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Field test of innovative digital technical assistance systems in the outpatient and inpatient care

Abstract: The tecLA project developed a modular system for the area of Ambient Assisted Living (AAL) that enables older people to have simple, intuitive access to medical and technical assistance systems. A commercially available AAL application portal has been subjected to acceptance tests and optimizations and has proven itself in field tests. Furthermore, when comparing the self-assessment values to cognitive measures before and after the intervention, a clear trend towards more positive values in the post-test was recorded. It was also shown that the use of the system has very positive effects on communication behavior and cognitive self-assessment. The nurses and doctors can follow the vital signs online in the patient's file and evaluate them immediately.

Keywords: Ambient Assisted Living, Technical care assistance systems, IOT medical measurement.

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1 Introduction

The average age of people in many countries around the world will rise sharply in the future. Life expectancy is increasing and older people will live longer. However, there are factors that affect the quality of life of older people and their morbidity. In order to maintain the quality of life for a long time and to enable people to live as long as possible in their own home, applications of the technical support systems have been developed in recent years, which on the one hand affect the medical areas as well as home automation and are named under the keyword Ambient Assisted Living. These products are already available on the market, with most of the solutions only addressing very special applications, such as

house alarms, stove shutdowns [1], telecardiology [2] or the like. There is also a wide variety of home health monitoring devices. However, some newer devices allow network capabilities that mostly support proprietary protocols and are sold as wellness systems (Apple watch, Fitbit etc.). There is still no data-secure system for integrating medical health data (telemedicine) and social data (telecare).

Previous AAL applications offers are only very hesitantly accepted by the older target groups (> 70 years) who could benefit from them. In order to make the various AAL options accessible to older people in the long term, an innovative and user-friendly human-technology interface was developed in conjunction with a service and communication portal. This should offer a useful range of functions and be intuitive to use. In doing so, particular attention should be paid to minimizing typical fears when dealing with technology. Early involvement of future users was a central concern of the process.

The aim of the tecLA [1] project was to develop a modular system for the area of Ambient Assisted Living (AAL) that enables elder people to have simple, intuitive access to technical assistance systems. To this end, the project partners, Harz University, Halle-Wittenberg University and Burg Giebichenstein cooperate with Johanniter Unfallhilfe Oschersleben [2] and Exelonix. The methods developed in the course of the project were subjected to a pre-test after implementation in the technical assistance systems in the AAL laboratory of the Harz University and then evaluated in two 3-month field trials in inpatient and outpatient care.

2 Methods

The interoperable, growing system adapts flexibly and cost-effectively to changing abilities and needs of users. Many systems have been developed in scientific research and development systems [3][4][5][6][7], but most of them have not been focused on the acceptance of use by elderly people. In this project, the focus was on the client. With the help of data sensors, the vital parameters are to be recorded automatically and made available to the medical services via a cloud system automatically or by manual start by the client. Furthermore, it was possible to order services from external

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service providers such as hairdressers, taxis, etc. via an easy-to-use portal using a touch tablet. In addition, information on current events or train timetables are able to be easily retrieved. Another important point is the improved social integration through the use of social network services. The video consultation also established a direct line to the medical services and doctors. For this purpose, Bluetooth-enabled and medically approved vital parameter measuring devices (blood pressure, blood sugar, heart rate, activity analysis) have been integrated so that the caregivers and responsible doctors can view the current data in the patient file.

Another important point is the mental, physical and social activation, which stimulates the clients with appropriate apps and motion videos and thus improves their physical and mental condition.

2.1 Project structure

The project structure consisted of three work phases within the project duration of 3 years. After a conception phase with the definition of the service offerings and the technology to be used, the right technology for 20 clients was procured in the following project phase: tablets, SIM cards, applications and user interfaces (NFC applications with cards in a haptic manner to start the apps). The technology / apps were then installed on all tablets and tested in the AAL laboratory. The user interface as well as the interfaces to the vital parameter measurements were adapted to the needs of the very old in the course of the evaluation and optimized for field use.

In preparation for the field tests, the project team designed a questionnaire that was given to the test subjects in advance by the care facility. This was then filled out by the test persons and after it was returned, the information contained therein formed the basis for the personalized set-up of the tablets and the compilation of the desired vital signs recording devices by the project team. Since at that time there was neither a WIFI connection in the inpatient nor in the outpatient area, all tablets were equipped with a SIM card. The required NFC cards were also configured.

