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Förderung der Aktivität von Menschen mit Demenz durch eine unterstützende Technologie

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an der Fakultät für Informatik

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Promoting Activity in People with Dementia through an Assistive Technology

A Comprehensive Approach from Conceptual Design to System Development

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Kurzfassung

Die Weltbevölkerung wird immer älter. Dies stellt eine wachsende Herausforderung für die öffentlichen Gesundheitseinrichtungen dar, da weltweit Millionen von Menschen zu dieser Gruppe gehören. Demenz ist eine altersbedingte Krankheit, die ebenfalls zunimmt. Nicht-pharmakologische Maßnahmen wie mehr körperliches, soziales und kognitives Engagement können die Entwicklung der Demenzerkrankung verlangsamen und die Lebensqualität von Menschen mit leichter Demenz verbessern. Diese Forschungsarbeit befasst sich mit dem Entwurf und der Entwicklung einer assistiven Technologie, die eine Person mit Demenz an die täglichen Veranstaltungen in einer Pflegeeinrichtung und an persönliche Termine erinnert, um sie zu mehr eigenständiger Aktivität zu motivieren. Diese Arbeit analysiert die Auswirkungen dieses Erinnerungssystems auf einer Teilnehmerin mit leichter Demenz, die sich aktiver an sozialen, körperlichen und kognitiven Aktivitäten beteiligt. Die Methodik verwendet qualitative Methoden, einschließlich Interviews und ethnografische Beobachtungen, um tiefe Einblicke in die Bedürfnisse und Erfahrungen der Nutzer dieser Studie (Teilnehmer, Betreuer und Familienmitglied) zu gewinnen. Das entwickelte Erinnerungssystem wird auf der Grundlage des Feedbacks der verschiedenen Beteiligten iterativ verfeinert. Mit dieser Studie soll die Auswirkung des entwickelten Produkts auf das Engagement der Teilnehmer und die allgemeine Lebensqualität überprüft werden. Die Ergebnisse können auch wertvolle Erkenntnisse für künftige Entwicklungen im Bereich der Demenzpflegetechnologien liefern.

Abstract

The global population is getting older. This is a growing challenge for public health institutions because millions worldwide are included in this group. Dementia is an age-related disease that is also growing. Non-pharmacological interventions like doing more physical, social, and mental engagement can slow down the development of dementia disease and improve the quality of life for people with mild dementia. This research explores the design and development of a user-centered assistive technology that reminds a person with dementia of the daily events available at the residential care setting and personal appointments to motivate them to be more active independently. This research analyses the impact of this reminder system on a participant with mild dementia in being more active in social, physical, and cognitive events. The methodology uses qualitative methods, including interviews and ethnographic observations, to gather deep insights about user needs and experiences from this study's stakeholders (the participant, caregiver, and family member). The developed reminder system is refined iteratively based on feedback from various stakeholders. This study intends to check the impact of the developed product on the participant's engagement and overall quality of life. The findings can also provide valuable insights for future developments in dementia care technologies.

Contents

CHAPTER 1

Introduction

1.1 Problem Statement

The proportion of people 65 and older is increasing faster than those under this age. A recent study by Mirzaei and Adeli [54] (2023) shows that dementia is more common in older age. As a result, dementia could become a significant social problem. Dementia leads to brain cell damage and reduces memory, thinking, and learning processes [54]. Approximately 100 years ago, Dr. Alois Alzheimer and his colleagues found that 'small cerebral vessel arteriosclerosis' could lead to dementia [51]. A recent study by Kovacic et al. [42] (2012) shows that there is a significant link between dementia and other health issues through hypercholesterolemia, heart failure, diabetes, high blood pressure, physical inactivity, aging, genetics, environmental factors, and obesity [42].

Dementia begins with very mild cognitive impairment (MCI) to mild and severe [54]. It can progress at different speeds, and most of the time, it begins with mild signs, and at the end stage, the patient has difficulty with physical abilities and loss of awareness [54]. The number of Person With Dementia (PWD) is expected to increase by about 152 million in the next years, which was 2018, approximately 50 million people [68]. While Alzheimer's Disease (AD) currently has no cure, various non-pharmacological interventions can help slow its progression and mitigate symptoms [54].

This study will focus on the development and testing of an Assistive Technology (AT), as detailed in Section 2.1 for a person with MCI or mild dementia disease patients to motivate the participant to do more physical and social activities. An AT is defined as digital or physical technologies that aid individuals with disabilities in improving their autonomy [75]. AT refer to services and systems which are digital or physical technologies [75]. They can support people to improve their abilities and autonomy [75]. The Global Assistance Technology Report, which was launched by World Health Organization (WHO) and United Nations International Children´s Emergency Fund (UNICEF) in 2023, announced

the decision to improve access to such technologies worldwide for everyone [75]. This highlights the high demand for research in this area, and this study aims to contribute to the development of ATs for people with dementia.

A study by Ahmadi et al. [1] (2023) shows that non-pharmacological interventions slow down dementia development. Example studies show that physical activity improves cognitive function, slows down the development of dementia in the brain, and reduces the risk of cognitive impairment [1]. Another study by Harada et al. [32] (2021) proves ordinary social interactions can help support brain functions and delay dementia symptoms. Mental stimulation like puzzles, chess, reading, or learning something new can improve brain function and mental health [47]. In this research, these stimulations want to be reached by developing an AT to motivate the potential PWD to do more physical activity, ordinary social interactions, and mental stimulation. Nowadays, a shortage of skilled workers in nursing homes affects the quality of care negatively [59]. The personnel do not have enough time to take care of each person in the Nursing home and check if they are visiting the different activities and courses or if they are just staying all day in their rooms and are isolated [59]. PWDs are not engaging in group activities in nursing homes [59]. This situation is not helpful for PWD because it can accelerate the development of disease [59].

In health care, Quality Of Life (QOL) refers to the overall well-being and satisfaction experienced by individuals [11]. Recent qualitative studies interpret the QOL in aspects such as family, social connections and engagement, activity, spirituality, and various other factors [11]. QOL for people with dementia is not always the same [62]. According to Oppikofer [62] (2023), current tools fail to consider individual perspectives when assessing QOL.

Given the growing challenges in dementia care, including a shortage of caregivers and the need for more personalized interventions, this research seeks to address these gaps by developing an AT tailored to the specific needs of individuals with dementia. This research encourages individuals with PWD to engage in activities that could improve their personal QOL. For instance, if someone enjoys sports but has no interest in puzzles, the system should recommend physical activities instead of puzzles. The study will examine whether personalized event recommendations can improve the QOL of PWD by encouraging them to participate more in interesting activities.

1.2 Research Questions

1. What are the short-term effects of using personalized reminder AT on the daily routines of a dementia patient in residential care settings?

2. What benefits do caregivers, and family members experience with using personalized reminder AT?

1.3   Motivation

The care of individuals with dementia presents a significant challenge for nursing staff and family members due to each patient's unique needs, as a recent study Martinez-Martin and Costa [50] (2021) shows. Consequently, these problems necessitate ongoing support and supervision from others [50]. Traditional nursing methods often prove inadequate as they struggle to accommodate individual needs effectively [50]. It is difficult for nursing staff to ensure that each resident participates in various entertainment programs because there are too many patients and insufficient staff [49]. Information sheets regarding these programs, located in the nursing home hallway, are often small and easily overlooked by elderly individuals [49].

During regular visits to a family member in a nursing home, the author observed the same problem at a nursing home in Vienna. The personnel did not have enough time to motivate and inform each resident to attend the following courses offered in the residential house. This motivated the author to develop a reminder AT, research the behavior of a PWD, and support the caregivers in this area.

As the population ages, the number of individuals affected by dementia is growing each year [23]. The request for skilled workers is also increasing, but there are not enough qualified workers in this area [76]. This situation increases workload and stress for all the staff members in the caring area [76]. This situation calls for innovative strategies to maintain and improve the quality of care for patients and caregivers [50]. A recent study by Martinez-Martin and Costa [50] (2021) wants to use modern technologies to act on and solve these challenges. These assistance systems have the potential to make better interactions between nursing staff and patients [50]. AT, can provide relevant information at the right time to help decision-making for a PWD [1]. As already mentioned in 2.2, the involvement of dementia patients in activities can help stimulate their cognitive abilities and improve their QOL [1]. By developing and implementing AT, task management in nursing facilities could be more efficient [44]. That can support both nursing staff and also significantly improve the quality of life of patients [44].

There are many AT for PWDs in development but a lack of comprehensive, personalized studies about their practical application and impact in real-world care settings [66]. This research aims to fill this critical gap by developing, testing, and evaluating a memory aid personalized AT specifically designed to address the needs of a dementia patient, caregivers, and family members, thereby contributing to both the theoretical understanding and practical application of AT in real-world care settings.

1.4   Expected Results

This research aims to increase the participation rate of individual PWD in activities offered in residential care facilities. As mentioned in section 2.2, mental stimulation like

puzzles, chess, social contacts, and learning something new can improve brain function and mental health [47]. This research will design a custom-designed device for one like this principle by Khaled [39] (2012), which developed games based on a user's needs and included the user in all development steps. The expected design will be achieved by conducting interviews and observations with a participant and reviewing recent studies in this area. It's expected that the AT device improves independence, engagement in daily activities, and enhanced social engagement of the individual with dementia.

