therefore, it is necessary to involve the target group into the development process of the AAL technologies; the implementation of frequent feedback loops and fostering constant contact through a support hotline are core-components of a successful AAL project.

ACKNOWLEDGEMENTS

The project RegionAAL (grant no. 850810) is partially funded in the program benefit by the Austrian Research Promotion Agency (FFG) and the Austrian Ministry for Transport, Innovation and Technology (bmvit). We also thank the consortium partners PWH Kirschallee GmbH, Resch Elektrotechnik GmbH and the trial participants.

The pilot region Smart VitAALity (grant no. 858380) is supported in the framework of the FFG program benefit and co-financed by bmvit. We would also like to thank the consortium partner Hilfswerk Kärnten, the associated partner Netzwerk Geriatrie Kärnten, LAiF in Ferlach and the cities of Klagenfurt, Villach and Ferlach, as well as the trial participants.

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