# ISA: An Integrated Environment for the Digital Inclusion of Elderly People

Bernhard Kohn[1][a], Klaus Dittrich[1], Carmina Coronel[1][b], Martin Litzenberger[1][c], Birgit Unger-Hrdlicka[2] and Karoline Reither[2]
[1]*AIT Austrian Institute of Technology GmbH, Giefinggasse 4, 1220 Vienna, Austria*
[2]*myneva Austria GmbH, Hietzinger Kai 133,1130 Wien, Austria*

Keywords: Active Assisted Living Technology.

Abstract: Elderly people are increasingly discouraged from using mobile digital devices due to the large number of applications. In this paper, we present ISA, an integrated system that is intended to simplify the inclusion of older people in the digital world, by a joint organisation of a digital calendar by care organisation, cared for person and informal carer. On a tablet computer daily routine such as home care, taking medication, but also appointments, meetings with friends or relatives can be easily managed by an integrated calendar. In addition, functions such as video telephony and photo albums are offered for better social interaction with friends and relatives. A pilot operation was carried out to check whether the system would be helpful in daily activities or in reducing the burden of informal carers. 12 pairs of participants, each consisting of the person to be cared for and the informal carer, were recruited for a study. They filled out questionnaires on activities of daily life and the caregiver burden before and after the test. Evaluation of the questionnaires showed no significant change of status regarding the activities of daily living or the caregiver burden.

## 1 INTRODUCTION

Participation of the elderly in the digital world is becoming more and more important as some basic services are only available through smartphones with internet connection. In the near future, registration for social events or even personal services, such as booking an appointment at the hairdresser, will only be possible via digital tools, such as web forms or smartphone apps. On one hand, existing digital technologies still pose a huge barrier for some elderly to participate in daily life and to organize their own agenda. On the other, care persons are facing an increasing burden to support the elderly in the use of the digital technologies or, in many cases, even having to completely take over these tasks for them.

Existing systems or software often pose a problem of being not optimized for a use by elderly people or not having the possibility to use the system by carer and cared for person cooperatively in a consistent manner. For example, although a digital calendar may be shareable among different people across different platforms, the necessary workflows for a cooperative usage by a caregiver and elderly are usually not supported. While the design of user interfaces optimized for use by elderly are already under investigation for some time (Iancu & Iancu, 2017; Kurniawan, 2008; Zhu et al., 2008), cases of successful implementation and adoption of assistive solutions are still rare (Haan et al., 2021; Martinez-Martin & Costa, 2021) and they concentrate more on the compensation of cognitive deficiencies than on the support of organizing general daily activities and fostering digital inclusion.

Baric et al. report on the "RemindMe" system (Baric et al., 2019) that combines an interactive digital calendar for the carer with short text message (SMS) reminders sent to the elderly users. The widely known SMS service has been chosen, instead of a smart phone GUI or app, to simplify the interaction

[a] https://orcid.org/0000-0002-3177-3159
[b] https://orcid.org/0000-0001-6304-0243
[c] https://orcid.org/0000-0002-2101-2188



Kohn, B., Dittrich, K., Coronel, C., Litzenberger, M., Unger-Hrdlicka, B. and Reither, K.
ISA: An Integrated Environment for the Digital Inclusion of Elderly People.
DOI: 10.5220/0011137300003188
In *Proceedings of the 8th International Conference on Information and Communication Technologies for Ageing Well and e-Health (ICT4AWE 2022)*, pages 344-350
ISBN: 978-989-758-566-1; ISSN: 2184-4984

for the elderly. A study with 20 subjects has been conducted. Project Freewalker (Litzenberger et al., 2021) piloted a GNSS based assistive technology that combined a GNSS dongle with smartphone apps for caregiver and user, to protect from wandering and getting lost. Through creation of appointments defined in a shared calendar, maintained either by the carer or cared-for person, the application generates optimized and safe travel directions for the cared-for persons