To achieve these outcomes, an AT will be developed based on User-Centered Design (UCD), which is defined in section 3.1.1, ensuring that the AT is tailored to the unique needs of the participant. UCD is an iterative design process in which the designer focuses on user needs in each phase of the designing process [36].

Potential challenges in the planning, design, and implementation phases are anticipated, particularly in adapting the technology to the cognitive and physical limitations of the participant. The user will likely encounter challenges and difficulties when using the device for the first time. Based on these findings, difficulties should be identified by interviewing, observing, analyzing, and improving the device. Focusing on highly individualized solutions can provide a more exact understanding of the specific needs and preferences of individuals with dementia; this type of study that designs the device for one is frequently absent in broader studies [39].

This study will rigorously define and adhere to ethical considerations, as outlined in section 3.4, and ensure that all research activities are conducted for the participant's autonomy and well-being. The practical insights from this research will contribute to developing more effective ATs for dementia care, providing a valuable framework for future studies and applications in this field.

CHAPTER 2

Background and Theory

2.1 Relevant approaches and their applicability

Studies show that our society is getting older and older [64]. This will bring with it many socio-economic problems, for example, a burden on families and governments in covering the rising medical costs and the burden on care services [64]. Medical advances are leading to increased life expectancy, but there is still no cure for age-related conditions such as Alzheimer's, high blood pressure, and osteoporosis [64]. Many older people live in care homes against their preference for independent living [64]. Ambient Assisted Living (AAL) and AT can help them stay on their property longer [64]. This study wants to support these people in becoming more independent in caring homes.

The older generation does not accept new technologies easily [24]. The new technologies for PWD need to be carefully designed to be easily integrated into the user's lives [24]. Numerous studies (for example [24, 67, 43]) try to find and analyze the characteristics to increase the level of acceptance, which can also be helpful to get better results in this research:

1. Trust and social presence: The study shows that trust between AT and older people is essential for their acceptance [24].

2. Ease of use and adaptability: user-friendly technologies could be easily integrated into users' lives. It is important that AAL can be customized to be adapted to individual user needs [24].

3. Improving the quality of care services: Technologies can provide more support to caregivers so the quality of care can be improved [24].

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4. Challenges and concerns: Caregivers and older people should be informed about using their data and data collection. Ethical concerns and data protection should be communicated to users and ensure they understand it [24].

5. Recommendations for practice and technical support: Feedback mechanisms should be provided so that users can easily give feedback to technology developers. The frequent training programs could also help the users and technology developers to get in touch and the users to accept the technologies easily [24].

6. People who initially trust technology tend to accept new technologies and devices more easily and build a positive relationship with them. [67]

7. Usage of AAL technologies could save on personnel costs in the long term. For example, AAL Technologies must not be too expensive so that all senior citizens and nursing homes can afford them. [43] That could be a reason to use ATs caring homes.

Different socio-demographic characteristics of the elderly are gender, age, educational background, digital literacy, and previous technological experience [31]. These characteristics make significant differences in the level of technology adoption [31]. The studies show less educated, less affluent, or disabled people tend to show less interest in new technologies [31]. Gender could also influence whether people are more technology-oriented; for example, men use technological devices more, especially in communication and entertainment [31]. That can also impact the result of this research when the participant has some of these characteristics.

Among many disabilities, cognitive impairments are more complex and difficult to find a solution for [44]. This includes dementia, social skill deficits, autism spectrum disorder, old age, and the cognitive consequences of diseases such as brain tumors [44]. Traditional medical therapies are expensive and stressful for the people involved [44]. With new technologies AAL, researchers are trying to mitigate challenges with AAL technologies [44].

Technologies are trying to make the daily lives of people with cognitive impairments easier, as a recent study from 2023 shows Szabó et al. [79]. Information technologies enable personalized treatments [79]. Among these applications are electronic health records, telemedicine, remote monitoring, digital tools for patient engagement, health analytics, and rehabilitation [79]. Information technology improves healthcare quality, reduces costs, increases efficiency, and personalizes healthcare [79]. The studies show memory disorders are caused by brain damage and cause memory formation, storage, and retrieval by patients [79]. Pharmacological treatments for these memory problems have undesirable side effects and are too expensive [79]. With game-based psychotherapy, much better results can be achieved in this context [79]. This research will design, develop, and test if a reminder AT helps a PWD in daily life to be more active and social, which can be affordable by the different organizations.

The number of people with cognitive impairments is increasing [79]. This shows us that it is important to find suitable support and solutions for this problem [79]. There are already many new technologies that improve the competence and independence of people with disabilities [79]. These technologies are categorized as the AT [79]. The AT seeks to improve the quality of life of people with disabilities and reduce costs compared to medical care or medical treatment procedures. [79]

A study by Szabó et al. [79] (2023) has divided the AT into two categories: "AT to improve memory" and "AT to support daily activities." Both categories help people with disabilities cope with their everyday lives. The AT can be based on virtual reality, artificial intelligence, mobile applications, etc. Each of these technologies has strengths and limitations in Figure 2.1, the strengths and limitations of the AT. In this research, the researcher will try to develop and test a mobile technology that is more common than virtual reality devices AT to support a PWD in daily activities.
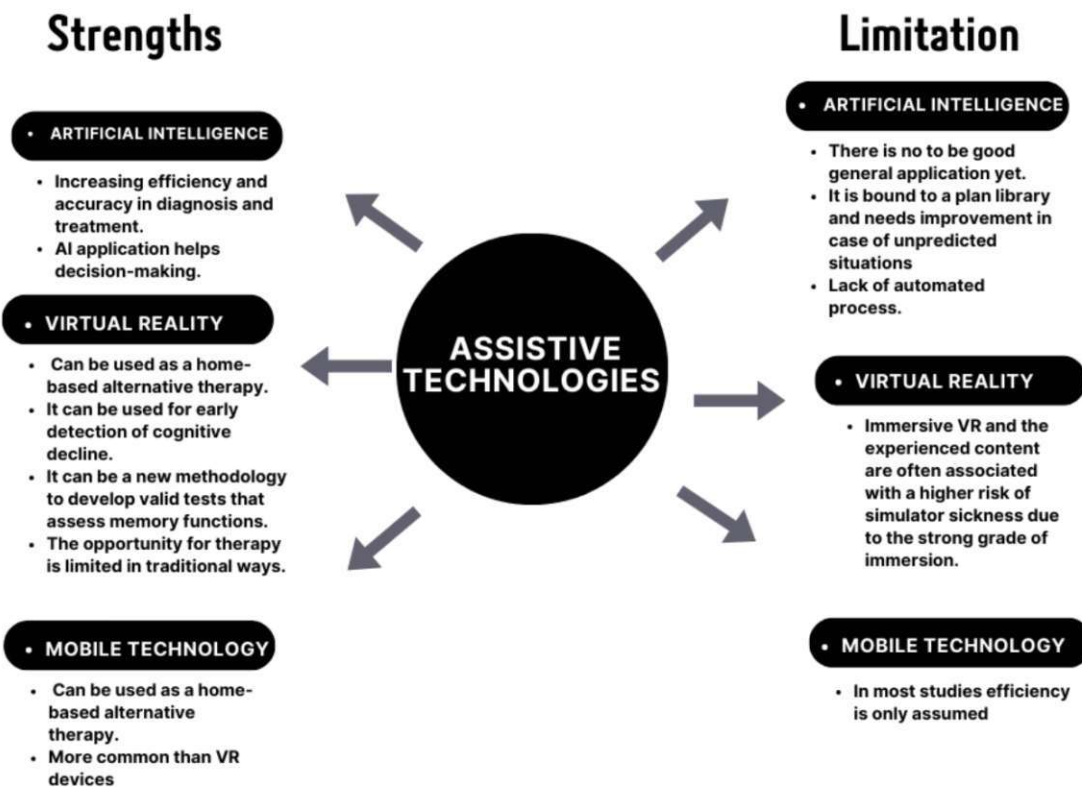

Figure 2.1: Bubble diagram of the strengths and limitations of AT.[79, p. 4]

This research wants to conduct a study using a personalized design reminder device to motivate a person diagnosed with mild dementia to engage in more physical and social activities independently.

Here are the benefits of AT for PWD from current literature which can be helpful for this research: Global Positioning System (GPS) technology can assist in tracking PWD which reduces risks associated with wandering [46]. Users who get support for the cognitive skills needed can manage daily activities better [57]. These technologies allow individuals to continue living independently longer before requiring more intensive care in institutional settings [14]. Safety can be improved by training independence [14]. That can be reached by promoting rehabilitation and psychosocial interventions [69]. AT should be affordable and cost-effective for the research [2]. User interfaces of AT should give users a sense of control [45]. The design should be well-considered. Personalized items help promote participation in interventions, and everything must be tailored to the needs of each user [77]. There should always be remote and in-person support to promote remote support and assistance to overcome environmental barriers [7].