The following information was requested in the questionnaire (extract from the questionnaire created):

1. Video telephony: Query which contacts should be saved on the device?
2. Email (electronic letter):
 - a. Query whether an e-mail address already exists (Access data are also requested)
 - b. Query which email addresses are on the device should be saved?
3. Short message service (WhatsApp): Query which

Cell phone numbers should be saved on the device? This information could also be used for SMS services.

4. Physical training: Inquiry as to whether the test subjects want to use the training videos.

5. Health parameters: Query which health data the test persons want to record (blood pressure, weight, fitness tracker)

6. Medication reminder: Query whether a medication reminder is required and when.

7. Diary: Query whether the diary (asina well-being app) should be used.

8. Messages: Query whether and which message services should be used.

Based on the information requested in advance, the tablets were set up, the vital signs recording devices were set up and the NFC cards were set up, as mentioned above.

3 Results

Two field tests were carried out with subjects from the age cohort > 70 years (8 subjects from inpatient care and 12 subjects from outpatient field tests). The social data of the test persons were also recorded to evaluate the acceptance barriers.

The usage phase in both field tests was 3 months each. A total of N = 9 test persons took part in the stationary and 12 in the ambulant field test. 17 of them were women and 4 men. On average, the people were M = 77.11 years old (SD = 11.53; range: 58-95 years).

The test persons were introduced to the system in an introductory course and then in a further meeting the personal data for the implementation of the desired functions was recorded in the AAL portal ASINA [8]. These data have been implemented in the tablets to be handed out to the sample clients promptly at the start of the field test and an introduction to the use of employees of the care station was given together with a scientific employee of the project team. Then the application phase starts in both field tests for 3 months. The frequency of use of the apps and their usage time were recorded in the background for all tablets and transferred to a secure server at the Harz University (see Figure 1).

Skype for video communication and WhatsApp for simple voice communication were used as the most common applications. According to the test persons, one of the main reasons is the ease of use of the apps and the easy accessibility of communication partners (friends, family) who generally also use these applications.

However, some technical problems arose during the project that should not go unmentioned:

- Interfaces: The integration of the various devices for recording vital signs could not be easily integrated into ASINA (see Figure 2). Some of the individual devices only work with

the apps supplied by the manufacturer. Manufacturer-independent standardization would be desirable here.

Figure 1: Data recording of app usage

Figure 2: ASINA applications portal

- **Hardware / operating system:** In several cases, the effect was that after starting the tablet, only the start screen was loaded and nothing else happened. The only thing that helped here was a complete reset of the tablet.

- **Setup / operation of apps:** during the two field tests, there were frequent inquiries from clients and their supervisors. These problems are very likely to become less in the future.

In summary, it can be said that most of the problems with its use occurred in test subjects who had little or no experience in using this technology. A technical support is desirable here, as this contributes to a significantly increased acceptance.

4 Acceptance analysis

When introducing innovative assistance systems into the care landscape, great attention should be paid to the care staff, especially with regard to acceptance. If it is these who are more and more often the only caregivers of those in need of care, it will also be these who can take away the fear of the elderly about technical assistance systems.

4.1 EVALUATION OF THE USE OF THE TECLA SYSTEM

The test persons were introduced to the system in an introductory course and then the personal data for the implementation of the desired functions was added to the AAL portal ASINA in a further meeting. This data was then implemented in the tablets to be handed over and handed out to the clients at the start of the field test and an introduction to the use of employees of the care station was given.

When comparing the self-assessment values with cognitive measures by interviews of clients and staff persons with qualitative analysis before and after the intervention, a clear trend towards more positive values in the post-test was recorded.

The following is a list of excerpts from interview responses from clients and nursing staff, which represent the acceptance of the system in personal opinions:

- ... with regard to senior-friendly human-technology interfaces?

For the most part, it is suitable for the elderly, but especially the font in individual apps (e.g. Skype; WhatsApp) is too small for older people. In order to support the operation of the tablets, touch pens should urgently be used.

- ... in terms of social activation?

“Very good!” Contacts, especially with the younger generations / relatives, became possible and were positively accepted by the participants.

- ... in terms of physical activation?

The motion videos at a higher volume are easy to understand and, according to the nursing staff, can also be implemented well on their own. They can be used to maintain physical functions for a longer period of time.

- ... in terms of cognitive activation?

Thinking through and learning how to operate the system promotes cognitive thinking in this target group. The test persons discover new possibilities, for example information about the Internet from their former homeland or about "Expelled from Sudeten Germany" increases mental activity. The test persons are “proud” to be able to learn something like this. In addition, it promotes a lively exchange between the individual participants and it can develop its own dynamic, because “everyone knows something and helps others”.