In this paper we report on the concept and software of the ISA project, developed in the framework of a research project, to test and validate a system based on a collaborative and maintained electronic calendar to organize all aspects of the daily schedule for care and support of an elderly person in close cooperation with the care person. ISA implements an intelligent web-based system intended to assist working individuals in their care and support duties and the data gathered by the system will be permanently available to the caring individual. A tablet installed with the application is placed in the home of the cared-for person. The application equipped with an optimized user-interface reminds and notifies regarding activities, not only such as eating, drinking, grooming, housework, but also outside activities such as shopping, exercising, family meetings, doctor visits. ISA should thereby enable the user to lead a more self-organized and self-empowered life and reduce the burden of the carer, too. It also displays motivational items such as family photos. Additionally, the possibility for video calls is integrated. For personal security, the system also notifies regarding special adverse weather conditions like heavy rains or thunderstorm and current weather information. In contrast to RemindMe, both carer and cared-for person can maintain the ISA calendar and organize care appointments. In the future the possibility of directly integrating various services (e.g., hairdresser) with the providers is planned. A first pilot study with ISA, in which the system has been used by 12 users and their informal carers has been conducted in Austria over the duration of three months. To analyse the impact of using ISA on the reduction of stress for the elderly person and of caregiver burden of the informal carers a questionnaire was used before and after the test. For the elderly persons the questionnaire of the Bayer Activities of Daily Living (Erzigkeit et al., 2001; Hindmarch et al., 1998) were used whereas for the informal carer the Zarid Burden Interview (Zarit et al., 1980) was chosen to get information how strong the burden of caring is recognized. Although both questionnaires are more related for cognitive impaired persons, they should give an indication if an influence occurs.

The paper concentrates on the technical description of the software component of ISA and on the first results of the pilot study and is organised as follows: The following section gives an overview over the system features and the system architecture.

In Section 3 the pilot is explained and how the questionnaire was carried out. The paper closes with Section 4, the conclusion.

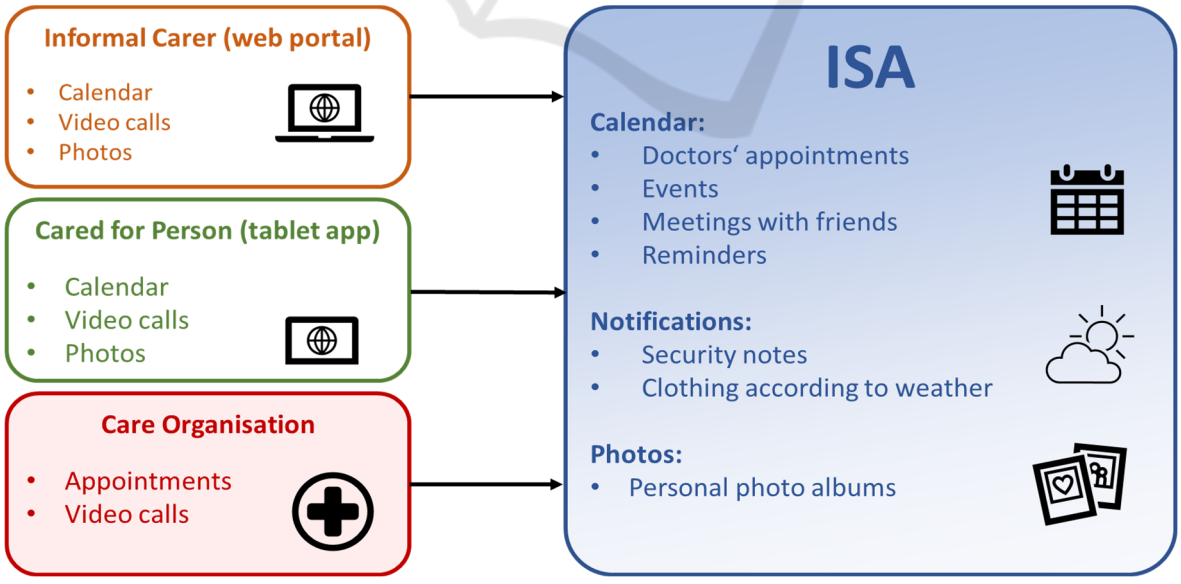


Figure 1: Overview of the features of the ISA system.