WHO recommends a guideline for people who work or are in contact with PWD [19]. These people can be doctors, nurses, other healthcare workers, policymakers, healthcare planners, and program managers. These interventions can be considered to make a better product for PWD [19]. Table 2.1 shows interventions that could help a person with dementia to slow down the development of dementia [19]. This research will develop AT to motivate a user to do more physical and cognitive activities with other people at the nursing home, which is also recommended in the research of WHO ([19]).

Intervention	Details
Physical activity interventions	Physical activity should be recommended to adults with normal cognition to reduce the risk of cognitive decline. **Quality of evidence**: Moderate **Strength of the recommendation**: Strong
Cognitive interventions	Cognitive training may be offered to older adults with normal cognition and mild cognitive impairment to reduce the risk of cognitive decline and/or dementia. **Quality of evidence**: Very low to low **Strength of the recommendation**: Conditional

Table 2.1: Relevant interventions of WHO for the PWD in our project [19]

2.2 Related Work of Current Assistive Technologies for Dementia Care

A study from 2021 [57] implemented an electric calendar for people with MCI and dementia. They had a Mini-Mental State Examination before and after using the developed electric calendar. The result of the study shows a significant change in the users' daily activity. They divided the participants into two groups: those who used the calendar and those who did not. In total, 27 people participated in this research. The electric calendar was an application on an Android tablet. Each day, the application displays the day's information and changes its state automatically. They used a light-colored wooden frame compared to the big black letters on display. That helps to read the text easily. The display is split into two halves, which display the next near events. The count of events per day is limited to 5. Users can stop the alarm by touching the screen till the next event. For the setup of the devices, the researchers visited the resident's place to decide about the operability to touch the alarm as a stop button, and most stayed place of the users. They defined an appropriate sound volume based on user needs. They used the application for about 12 Weeks. They conducted a qualitative interview to get feedback about the usage of the electric calendar. Most participants found the calendar useful because it's easily viewable, and they would continue to use it. The negative comments were about battery charging and defining the events by themselves for participants who did not have dementia, and 3 of the participants without dementia found it useful in their daily life but preferred that someone else define the events for them [57]. In this research, caregivers or family members define the events for the participant. The caregivers will define the events without needing battery management to make the usage easier for PWD.

A recent study from the year 2021 by Pappadà et al. [66] reviews all types of AT in dementia and MCI care. Some of these projects are a combination of more than one type of AT. They found 17 types of different AT relevant for people with dementia. These 17 types of technologies are GPS, Patient coaching system, Caregiver coaching system, Cognitive support, Reminder device, Health monitoring system, AT Monitoring and control system, Virtual reality therapy, Facial recognition device, Patient behavior manager, Database search tool, Exercise program, Digital, life story, Surveillance system, Ambient Assisted Living, Multi-sensory environment (MSE), Video conferencing system [66]. The most common technologies in this area are positioning systems, caregiver coaching systems, patient coaching systems, cognitive support, health monitoring systems, and reminder devices [66]. This research will be developing a device that would be a cognitive support and reminder device for a PWD. Here are some other recent similar works to this research:

A study by ChePa et al. [18] from the year 2023 developed a music-based AT. This helped students to memorize semantic declarative facts. To do this, they conducted a pilot project and collected feedback. They used the feedback to develop a mobile application. The results showed that it can effectively help students memorize semantic declarative facts. Future improvements will again be made and studied based on student feedback.

This research ChePa et al. [18] shows by getting the user's attention. The application usage can be increased.

The study by Kawasaki et al. [38] from the year 2023 has taken elderly people with cognitive impairment and dementia as their target group to support them. They developed an electric calendar to improve their cognitive functionality. The participants have shown a significant increase in global cognitive function and daily activities after using the developed AT. The healthy seniors have found the calendar useful but not necessary. The electric calendar may be useful for seniors with mild dementia who struggle with remembering daily activities. The group had a positive impression of the new technology. The study of Kawasaki et al. [38] has the same basics as this study. In this research, we develop and test an AT on just one person with mild dementia, which can be personalized to users' needs.

Sheahan et al. [73] from the year 2023 mentioned that in Australia and the USA, at least 5 percent of people have a cognitive impairment. They need support when making decisions. They have proposed a technology to support these people in their decision-making, and the system's evaluation has shown that it is very effective. This study will also give PWD more choices throughout the day and events to visit, but just one event will be offered at one time to prevent confusion, which makes decision-making easier and less confusing.

New reminder AT should be designed to be easily accessible for people who need it. The events should be adaptable for different users, and the design should be so that different PWDs can use it. For example, PWD have problems using smartphones or smartwatches, which make them anxious or frustrated [12]. Using wearable devices could bring some challenges. For example, PWD can forget to charge the device, and taking care of charging devices each day needs more effort for the caregivers and relatives [52]. Some Users found using a visible AT embarrassing and uncomfortable [52]. So AT should be as comfortable and unobtrusive as possible for the user [52]. The main signs of dementia are also memory problems and a high risk of misplacing the devices somewhere or forgetting how to use them [29]. In this research, the planned AT would be a wired desktop device that can not be used without cable and needs a charging cable to work. There is no battery installed in this device. The device will be placed on the desk or somewhere always visible and in the user's field of view.

2.2.1   Smart Home Technologies for Dementia Care

Maybe using smart technologies is not easy for PWD, but caregivers and relatives can use this new technology to make caring for them easier [74]. The caregiver would be notified, for example, sensors that detect falls, gas and water leaks, and automatic lights [74].

One of the sensors that could help dementia caregivers is a Locator device [74]. The Sensors can be used as tags, cards, or stickers on different objects [74]. With these features, the users can also see a location history, which can help if the device has no

battery anymore [74]. This technology can also help to find missing persons and detect if the person is out of the safety boundaries [74]. The other smart home technology is smart lighting technology [74]. They can activated by motion sensors or via voice activation [74]. These motion sensors can also used as home security systems. The other smart home technologies can support water leaks or fire safety, which are common problems and accidents [74].

This research will not use any sensors. It will use different visual and audible cues to get the attention of the PWD and suggest activities offered at nursing homes or personal events. It's important to find out how much earlier the PWD should be informed so they can join the activities on time. It would be challenging to find the right elements to get the user's attention and inform them about the events.

2.2.2 User-Centered Design in Dementia Care Technologies

A study by Tiersen et al. [82] used an iterative user-centered design, which implied other studies to find the best way to design cognitive Support Systems. They conducted different interviews with stakeholders like caregivers, academic and clinical staff, and workshops with pairs of people with dementia and caregivers [82]. They chose this way to identify needs, daily activities, and how they use innovative care technologies [82]. Afterward, they equipped the stakeholders with environmental sensors, physiological measurement devices, smartwatches, tablet-based chatbots, and cognitive assessment puzzles [82] also a cognitive support system. After the testing stage, they conducted the interviews again to analyze the differences [82]. This research shows that user-centered design can also help develop a better design for PWDs and increase user-friendliness.

There are different ways to design products for dementia patients [49]. One way is to focus on addressing the behavioral needs of these users. Early studies recommended that PWD should get minimized help to enhance self-esteem [49]. The most recent studies show that using smart home touchpoints, such as sensorised lighting, using updated technology to communicate, and tracking night-time wandering can help PWD to have a higher life quality [4]. This research also used a user-centered design for the successful technologies they provided, which could reduce user acceptance and ease of user use.

Involving PWD and other stakeholders in the design process can help to enhance users' experiments [65]. The resulting product should have familiar appearances and include verbal prompts and reminders [65]. For example, automated interventions should not decide for the user because it makes them feel helpless, but giving them a choice to close notification can enhance their self-esteem [3]. The technology should not use too many notifications and prioritize the alerts to prevent the app becomes too intrusive [21].

The design process for PWD should focus on design with them and not for them [84]. To find the main needs of stakeholders, a research group did interviews and workshops to gather insights about users and their needs [82]. Afterward, they gathered the key subjects from these activities; activities were transcribed, organized into affinity diagrams,

and discussed in collaborative workshops. This process helped to find the usage pattern for all the stakeholders [82]. To identify and prioritize patient needs, an event was conducted with 35 PWD caregivers and PWD [82]. Table 2.2 shows the most important needs of the PWD. They have recognized that preventing illness and injury, good sleep, hydration, continence and hygiene, psychological states, and medication were the most significant concerns of PWD [82].

This research will try to help PWD with their concern about Mood, delirium, agitation, Taking medication, Loneliness and isolation, and Managing appointments. These concerns are also important concerns of the PWD. Helping them in these areas can also reduce the caregiver's workload, and they have more time to support the PWD in other aspects.

Needs Map Item	Cumulative Score
Avoiding infection, staying well	280
Falls and injury at home	269
Getting good sleep	269
Staying hydrated	269
Continence and hygiene	268
Mood, delirium, agitation	254
Taking medication	244
Washing and dressing	231
Loneliness and isolation	223
Losing items	218
Security in the house	207
Food preparation	185
Managing appointments	185
Getting out and about	177
Planning for change	175
Money, bills, paperwork	155
Housekeeping	136
Managing technology	117
Weekly shopping	114

Table 2.2: Patient Needs and their Cumulative Scores [82]

A study that designed Smart Systems ensures easy navigation and a good user experience and helps them ensure security by leaving the house for PWD [17]. The caregivers and family would also be informed automatically when they leave the house. The study of Ceccacci and Generosi [17] developed a successful AT device for a PWD with this design elements:

1. Designing Big buttons at the bottom of the display can support them through the action

2. Large screens and fonts make the reading easier.

3. The text usage should be minimal because PWD have limited short-term memory. The display should provide just essential information.