- ... with regard to the range of services?

Something fell under the table in the stationary field. The menu plan and leisure activities were looked at, but you can't really rate anything about it.

- ... with a view to promoting autonomy and independence?

Similar to the points above. It gives the seniors autonomy: "look outside", although they live in the facility and may not really physically be able to go outside. You can operate the system independently, especially thanks to the NFC cards, if you have physical / motor restrictions.

- ... in terms of benefits for seniors?

Seniors get the feeling of independence back and if it is only the query of today's weather. But they also have new topics of conversation that they can share with the nursing staff or with each other through information on a tablet or via the Internet.

- How do you think the elderly rate the system?

"Well!" Most of all seniors have now got their own tablet and internet access.

- Do you notice any changes in the subjects as a result of using the system?

Yes, they are more alert, have more topics to talk about and are "proud" of their new knowledge, which they also share in front of relatives, nursing staff and other residents. This resulted in a higher level of social participation among relatives and among each other.

Overall, the test subjects and the staff rated the TecLA system very positively. Participants stated that they "felt that using the system improved their ability to concentrate", "increased their communication with friends and family", and "made everyday life easier in general".

5 Conclusion

A commercially available AAL application portal has been subjected to acceptance tests and optimizations and has proven itself in field tests. Furthermore, when comparing the self-assessment values to cognitive measures before and after the intervention, a clear trend towards more positive values in the post-test was recorded.

The evaluation of the data shows an intensive use of the communication applications, the web search / Google as well as the recording of the vital parameters. Furthermore, when comparing the self-assessment values with cognitive measures before and after the intervention, a clear trend towards more positive values in the post-test was recorded. Furthermore, the use of the system has very positive effects on communication behavior and cognitive self-assessment.

- In principle, the interest of the clients is quite high
- Innovative user interface, very intuitive, is well received
- even those over 85 years old clients accept the offer quite well
- Video calls especially popular, social engagement important, is perceived as an extension
- Motion videos also popular, very easy to use

On the other hand, technical challenges have also arisen in day-to-day operations that have to be resolved in order to make it easy to use such systems:

- Technical IT status in nursing homes is very low
- Data collection can be implemented very easily
- Many technical problems when integrating the software in tablets

The use of the system has very positive effects on communication behavior and cognitive self-assessment. The nurses and doctors can follow the vital signs online in the patient's file and evaluate them immediately.

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References

- [1] U. Fischer--Hirchert, G. Hübner, W. Mau, and F. Meinel, "Application of technology-assisted care assistance systems - Project TECLA," in *International scientific conference Active Healthy Aging 2015 (AHA2015)*, 2015, p. 2.
- [2] "Johanniter Unfallhilfe Oschersleben," 2021. .
- [3] S. Bensch and M. Geiger, "Zwei Schritte vor, einer zurück," *Psych. Pfl. Heute*, vol. 22, no. 01, pp. 16–22, 2016.
- [4] S. Reutzel, B. Klein, H. Roßberg, D. Hausnotruf, and D. Jahre, "Akzeptanz und Nutzenpotentiale erweiterter Sensorik eines Hausnot- rufs . Erste Ergebnisse der Nutzerbefragung eines Feldtests Kurzfassung Ausgangslage Die vorgestellten fünf Generationentypen bilden jeweils," 2014.
- [5] L. A-k et al., "GENIAAL Beraten – Netzwerklösungen für Handwerk und Endver- braucher GENIAAL Beraten – networksolution for craftsman and end- consumer Problemstellung Methodik Diskussion Literatur Ergebnisse / Ausblick," pp. 21–23, 2014.
- [6] C. Weiß et al., "Ergebnisse der BMG- Studie „ Unterstützung Pflegebedürftiger durch technische Assistenz systeme “," pp. 2013–2014, 2014.
- [7] R. Lutze, I. Rainer, and L. Consulting, "Zur Praxistauglichkeit von Assistenzsystemen zu Hause Road Capability Aspects of Assistance Systems at Home," pp. 1–5, 2014.
- [8] Borowski IT GmbH, "ASINA," 2021. [Online]. Available: <https://www.asina.de>.
- [9] S. J. Danbatta and A. Varol, "Comparison of Zigbee, Z-Wave, Wi-Fi, and Bluetooth Wireless Technologies Used in Home Automation," in *2019 7th International Symposium on Digital Forensics and Security (ISDFS)*, 2019, pp. 1–5.