# 2 ISA SYSTEM

## 2.1 Features

In Figure 1 a schematic overview of all system features is shown. The basis of the ISA system is the calendar. Using the calendar, it's possible to plan daily activities. The entry point for the cared for person is the day view (see Figure 2 top) of the system. He or she can add special reminders for daily activities like medication or drinking times, meeting appointments with friends or relatives (see Figure 2 bottom). Each appointment added to the calendar can be given a category, one of: appointment out of house, medication, video call, event or other (see Figure 3 top). For appointments of the category out of house the user will get a reminder with additional information regarding the actual weather situation, so she is reminded to dress accordingly (see Figure 3 bottom). Additionally, the cared-for person can add video calls (see Figure 4 top) as appointments and invite the informal carer or other contacts to join. A photo album (Figure 4 bottom) can be used to share pictures of family or other events. This should help, especially in times of the COVID-19 pandemic, to keep personal contact with family and friends. All these possibilities are offered by an application for an android tablet. The user interface is specially designed for an easy and intuitive use.

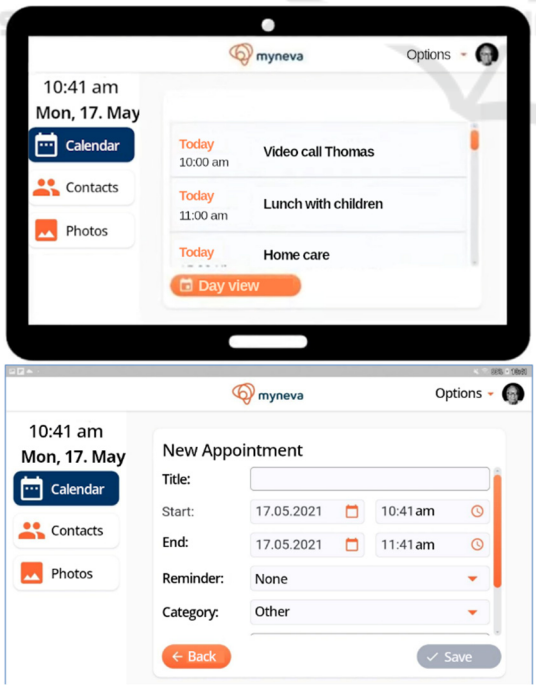


Figure 2: Top) overview of appointments, bottom) add new appointment.

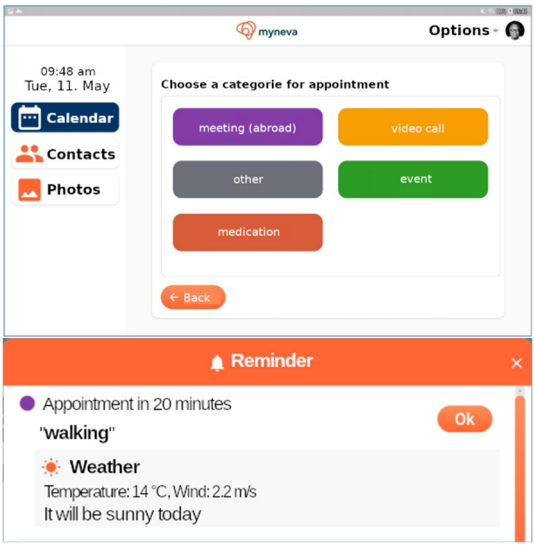


Figure 3: Top) available categories for appointments, bottom) reminder with weather information

For the informal carer a web portal is offered to access the calendar, contact list, and photo albums. The cared for person can grant rights to the informal carer via an access list, so that the cared for person maintains control on the data to be shared. If access right is granted, the informal carer can access and add pictures to the photo album, add additional contacts to contact list and view and add appointments.

The ISA systems also offers an API to directly interface to care organisations, so that home care appointments can be sent automatically to the calendar. This feature allows the cared-for persons to know at which time the home care person will visit them. In case that a home care appointment is late, the cared for person can be informed by the care organisation through the table application (see Figure 5). Additionally, the cared for person or the informal carer may also cancel appointments if the cared for person is unable to attend due to unforeseen situations like doctors' appointments or hospitalisations.