4. Using a high-contrast design with a white background and black text can help.

5. Images should be black/white.

6. Using Square shapes is easier to operate on a display than rectangular ones.

7. The goal is to get the user's attention.

The goal of the design is the Understandability of the product, which shows that the user comprehends the product easily [17]. Learnability specifies that the user can learn the product easily [17]. Ease of Use considers that users should start and execute tasks autonomously [17].

2.3   Positioning the Research Question in the Current Research Context

The growing demand for solutions for dementia shows the increasing count of people with dementia [54]. The current situation needs better innovative solutions to support caregivers and patients in this way [54]. Many studies analyzed that using AT for people with dementia can enhance cognitive functions and QOL. For example, [57] and [55] used AT to enhance the memory and the QOL of these users, but most of these studies did not use customization based on the individual user and user center design in their development and design process.

This research would like to fill these gaps and support PWD in task management and encourage PWD to do more physical and social engagements independently that automatically enhance the QOL. This study will demonstrate this device with empirical evidence to determine the effectiveness of these systems in an individual's life at a nursing home.

Methodology

3.1 Method Selection and Epistemological Foundations

This section outlines the research methodologies employed to design, implement, and analyze an assistive technology system for an individual with dementia, focusing on increasing the participant's engagement in daily activities.

3.1.1 Overview of Research Methodologies

In previous sections, a comprehensive literature review was conducted to understand the current state of assistive technologies for PWD. This review provided updated background information and highlighted significant gaps in developing event management devices, which this research aims to address. That helped to collect a comprehensive understanding of what already exists in the area of AT for PWD. A literature review could help the researcher find the gaps in developing event management devices for PWD [33]. This information from the literature review can avoid the duplication of the research and develop a new device and research in this field [33]. Another advantage of the literature review used in this research is that it helps refine the research question and collects updated background information [37]. Some of the disadvantages of the literature review that should be considered are reading, and analysis of numerous sources can be extremely time-consuming [25]. The literature should be chosen to always reveal its relevance to the research and the quality of these works [25]. The researcher may find too many resources during the literature review. Taking the relevant studies out of them could be challenging [25]. The publication period will be set after 2020 to get the recent publications, but maybe some references are older in the research because these were used in searched publications after 2020. These resources are used to find the literature: Google Scholar, PubMed, IEEE Xplore, and SpringerLink.

The main goal is to improve task management for PWD at residential care. This research goes through designing and evaluating an AT system to fulfill this main purpose. The primary goal is to motivate PWD to get more involved in physical activity, social interactions, and mental Stimulation. Here are some points that should be considered by the research:

1. Design an Assistive Technology System for an individual: In the planning phase, the recent scientific work about AT for PWD should be considered as the key design features and build the new design based on this. It's important to find an effective design for PWD, and it should have a degree of customizability. UCD principles should be applied that fit the cognitive level of each person with dementia by doing interviews and, more often, observation sessions on different days and times.

2. Evaluate the System's Effectiveness: The Evaluation phase should be tested if the engagement of the dementia resident changed after using the new AT. Should be defined longer test duration to be sure if any changes in cognitive functions and quality of life can be observed in this one dementia patient after AT usage.

3. Explore the Impact on Caregivers and Family Members: A qualitative interview with the nursing personnel can give the researcher insight if they see any changes in patient behavior. This interview can provide information about challenges that should be considered for improvement.

4. Identify Key Challenges and Solutions: It could be helpful to find potential challenges in implementing the AT, for example, to ensure successful adoption and long-term usability of the system in a real-world setting. It's also important to find a solution to convince PWD to use this AT.

5. Contribute to the Field of Assistive Technology: The data collected from PWD, nursing personnel, and detected challenges can help for the similar technologies of AT for future works.

6. Ethical Considerations and Policy Implications: Ethical standards should be defined correctly in the research field of dementia care and, in this case, for the individual participant of this research. After the research, The research should discuss the ethical considerations that are well defined and addressed correctly for this purpose PWD.

The methods of data collection are defined as follows, which will be used in UCD steps: One of the selected methods is ethnography, which allows one to experience the life of a PWD [58]. That helps to observe the users' daily activities, social contact, and daily needs. During the ethnography, the researcher should listen and pay enough attention to what the user does to improve the data collection [58]. By ethnography, the data can be collected very quickly [58]. The collected data is plain, and there is nothing hidden to decrypt [58]. Ethnography can also help to develop a general sense of the situation.

After the implementation, ethnography can help validate and evaluate the research and prove any change in users' behavior after using the new system [58]. Ethnography also gives the researcher a fair chance to explore new lines of research [58].

Ethnography also has some weaknesses that the researcher should consider [35]. When the researcher does not take enough time for the ethnography, the result can focus on individual cases and not the whole situation, giving the researcher limited information to apply the findings to different situations and populations [35]. Ethnography is very time-consuming to collect enough information about users [58]. It could be difficult to collect exact conclusions about all possible situations [58]. During the ethnography, the observer should have some knowledge about the problem domain to pay attention to important situations [58].

The other qualitative method that will be used in this research is interviewing. Through interviews, the researcher can collect rich and precise data about the perspectives of an individual [40]. Interviews should be conducted at times that are suited better for the participant [40]. Researchers can direct the interview in a direction that is relevant to the research, which is time-saving and detailed [40]. Interviews give the researchers a chance to explore aspects of users' lives that are not accessible through ethnography [40].

The UML Figure 3.1 is an overview of the UCD steps that this research goes through in the design. At each step are also the sub-steps defined that help collect data for choosing a better design for the user [36].

The place of the "Implementation & Develop" step and "Test & Evaluate" step are interchanged for this research and are not like the source of this UCD diagram [36]. This research will follow UCD [36] as in the figure 3.1. Developing a product based on the user's needs is an iterative design process. The first step will define user needs with interviews and ethnographic observations. Then, the gathered detailed information will be defined as users' requirements [36]. In the second step of UCD, based on the requirements from the last step, the design concepts and prototypes will be defined, and sketches and wireframes of the project will be defined [36]. This would be the prototype to test the initial ideas. In the third step, the fully functional product is implemented. At the end of this step, the functional product is ready to be used and tested by the users [36]. In the fourth step, the prototype is tested with usability testing and a user feedback session [36]. Implementation and Development steps will be iterated to the beginning after testing to get a better result [36]. The research data collection methodologies are qualitative methods. The chosen methods for collecting user data are interviews and ethnography.

The number of UCD iterations in this research is three, as in figure 3.2. The first iteration is a Pre-Launch iteration that develops an AT based on user preferences. The second iteration is the Post-Launch iteration, which reviews and refines the product again based on users' feedback after product usage. After the Post-Launch release and AT usage by the participant, there will be a Post-Release Testing, the final test to answer the research questions.
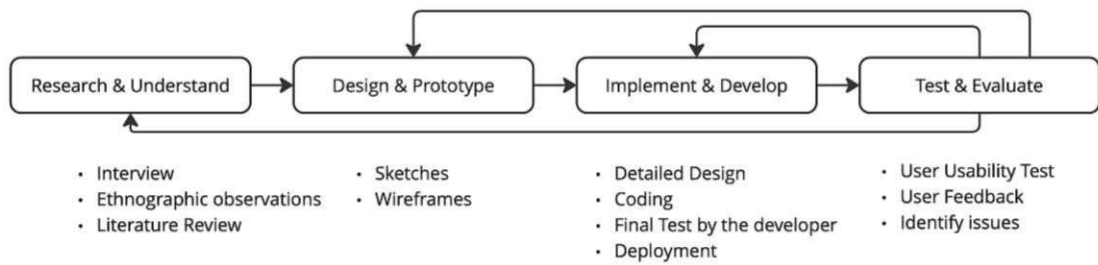
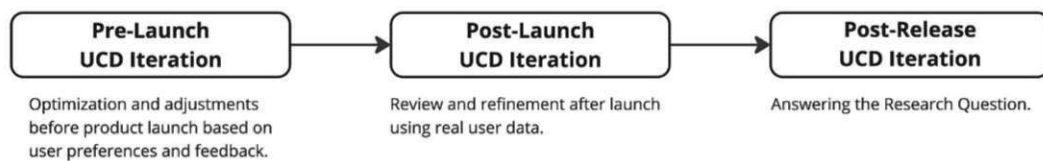Figure 3.1: UCD process for Developing Assistive Technology for PWD [36]

Figure 3.2: Number of UCD Iteration in this research

The first iteration is called **the Pre-Launch UCD Iteration**. At this step, the researcher wants to implement and develop the AT based on collected data from the user and then "Test & Evaluate" the application by the participant. The second iteration is called **the Post-Launch UCD Iteration**. In a second iteration, feedback is again obtained from the participant and caregivers on how well they liked the developed AT and what should be changed. Then, new designs are made, and new refinements are based on the participant's feedback. After this iteration, it begins with **the final review of the AT** in **the Post-Release UCD Iteration** and answering the research questions. The researcher will verify if there is any change in the participant's routine and answer the research questions. It will prove whether the AT help make the PWD more social and physically active.