Additionally, a so-called logic engine is integrated into the system. The purpose of the logic engine is twofold. On one hand, it automatically checks if a new added appointment conflict with an existing one. This is necessary, as the home care appointments typically are only available for the next four weeks. The logic engine derives over this four-week period when home care appointments are made and hints the user about potential conflicts. On the other hand, it analyses the daily activities, especially the medication intake and home care appointments. If the logic engine detects unusual behaviour of the cared for person in her daily routines, it sends a message to the

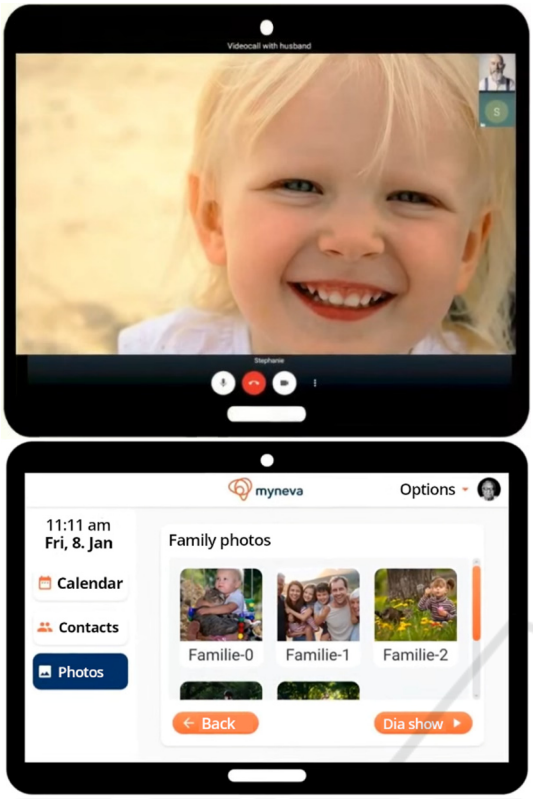


Figure 4: Top) video call, bottom) photo album.

informal carer to inform her about the observation. This can give the informal carer an early chance to contact the cared for person to ask if anything is wrong. Of course, the cared for person can activate or deactivate this feature on their own will.

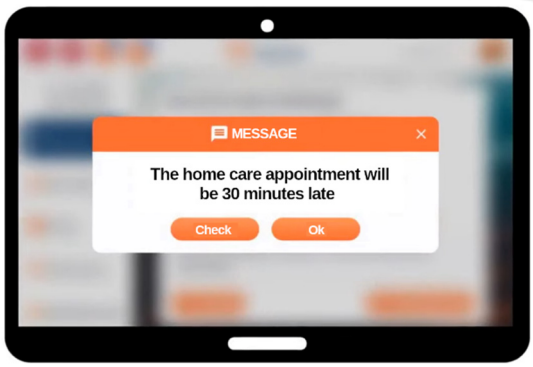


Figure 5: Notification that a care appointment is shifted.

## 2.2 System Architecture

In Figure 6 the overview of the system architecture is shown. It consists of three server applications. The basis of the system is the ISA server, which stores all the user and calendar data, and provides the web portal for the informal carer. For the tablet app it serves a web API to give access to all needed information. The tablet app can also be notified when reminders or messages should be shown by this mean.

The second server application is the logic engine. It is served by a separate server. The decision to separate the logic engine from the ISA base was to ease the parallel development of the two components. The communication between the ISA server and the logic engine is realized by several dedicated endpoints. For each change of the calendar (e.g., adding, changing, or deleting an appointment) the ISA server asks for approval by the logic engine. By this design the logic engine receives the complete information of active appointments and can check, if there is any conflict with any existing appointments for a given user. Additionally, the logic engine records each reminder of appointments. By this the logic engine can check several corner cases,

- Is a home care appointment cancelled?
- Is the cancellation time under a certain time range, where it may cost a cancellation fee?
- Is there an overlap within a time range, where usually a home care appointment takes place?
- Is there an overlap with another appointment?