3.1.2 Muse-Based Design (Design for One Person)

This section will justify the design choice for one person in this research, which goes through user needs not in width but in depth by focusing on one user. A study challenges a common perspective that stereotyping or generalizing people based on their disabilities or age. The research from Pullin and Newell [70] (2007) focuses on a design for one, which means the research is around the design for a specific individual to avoid stereotypical thinking about users based on their age or disability. Cabrita et al. [15] (2007) and Gregor et al. [28] (2002) suggest focusing on specific characteristics of each individual, especially since older adults are not a homogenous group and they have a range of different abilities, hobbies, interests, and needs, etc. need to consider each individual's unique experiences. A novel example of personalized design is the custom-made technology that

gave Professor Stephen Hawking a voice, leading to wider technological innovations in text-to-speech software Bertelsen et al. [9]. That shows personalized designs are based on one specific user need, but the principles can help that benefit many people. Addressing an individual's needs can reveal insights for a bigger group Mitzner et al. [55].

Different research in design for one field shows that the design for One Principe can be useful in improving the design process and providing a better understanding of personalization in future works Den Haan et al. [22].

The Human-Computer Interaction (HCI) researchers are always looking to find ways of designing technologies to make them more inviting, attractive, and satisfying for the user [39]. One of these methods is the Muse-Based design in that the designer follows the player's ideal to develop a game [39]. They named this method Muse-Based Design because the designers focused on one user who was defined as a muse. Muse is a goddess of inspiration for the arts and sciences from Greek mythology [39].

The designers take the user experience in design and the product design as an important factor [30]. By using this method, some researchers like Sengers et al. [72]. suggest that the design should combine user and designer preferences because the players alone cannot initiate or instigate interesting game concepts. A deep connection between the designer and the user increases the Self-understanding of the designer about users' habits, Style choices, and behaviors [72]. This deep understanding can be reached by focusing on one user at a time [72]. Learning about the lives and experiences of the user increases the probability that the end products and services have a good User Experience (UX) [41]. This research is also based on Design for One and will use the Muse-Based Design. Section 3.2.4 is the detailed information about the selected user-defined.

The research from Khaled [39] suggests ethnography as a popular approach to gaining first-hand information about the user in the data collection phase [72]. Based on the Khaled [39] study, this research also uses ethnography to collect user data. The designer should always differentiate between the wants vs. needs of the user [39].

The challenges in muse-based design could be User research skills, such as preparing suitable material and creating a good connection with the participant [39]. Secondly, Data Analysis Abilities could also be challenging because, in muse-based design, the designer should divide the data into negative and positive categories, which can oversimplify the design process [41]. Thirdly, developing a unique design from data interpretation can be challenging [71]. By the data interpretation in this research, these challenges could also be relevant.

The "Design for One" study participants gave good feedback on the concepts, mechanics, and aesthetics of the designed products [39]. Over time, a good conversational dynamic has developed between the user and the designer [39]. The design concept is refined iteratively based on the user's feedback to the prototypes, which provide an acceptable end product for the muse user [39]. It's important to involve the user early in the design process to get better results [39]. Based on these results of muse-based research, this research also follows a Design for one method.

3.1.3   Epistemological Foundations

In this research, the selected epistemological viewpoint is interpretivism [5]. The research chose this perspective because it is ideal for understanding the detailed and individual experiences of individuals [5]. Within the context of this research, the researcher explores and understands the personal and contextual factors that can influence the engagement of PWD in more daily activities [5]. Here is a description of Interpretive Description and epistemology from Prof. Chuck Arize (Texas A&M University-Commerce):

"Epistemology is concerned with the general basis of that reality, including different methods of gaining knowledge. Interpretive research often embraces a relativist epistemology, bringing together different perspectives in search of an overall understanding or narrative. Interpretivists believe that reality is multiple and relative and that these multiple realities depend on other systems for meanings." [5]

Selecting interpretivism can work well with the goals of this research because it includes the personal and contextual factors that affect the level of engagement of PWD in daily activities. Individual experiences can allow the researcher to explore real-world experiences as PWD in daily life. The research questions aim to uncover the complex situation and personal insights that can impact the activity level of PWD. To collect more personal and subjective experiences, qualitative methods like interviews and ethnographic observations support the research. These methods provide the researcher with deep insights into perspectives of PWD. Interpretivism stance will provide and support the researcher for this research to find ways of how PWD are getting better engaged with assistive technologies and social activities.

Such deep insights sometimes can not be reached through quantitative approaches. For example, an online Article from Fullstory:

"Qualitative research delivers a richness and depth of insight that is often not possible with quantitative research alone, particularly when exploring complex behaviors and contexts." [26]

This is why the research used interviews and observation, which gave the researcher deep insight and helped the researcher interpret the participant's complex behavior.

3.1.4   Research Design

Here are the steps of how the Research Design is implemented:

1. Initial Phase: the appropriate PWD and caregivers should be identified. At this step, the baseline data and ways to engage people to be active physically and socially will be collected. That can be done by searching the actual literature.

2. Getting Consents: A consent Form about data collection will be handed to the participant to sign. All the relevant points to ethical aspects will also be verbally discussed to ensure that the participants agree about using their data.

3. Collecting user data to develop a baseline: Conduct an interview and observation session to collect user requirements. This baseline can help to have a reference point for comparison after implementation.

4. Development and Implementation of Assistive Technology: The product will be developed based on UCD and user requirements collected in the previous step.

5. Data Collection and Observation: The participant's interaction with the developed AT will be monitored in their daily environments. Interviews and semi-structured interviews will be conducted to gather information.

6. Analysis and Interpretation: Collected Data from the last steps will be interpreted by analyzing the interview transcripts and observation notes using thematic analysis.

3.1.5 Data Analysis Techniques

This research uses qualitative research method interview. The researcher [53] realizes that qualitative methods like interviews have a long and complete description and explanations about the subjects, which are important in this research:

> "a source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts" [53]

This quote states that interviews can give the researcher an insight that is more than just numbers.

In education, it is more popular to use both qualitative and quantitative data analysis [53]. The quantitative study focuses more on the frequency, the degree of strength, or how long a behavior takes, but qualitative research can get a deep insight into the participant's beliefs, values, and motives and why they act so in a specific way. It can also explore complex scenarios more exactly [87]. For this research, we need qualitative methods for the participant's better understanding. Firstly, it should be considered that textual data is more challenging to find patterns in it. Secondly, quantitative data is easier to analyze [20]. Here are the steps to analyze the textual data in this research:

3.1.6 Transcription

This research will analyze the data using thematic analysis. The first step of the analysis is transcribing the interview into text. Some of the professionals recommend doing that by yourself because it's expensive and takes more time if someone paid [78]. The other reason for that is getting more familiar with the data if the researcher invests more time in contact with it [16]. After transforming the data into an organized format, it will be disassembled [16].

3.1.7 Disassembling & Reassembling

After organizing the data, the data must be separated and assigned to the created groups (for example, by tagging) that are important for this research [6]. This grouping can be done by coding. Through coding, raw data will be transformed into usable data [6]. Coding identifies the connections, themes, concepts, and ideas in the text [6]. Coding helps to find similarities and differences in the data [6]. Coding can also help to count common themes in participant language [13]. The coding process can be done automated or manually [13]. This research will use the manual coding process with inductive coding [13]. Inductive coding develops the code directly from data. There are no predefined categories or themes [13]. This method helps to find new patterns from the data [13]. The exploratory nature of inductive coding helps the researcher to find new insights about the experiences of PWD [13]. Here is a way to execute inductive coding: [81]

1. Go through the data, find the important parts, and group them by the first set of tags.
2. The text should be checked line-by-line, and the tags should become more detailed at this step.
3. Create categories for the tags and find out how they fit into your tagging frame.
4. Determine which tags are relevant for the researcher and keep them.

After creating tags, these tags should then be contextualized to create themes (reassembling). These themes should be considered as related to the research questions. The themes can also be divided into sub-themes [80]. At this step, the researcher should collect the important data into themes and check if the themes are robust and relevant to the research question [80].

3.1.8 Interpreting & Concluding

At this step, the researcher should interpret the data because „data do not speak for themselves" [87]. This step is critical because this step should conclude the tags and themes that are collected [87]. Interpretation should not happen at the end [87]. The researcher's interpretation should start from the first three steps [87]. The goal of the interpretation is that the interpretation should be complete, the interpretation result

should be the same if other researchers work with the same data, the interpretations should present the raw data, they should be within the framework of current literature, another researcher should accept the data collection methods and interpretations [87]. Interpretations should naturally come from the data, creating the foundation for the conclusions [16]. After that, concluding responses should be made during all three steps, as well as answers to the research questions.