Depending on the results of this analysis next step will be executed. E.g., if the cancellation of a home care appointment within the next 24 hours is detected, the user will be notified, that the cancelation may cost a cancelation fee. If a conflict of appointments is

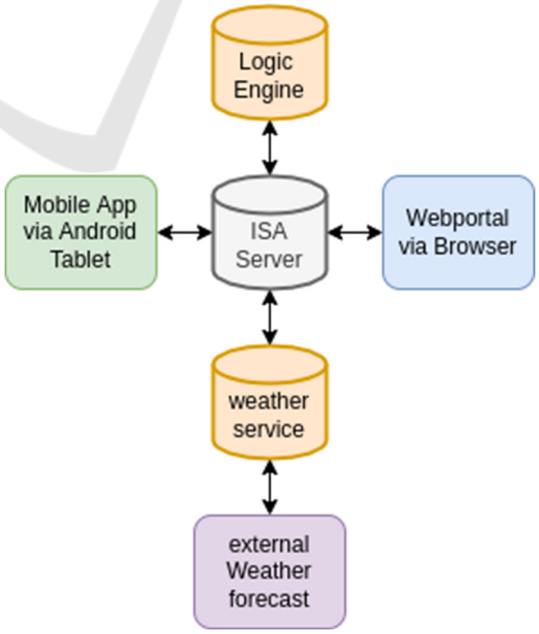


Figure 6: ISA System architecture: ISA Server, Logic Engine and weather service.

detected, the user will be reminded, that another appointment is planned at the same time, and if she would like to proceed or choose a different time.

An additional task of the logic engine is to detect unusual behaviour. Unusual behaviour can be assumed, for example, if a cared for person frequently cancels home care appointments, or if reminders for medications aren't acknowledged. In the case of the not acknowledged reminder the logic engine triggers the ISA server to send a message to the user. If the acknowledgement is not given by a user several times a week, a message to the informal carer is send, to notify about the situation. Of course, such a strict monitoring must be explicitly approved by the cared for person and the general aim is not to enforce strict monitoring. The aim of this function is to give the informal carer a hint, that there might be something not in order and that they could ask sensitively about medications or cancelled home care appointments. The logic engine can be configured to follow different workflows, depending on the care organisation the user is registered with. The workflows allow to configure which type of messages should be send, like SMS, emails or by other message applications. By this different connection methods and different type of users can be defined according to the needs of the care organisation.

The third server application is the weather service. By the separation of the weather service from the other components, the local weather provider could be easily exchanged. The weather service provides two different services. Each user using the ISA system will be registered by the place he is living (over the area code) at the weather service. In regular time intervals (every 10 mins) the weather service asks an external weather information provider if there is any local warning for extreme weather situations like heavy rain, strong wind, thunderstorms and other similar situations. If there is warning, each user living in the affected area will be notified by the tablet about it. Additionally, it provides a web endpoint for the ISA server, so that any reminder on an out of house appointment will be accompanied with weather information. This gives the user an indication on what appropriate clothes to wear.

# 3 PILOT STUDY

The ISA system was piloted in a field trial from October 2021 till the end of December 2021. The pilot was accompanied by a set of questionnaires to get a measure if the usage may help to reduce the daily stress of the cared-for persons and for the informal carers.

For the pilot a care organisation (Vienna Red Cross) and one research project partner searched for candidate pilot participants of cared for persons and informal carers. Due to the Covid pandemic the response of potential study participants was moderate. In total 12 candidates were involved in the pilot study. The cared for persons have an average age of 74 years ranging from 64 to 95 years. The group consists of 5 women and 7 men. The informal carers had an average of 39 years ranging from 29 to 64 years, consisting of 7 women and 5 men.

All of them answered the questionnaire before the beginning of the pilot and within three weeks after the end of the pilot.

## 3.1 Questionnaires

As questionnaire for the cared-for persons the Bayer Activities of Daily Living (Bayer ADL) was chosen. The questions were in German language and consisted of 25 questions regarding different daily activities. Each question could be assigned a value between 1 and 10, and 'does not apply' was also a possible answer. Higher values meant more difficulty executing the activity. At the end, all answered values are summed up to give an overall score and a mean value for all answered questions is calculated. Depending on the mean value the Global Deterioration Scale (GDS) for the person has be assigned (Erzigkeit et al., 2001).

The Zarid Burden Interview (ZBI) questionnaire was chosen for the informal carer. This questionnaire has the intention to score the burden of a partner of a cognitive impaired person in home care. Although no cognitive impaired person was involved in the pilot, this questionnaire was assumed to be the best approach to score the burden the informal carer is experiencing. The Zarid Burden Interview consists of 22 questions in German language. Each question could be assigned a value between 0 and 4. Higher values meant higher burden. The total sum of the values gives the overall score. Scores between 0 and 20 indicates no or little burden, 21-40 mild to moderate burden, 41-60 moderate to severe burden, 61-88 severe burden.