3.2 Selection of the Research Object

This section outlines the criteria for selecting participants, ensuring that the data collected is valid and directly relevant to the research objectives. Careful selection is crucial for obtaining meaningful insights into the effectiveness of AT for individuals with dementia. By carefully selecting participants, the data collection gives the researcher more usable information and helpful insights for the AT that developed for PWD. This section includes the criteria for selecting and not selecting the participants. There is also a short intro to the ethical considerations. Ethical aspects will be defined in more detail in this section.

3.2.1 Inclusion Criteria

The participant must have a confirmed diagnosis of dementia. While this research includes individuals with mild dementia to focus on early-stage interventions, it excludes those with moderate to severe dementia due to the increased complexity of care. This research can include participants with different dementia types like Alzheimer's Disease, Frontotemporal Dementia, Lewy Body Dementia, or Vascular Dementia. The participant can have symptoms like Wandering and getting lost, Repeating questions, difficulty planning and organizing, excessive emotions, forgetting current or past events, or Misplacing items. In Figure 3.3 shows different types of dementia. The participants can be in their mid-60s and above, but younger people with mild dementia symptoms can also participate in the research, which is not so common. The participant should be able to read and hear the notifications. The participant be able to move to participate in events. The participant should be a nursing home resident who offers different activities to the residents. The participant should agree to participate in the research. If the researcher is not sure about the participant's sanity, the nearest family member or legal representative can sign the consent form. The participant should read and understand the research's language. The language of the research is German because it will be tested in a German nursing home in Vienna, Austria.

3.2.2 Exclusion Criteria

This research excludes patients with moderate and severe dementia disease. The participant has impulsive behavior, difficulty understanding speech, hallucinations, or delusions.

Alzheimer's Disease	Frontotemporal Dementia	Lewy Body Dementia	Vascular Dementia
Symptoms			
Mild · Wandering and getting lost · Repeating questions Moderate · Problems recognizing friends and family · Impulsive behavior Severe · Cannot communicate	Behavioral and Emotional · Difficulty planning and organizing · Impulsive behaviors · Emotional flatness or excessive emotions Movement Problems · Shaky hands · Problems with balance and walking Language Problems · Difficulty making or understanding speech *There are several types of frontotemporal disorders, and symptoms can vary by type.*	Cognitive Decline · Inability to concentrate, pay attention, or stay alert · Disorganized or illogical ideas Movement Problems · Muscle rigidity · Loss of coordination · Reduced facial expression Sleep Disorders · Insomnia · Excessive daytime sleepiness Visual Hallucinations	· Forgetting current or past events · Misplacing items · Trouble following instructions or learning new information · Hallucinations or delusions · Poor judgment
Typical Age of Diagnosis			
Mid 60s and above, with some cases in mid-30s to 60s	Between 45 and 64	50 or older	Over 65

Figure 3.3: Types of Dementia. [61]

Candidates with severe physical disabilities who can not participate in different nursing home events can not participate in the research. Individuals are not living in a nursing home because collecting information about participation in different nursing home events is impossible. A participant who can not read and hear the notifications is excluded. Participants who cannot understand informed consent and do not have a legal caregiver or family member who does not agree with the consent can not participate. The ethical rules of the research require that the participant understand the research and freely agree to participate.

3.2.3   Strategy and Size

The approach of the research is to check the impact of AT of PWD. This research has a single participant. Given the exploratory nature of this research as a research by Khaled [39] from the year 2012, a single participant was selected to allow for a detailed as a research, in-depth analysis of the impact of AT on one individual's daily life. The behavior of a single participant will be inspected before, during, and after the research. It can be a challenge to have only one participant. An acceptable analysis can be reached by collecting comprehensive data during the data collection phase. The research needs more times interviews and observations during the design and prototyping of the device.

3.2.4   Selected Participant

This research cooperates with a nursing home for elderly people in the 10th district of Vienna, Austria. Some inhabitants of the nursing home are diagnosed with dementia. The

participant who is chosen for this research is a woman who is 66 years old and diagnosed with mild dementia. The participant is informed about all parts of the research and data collection. The researcher has a family relationship with the research participant but does not know her very well or in detail. The researcher needs more observation and interview sessions to define her needs adequately.

3.2.5 Participant Recruitment & Ethical Considerations

The participant is informed about all parts of the research and data collection. The participant is informed orally and in writing about what happens with their data. The caregivers and her family have also been informed in writing and orally. To be sure, her son explained everything to her again orally, and then the participant signed the consent form. In the section Ethical Aspects in Section 3.4, detailed ethical considerations for PWD are defined. The used consent form can be found in Section 7.5.

3.2.6 Data Management and Storage

The collected data will include audio recordings, interviews, observation notes, interview transcripts, and consent forms, which will be stored securely. All data collected during this research, including audio recordings of interviews, interview transcripts, consent forms, and any observational notes, will be organized and securely stored on an encrypted hard disk. All the individual data that can reveal the identity of the participant is removed. That includes the name of the participant and other information like the place of the interview and exact address. Electronic data, like the recording of the interview, will be saved on an encrypted hard drive. This hard drive can be only accessed by the researchers. Hard copies of the consent forms will be locked in the researcher's working office in a locked locker, which can be accessed by request.

3.3 Data Collection and Preparation

See Section 2.2 for the literature review. In this research, AT will be designed using a UCD approach to improve the daily tasks and social engagement of individuals with dementia. To achieve this, the data collection will focus on understanding participants' needs, routines, and interactions with technology. The interview questions should be defined at the beginning of the initial data collection step. After initial Semi-structured interviews and observation, the research will collect important data about daily routines, preferences, challenges, and interactions with existing assistive technologies.

After gathering the information from the participant. The research will start the design and development of the prototype based on information gathered from the initial observation session and interviews. Users should use the product for at least 2 weeks.

After the usage period, the researcher should provide the second test & evaluation of the product with the user. The result of this evaluation with the user should identify the issues and correct them for the next implementation. The collected feedback will be taken into account during the development of the new version of the product. The user will use the product for a second time for 2 weeks and then conduct a new interview session to see if there are any changes in their engagement in events in their nursing home in comparison to the initial interview.

The next sections will explain the procedures discussed above in more detail.

3.3.1 Observation Session and Interviews

The first interview focuses on understanding the participant's **daily activities and routine**. The questions should regularly identify activities that are **enjoyable** for them. The participant should also speak about activities that bring them **difficulties**. The participant should speak about family members, friends, and other **social contacts**. The participant should tell the researcher the **frequency of social activities** that they are engaged in. The participant should tell the researcher if they are happy with the frequency and types of their social contacts. The participant should describe the difficulties they face in their activities and tasks. The researcher needs information about the usage of AT and other **electronic technologies**. The participant should tell the researcher about the **effectiveness** of the technologies that they already used. Preferences for how the technology should be customized to meet participants' individual needs. The research should provide some **initial concepts and prototypes** of this AT to get initial feedback. That can also help the researcher make the result more user-friendly.

During the *observation*, the date and time of the observation session will be written down to see if it makes any difference at different times. During the observation, the interviewer will take notes. The **place** of the observation will be a nursing home where the participant usually spends his time and in the private room where the participant is on a normal day. The focus of the observation session will be on any changes in the **behavior of the participant** in the presence of family members and caregivers. The researchers should note their **routine activities** like eating, watching television, reading a magazine, etc., and the **time that they spend** on each activity. The researcher should observe the level of contact that the participant has with other people. It could be helpful to find out if they have more **passive or active engagement**. The level of use of the assistive technologies used by the participant can help estimate their familiarity with the technologies. This includes devices for mobility, communication, and daily tasks. It's important to find out if they are using the devices **independently, or do they need assistance**. The **difficulties** should be also **documented**.

3.3.2 Data Collection Procedures

At the first step of data collection, it's important to get the consent of the participant in oral and textual form. The participant is diagnosed with mild dementia. The participant can understand the informed consent form. Before starting the interview, the participant will be informed about the details of the process and the consent form to ensure the participant understands everything. The participant will also be informed about the research's purpose, procedures, risks, benefits, and the anonymity of all collected data. As already mentioned in section 3.3, the interview will be semi-structured to make the interview more flexible. The interview will take about 60 Minutes. The interview will be audio recorded and transcripted and will be anonymized. The initial observation as already mentioned in section 3.3 will be done on the same day in the same room where the participant lives. Collected data will be analyzed with qualitative methods and find the key themes and insights that can support the researcher with the design and development of the AT. Three observation sessions (4.1.1) are planned for the per-launch. In the second phase, post-launch, there will be one interview with the participant and one interview with the caregiver. In the third phase of the Post-Release, it will conduct again an interview with the participant, a family member, and a caregiver and an observation session by the participant to see if there are any changes in the daily routines of the PWD.