## 3.2 Results

Table 1 summarizes the results for the Bayer ADL questionnaires. In case of the cared for person only for 4 persons a change in the score before/after the pilot is observed, whereas for the other 8 person no

change could be seen. The total sum of the changes cancels out. To further analyse the results, we select all those questions from the Bayer ADL related to subjects which might be impacted by using the application like keeping appointments and support by reminders for medication etc. In total 5 questions could be separated. The results of the score can be seen in Table 2. In this restricted questionnaire there is no change in the average value of 10 persons observed, in 2 persons a change by -2.3% respectively -16.7% is seen. The increase of scores in Table 1 can be attributed to questions with subjects that are not directly related to the app.

Table 1: Results of the Bayer ADL questionnaire. In the column before/after pilot the average value of all questions score is shown, the difference is given both in absolute and in percentage.

| Id | Before pilot | After Pilot | Difference [abs] | Difference [%] |
|---|---|---|---|---|
| 1 | 1.0 | 1.0 | 0.0 | 0.0 |
| 2 | 1.0 | 1.0 | 0.0 | 0.0 |
| 3 | 1.0 | 1.0 | 0.0 | 0.0 |
| 4 | 8.6 | 8.6 | 0.0 | 0.0 |
| 5 | 2.4 | 2.7 | 0.3 | 12.5 |
| 6 | 1.4 | 1.4 | 0.0 | 0.0 |
| 7 | 8.5 | 8.4 | -0.1 | -1.2 |
| 8 | 1.0 | 1.0 | 0.0 | 0.0 |
| 9 | 1.0 | 1.0 | 0.0 | 0.0 |
| 10 | 1.8 | 1.5 | -0.3 | -16.7 |
| 11 | 2.0 | 2.1 | 0.1 | 5.0 |
| 12 | 1.2 | 1.2 | 0.0 | 0.0 |

Table 2: Results of the Bayer ADL questionnaire restricted to questions directly connected to the usage of the app. In the column before/after pilot the average value of all questions score is shown, the difference is given both in absolute and in percentage.

| Id | Before pilot | After Pilot | Difference [abs] | Difference [%] |
|---|---|---|---|---|
| 1 | 1.0 | 1.0 | 0.0 | 0.0 |
| 2 | 1.0 | 1.0 | 0.0 | 0.0 |
| 3 | 1.0 | 1.0 | 0.0 | 0.0 |
| 4 | 8.4 | 8.4 | 0.0 | 0.0 |
| 5 | 1.3 | 1.3 | 0.0 | 0.0 |
| 6 | 1.4 | 1.4 | 0.0 | 0.0 |
| 7 | 8.8 | 8.6 | -0.2 | -2.3 |
| 8 | 1.0 | 1.0 | 0.0 | 0.0 |
| 9 | 1.0 | 1.0 | 0.0 | 0.0 |
| 10 | 1.5 | 1.3 | -0.3 | -16.7 |
| 11 | 1.2 | 1.2 | 0.0 | 0.0 |
| 12 | 1.0 | 1.0 | 0.0 | 0.0 |

In Table 3 the results of the Zarid Burden Interview evaluation are shown. There are only relatively small changes in the ZBI scores before and after the pilot. Only in one case the caregiver burden is increased from one burden level (scores between 0-20) to the next burden level (21-40), but the absolute change of the score is only 3, which compared to the burden range of 20 score points is a relatively small increase. In total, all 12 informal carers report no or little burden.

Table 3: Results of the ZBI questionnaire. In the column before/after pilot the sum of questions scores is given, the difference is given both in absolute and in percentage.

| Id | Before pilot | After Pilot | Difference [abs] |
|---|---|---|---|
| 1 | 13 | 12 | -1 |
| 2 | 13 | 12 | -1 |
| 3 | 4 | 5 | 1 |
| 4 | 13 | 14 | 1 |
| 5 | 0 | 0 | 0 |
| 6 | 17 | 18 | 1 |
| 7 | 0 | 0 | 0 |
| 8 | 12 | 8 | -4 |
| 9 | 1 | 1 | 0 |
| 10 | 20 | 23 | 3 |
| 11 | 11 | 7 | -4 |
| 12 | 2 | 7 | 5 |