3.3.3 Preparation of Data Collection

The research needs careful preparation to ensure a complete data-collecting process [86]. An important step for comprehensive data collection is developing interview questions [86]. The quality of the interview data collection depends on the quality of the interview questions [86]. The recent study proves the effectiveness of interviews regarding PWD [86]. Questions for the interview are prepared beforehand. The researcher can ask additional questions if there are more interesting questions to ask during the interview. These questions will be added to the list of questions. A consent form will be printed and provided for the interview and the observation session. The first observation session was conducted on Wednesday, 15.07.2024, and will take 6 hours continuously. The data collection will be done by taking notes of the things that occur during the observation. The chosen date and time can be useful for the observation output. There are not many external visits to the nursing home. The interview began on one Sunday 07.07.2024 morning at 10:00. For the audio recorder, the mobile phone is used, and for the transcription tool, restream software is used: https://restream.io/tools/transcribe-audio-to-text For the preparation, the researcher will do a pilot testing to identify potential issues and refine the questions before the interview. The questions should be clear and understandable to ensure PWD can answer the questions effectively [76]. The interview will be conducted in the nursing home cafeteria to make it comfortable and familiar to the participants. That reduces anxiety and promotes the natural behavior of the participant. The initial observation session will be done on the same day as the interview. Three pre-launch

observations will be planned for some hours in the participant's room at the nursing home. During the observation, the observer will take notes on important things.

Pre-Launch Iteration Interview PWD Questions

Here are the questions defined for the first initial (Pre-Launch) interview and the reason for choosing these questions:

1. How are you feeling today?

   - This question helps establish the participant's current emotional and physical state, which can influence their responses and provide context for their overall well-being.

2. Can you tell me your age, gender, and level of education?

   - The researcher already knows the answer to this question, but this question can also help find if the participant can give the right information about herself.

3. Do you have any needs/wishes that you want me to know?

   - This question may help the participant feel well and comfortable before starting with the important questions.

4. Can you walk me through a typical day in your life?

   - This question can help to find the daily routines and level of her activities in a day.

5. What activities do you enjoy doing the most?

   - This question can help find the participant's more interesting activities. These activities could be offered more in the application.

6. Do you communicate with other people at the nursing home? How often?

   - This question can provide the researcher the information about how sociable is the participant before the research and the researcher can compare it later after the usage of the developed AT.

7. Who do you interact with regularly (family, friends, caregivers)?

   - That can show who is the participant's favorite contact persons and these people can be asked later if they see any positive changes after usage of the developed AT.

8. How often do you participate in social activities or group events?

- The answer can provide information about the participant's socialization level.

9. What kind of support do you receive from caregivers or family members?

   - The answer can help to find out the level of independence from other people at the nursing home.

10. Are you currently using any assistive devices or technologies?

    - This question can provide the information about level of familiarity of the participant with other technologies.

11. How effective do you find these technologies? Are there any challenges you face with them? How comfortable are you with using technology in general?

    - The level of acceptance can show if the participant is satisfied with technologies and is open generally to using tools.

12. Can you describe your physical health and any mobility issues you might have?

    - With the answer to this question the right physical activities can be chosen in the AT to be offered for the participant.

13. How would you describe your cognitive function and mood regularly? How do you feel about your overall well-being and quality of life?

    - This answer identifies how the participant assesses the cognitive function and if there are any mood fluctuations.

14. Do you have any concerns about using new technology? How would you like the technology to be customized for your needs?

    - The participant can give some information about what is important for her and whether the participant is open to trying new technologies.

15. What are your initial impressions of these technology prototypes? Which one do you prefer? (Figures 3.4, 3.5, 3.6, 3.7, 3.8) How usable do you think these designs are? What changes would make them easier to use? (Figures 3.4, 3.5, 3.6, 3.7, 3.8)

    - With this question the researcher can get feedback about the prototypes which can help with the design.

16. How easy is it for you to read text on screens? What colors are most satisfying for you to see? Do you like the colors used in the prototypes?

    - It's important to know if the participant can read some text on the screen and if there are more preferred colors. This information can help in deciding the right colors.

17. Do you have difficulty pressing buttons on screens?

   - This information can help the researcher to find if the participant has a better feeling about the buttoned interface or touch screen.

18. Are there specific sounds or music that you find calming or pleasant?

   - This preferred sound can be used to notify the participant which is calming and pleasant.

19. Are there certain times of the day when you feel most comfortable using the application? Would you find it helpful if the application sent reminders or notifications? If so, for which activities?

   - This information can be used to notify users to suggest the near interesting courses that will take place soon at the nursing home.

20. Are there specific tasks or activities you would like the application to assist you with?

   - This information can be used to notify users to suggest the near interesting courses that will take place soon at the nursing home.

21. How do you feel about using touchscreens versus physical buttons?

   - The researcher has already asked a question about buttons. This question shows if the participant's answer is consistent or if the participant's opinion changes during the interview.

Here are the initial prototypes for the first interview with the participant: Figures 3.4, 3.5, 3.6, 3.7, 3.8, 3.4, 3.5, 3.6, 3.7, 3.8. These prototypes are a way to determine user preferences. Four designs are defined for each batch of photos for the initial design. The first group of designs contains: 3.4 firstly, a screen without any symbols and colors with locations and times of the next year's events. Secondly, the design includes colored time, which shows how much time remains for the next course. The third prototype contains a symbol that shows the subject of the course. The fourth design also includes the course time. With these designs, users have no opportunity to skip or change to the next screen. The display will update without user selection after the time to visit the near events expires.

The second group of designs contains: 3.5 is like the last batch of designs, but they have a button at the bottom of the screen that allows the user to move to the next events. Users have an effect on changing the screen. The researcher would like to find out if the participant likes the placed button at the bottom of the display.

The third group of designs contains: 3.6 is like the last batch of designs, but the button is placed at the right of the display. The participant can change to the next available
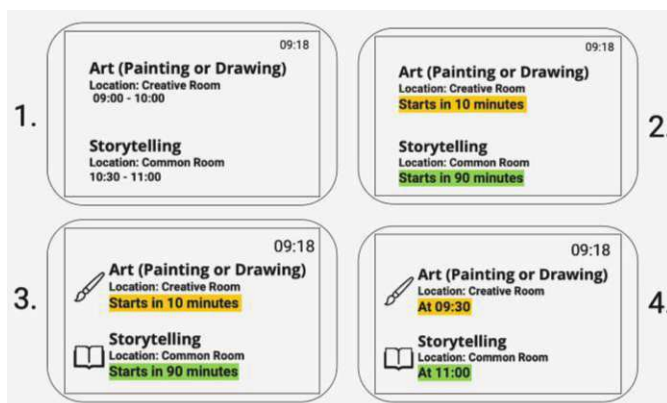
30

Figure 3.4: Initial prototypes from the first batch of designs.

Figure 3.5: Initial prototypes from the second batch of designs with a button at the bottom of the screen.

Figure 3.6: Initial prototypes from the third batch of designs.

screen with this button. The screen will rotate to the beginning if no more events are available to change to.

At night or on weekends when there are no events or appointments to participate in (Figure 3.7 and 3.8), the display will show, for example, the meal times or a motivating sentence for the participant to motivate them to do something.

Figure 3.7: Idle Screen 1: Initial prototypes for display during evenings with no events.
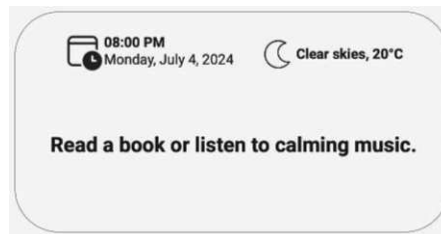

Figure 3.8: Idle Screen 2: Initial prototypes for display during evenings with no events.

Post-Launch Interview Questions

After implementation and usage of the AT based on collected data in the Pre-Launch phase. Here are the interview questions for the second loop (Post-Launch UCD Iteration). At this iteration, the researcher asked the participant to get feedback about the event display page. It is also important to get feedback about the functionality of the events management page from at least one caregiver and one participant's family member.

Post-Launch (PWD) Questions list: It has been tried to hold the question list short. Because the first interview showed that a long list of questions was confusing and overwhelming for the PWD participant.

1. How did you feel while using the product?

   - This question provides information about how using the product changes the participant's social or physical routines.

2. How well did the product help you to become more active?

   - This question can help to understand the product's effectiveness in increasing physical activity or social life.

3. Were there any features that you found less helpful or that you did not use?

   • This can help identify features that may need to be revised or removed.

4. Did you have any technical difficulties using the product? If yes, which ones?

   • This question is intended to uncover technical obstacles or usability problems.

5. How useful did you find the product's reminder or notification functions?

   • This question helps to understand whether the application's reminder function is effective for the participant.

6. Do you have any suggestions on how the product could be improved to make it even more helpful for you?

   • It can help to get direct feedback and ideas for potential improvements.

7. Have you noticed any changes in your physical activity or social behavior since using the product?

   • This question can be used to check whether there have been significant changes in behavior since the product was introduced.

Post-Launch Caregiver & Family members Questions list: These questions aim to get feedback about the usage of the "display management page" and if they see any changes in the daily routine of the PWD after usage of developed AT.

1. How often do you use the event management page to change the assignee's plans or activities or add new activities?

   • This question helps to understand the frequency of use and importance of the page.

2. How easy was it for you to define new activities on the site and select suitable icons?

   • This question aims to evaluate the ease of use when creating new activities.