# 4 CONCLUSIONS

We have presented the ISA system for digital inclusion of elderly people. The system is capable to provide services like calendar and appointment administration, photo albums can be shared with friends or relatives, also video telephony can be used. A pilot with 12 participants, pairs of cared for persons and informal carers, has been conducted and was accompanied by questionnaires before and after the pilot (B-ADL for cared for persons, ZBI for informal carer). The scores of questionnaires are used to evaluate whether the ISA system is helpful for facilitating the daily activities of the cared for persons and if it was able to reduce the caregiver burden. Evaluation of the questionnaires showed no significant change of status regarding the activities of daily living or the caregiver burden. We attribute the results to a still too high complexity of usage of the apps and the implemented workflow of jointly organising a calendar and daily routines. Thus, the results are somewhat unsatisfactory as they indicate

that even for a system tailored for digital inclusion of elderly, the measured acceptance was low.

Future work is to provide the web-based portal as a mobile app, so that the functionality for the informal carer is always accessible on the mobile phone.

## ACKNOWLEDGEMENTS

This project has received funding in the program "benefit" by the Austrian Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK).

We would like to thank the Vienna Red Cross for their contribution in running the pilot.

## REFERENCES

Baric, V., Andreassen, M., Öhman, A., & Hemmingsson, H. (2019). Using an interactive digital calendar with mobile phone reminders by senior people—A focus group study. *BMC Geriatrics*, *19*(1), 116. https://doi.org/10.1186/s12877-019-1128-9

Erzigkeit, H., Lehfeld, H., Peña-Casanova, J., Bieber, F., Yekrangi-Hartmann, C., Rupp, M., Rappard, F., Arnold, K., & Hindmarch, I. (2001). The Bayer-Activities of Daily Living Scale (B-ADL): Results from a Validation Study in Three European Countries. *Dementia and Geriatric Cognitive Disorders*, *12*, 348–358. https://doi.org/10.1159/000051280

Haan, M. den, Brankaert, R., Kenning, G., & Lu, Y. (2021). Creating a Social Learning Environment for and by Older Adults in the Use and Adoption of Smartphone Technology to Age in Place. *Frontiers in Public Health*, *9*, 568822. https://doi.org/10.3389/fpubh.2021.568822

Hindmarch, I., Lehfeld, H., Jongh, P. de, & Erzigkeit, H. (1998). The Bayer Activities of Daily Living Scale (B-ADL). *Dementia and Geriatric Cognitive Disorders*, *9*(Suppl. 2), 20–26. https://doi.org/10.1159/000051195

Iancu, I., & Iancu, B. (2017). Elderly in the Digital Era. Theoretical Perspectives on Assistive Technologies. *Technologies*, *5*(3), 60. https://doi.org/10.3390/technologies5030060

Kurniawan, S. (2008). Older people and mobile phones: A multi-method investigation. *International Journal of Human-Computer Studies*, *66*(12), 889–901. https://doi.org/10.1016/j.ijhcs.2008.03.002

Litzenberger, M., Dittrich, K., Unger-Hrdlicka, B., Buimer, H., Rigamonti, I., Wintjens, W., Arendse, M., Murko, P., Zeller, M., & Auer, S. (2021). GNSS based Adaptive Monitoring for the Assistance of Persons with Orientation Difficulties: *Proceedings of the 7th International Conference on Information and Communication Technologies for Ageing Well and E-Health*, 236–243. https://doi.org/10.5220/0010494600002931

Martinez-Martin, E., & Costa, A. (2021). Assistive Technology for Elderly Care: An Overview. *IEEE Access*, *9*, 92420–92430. https://doi.org/10.1109/ACCESS.2021.3092407

Zarit, S. H., Reever, K. E., & Bach-Peterson, J. (1980). Relatives of the Impaired Elderly: Correlates of Feelings of Burden. *The Gerontologist*, *20*(6), 649–655. https://doi.org/10.1093/geront/20.6.649

Zhu, Y. (The O. S. U., Dariush, B. (Honda R. I. U., & Fujimura, K. (Honda R. I. U. (2008). *Zhu2008 Controlled Human Pose Estimation from depth image streams.pdf*.