3. How intuitive is adding a new event (e.g. selecting the day, time, room, and activity)?

   • This can help to understand whether the user guidance for planning is clear and simple.

4. Have you had problems deleting events that are no longer relevant? Was this process easy for you?

- This question helps to evaluate the functionality and simplicity of deleting events.

5. Do you have any suggestions on how the site could be improved to make adding and managing activities easier and more efficient?

   - This helps to see if there are any good ideas for improvements based on user needs.

6. Overall, how satisfied are you with the current features of the event management site? Which functions are particularly useful to you?

   - This helps to summarize the satisfaction with the functions of the page.

7. Have you noticed any changes in the person's daily routines since they started using assistive technology? Do they now participate in activities more often or have they become more active overall?

   - To determine if PWD become more active and improved the daily routines.

Post-Release Interview Questions

After the Post-Launch phase again, the last phase is starting the Post-Release phase. In this phase, the researcher again takes feedback from the participant and a caregiver for the last time in this research to answer the research questions and make the last adjustments. The questions from the PWD tried to keep simple for easier understanding. Some questions are the same as the first interview to compare the answers. The question list does not contain too many questions so as not to be too demanding for the PWD. Interview questions from the caregivers are designed to get feedback from the event management page and get feedback to ensure if there are any changes in the daily routines of the PWD.

Post-Release Interview Questions PWD:

1. How do you feel about using the reminder technology?

   - This question helps to find the general experience of the participant about the reminder technology.

2. Was it easy or difficult for you to use?

   - This question helps determine if the participant already accepts the technology.

3. Has the reminder technology helped you join more activities or spend time with others?

- This information helps to find if there are any changes in the frequency of visiting activities.

4. Did it help you remember to do physical activities, like walking or exercise? Helping with Activities

   - This helps to find if the memory aid is working and it helps remembering the activities.

5. How often do you participate in social activities or group events? (The same question as in pre-launch phase 3.3.3)

   - A question to compare the answers from the pre-launch and post-release phase

6. Do you have any concerns about using new technology? How would you like the technology to be customized for your needs? (The same question as in pre-launch phase 3.3.3)

   - A question to compare the answers from the pre-launch and post-release phase

7. Do you feel more connected with other people because of it?

   - This can help to find out if there are any changes in the social activities of the participant.

8. Do you think it has improved your memory or thinking skills? Changes in Well-being

   - Finding changes in the well-being of the participant.

9. Has using it made your day-to-day life better? How so?

   - Finding changes in QOL of the participant.

10. Is there anything you would change to make the technology better for you?

    - getting overall feedback about the developed AT

3.4 Ethical Aspects

This section will get into the Ethical aspects of this work to analyze how assistive technologies should align with human rights laws [63].

3.4.1 Ethical Considerations

AT offer a good opportunity for PWD in social engagement, decision-making, and advance planning [8]. Some concerns show that these technologies limit their freedom of movement and break privacy. This research wants to design and evaluate a AT for PWD [8]. Based on a report from WHO, at least more than a billion people can potentially profit from AT, but just 1 out of 10 people have access to these technologies [63]. Based on WHO report, more than 2 billion people will need at least one assistive technology by 2050 because society is getting older and older [63]. Boada et al. [10] (2021) reviewed 56 publications and recognized 26 ethical issues that are associated with Socially Assistive Robotics (SAR). You can see the list of these issues in Figure 3.9. This research Boada et al. [10] (2021) categorized the ethical issues into three groups: Well-being, Care, and Justice. Well-being, Care, and Justice correlate to the ethical dimensions of individual life, practice-related concerns, and sociopolitical implications. More than 60% of these ethical issues are categorized as well-being [10]. Each ethical issue can be categorized
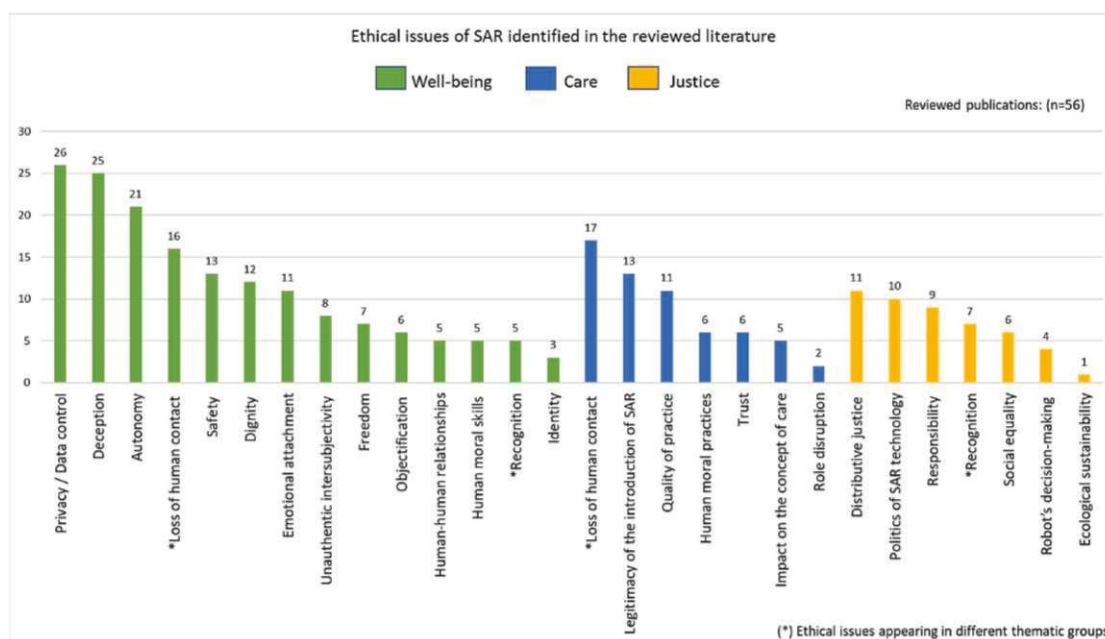

Figure 3.9: Ethical issues associated with SAR. [10]

based on a study by Götzelmann et al. [27] (2021) under one of these eight principles for ethical research: "respect for participants", "independent review", "fair participant selection/recruiting", "favorable risk-benefit ratio", "social value", "scientific validity", "collaborative partnership", and "informed consent (IC)". The following sections will go through some important ethical issues presented in Figure 3.9, which could be important in the context of this research.

3.4.2 Well-being

Privacy/Data Control should be well informed to the user [56]. Users should know what happens with personal data, called informed concerns [56].

Deception is important because it can cause negative consequences for the user, for example, emotional dependency on the Human-Robot Interaction (HRI) [10]. The research prevents the deception by not leaving the user alone with the product. The user is in a retirement home and is regularly visited by nursing staff.

Autonomy shouldn't be damaged by AT [60]. It should be considered excessive, and inappropriate SAR support can make the user dependent [60]. This could lead to a loss of user skills and a dependence on technology, which contradicts the primary goal of support (promoting autonomy) and creates new forms of vulnerability [60]. The challenge is to ensure the appropriate type and level or proportionality of support [60]. We'll try to manage events in the calendar and suggest different available activities nearby or at home to motivate them. Users can accept or reject this suggestion. It'll be considered not to trigger ethical concerns on human autonomy by using AT.

Loss of human contact This research aims to motivate PWD to do more activities and help them not lose human contact, prevent social isolation, and promote certain relationship disorders [10]. Social isolation harms well-being [10]. This research wants to encourage users to do more group activities in the retirement home.

Freedom Researchers emphasized including family members and people with dementia during the authorization process [48]. Including their feedback can help to accept the AT better [48]. The researcher should always keep that in mind, granting freedom of choice and recognizing expressed their ability to do this [48].

Human moral skills SAR can be a potential threat and cause ethical problems [83]. HRI can decrease moral competence and limitations of dialogue systems between humans and robots, which may affect human ethical decision-making processes [83]. This research could be a problem because this research wants to encourage PWD to become more involved in different activities using HRI. Rejecting the proposal should be very easy and force you to decide.

3.4.3 Care

Safety concerns focus mainly on the physical integrity of users, including risks of accidents arising from human-robot interactions and the presence of robots leading to shared spaces [10]. These concerns go beyond actual harm but also include perceived security [10]. Security is an ethical concern for potential damage and the complex interaction between security, autonomy, and privacy [10]. This research will test the Hardware and software to prevent any safety concerns.

Anonymity of participants Hoge et al. [34] emphasize that the anonymity of participants is a standard ethical practice. Researchers typically employ pseudonyms and blurred faces in photographs to ensure that the data collected cannot be traced back to the original participants [34]. Throughout the interviews, researchers demonstrated an understanding of the importance of safety and respect when anonymizing data [34].

This research should ensure that the collected data stays within the university to avoid harm to participants.

3.4.4 Justice

dignity Using AT should prevent making old people feel like they are not important to the researcher or infantilization of the elderly [85]. AT An AT should be built so that they do not lose their usefulness and are not used as toys [85].

Privacy The privacy of the user shouldn't be sacrificed for the quality and reliability of the technology because PWD needs to use AT [85]. In this Project, we'll define a user consent form (please refer to Appendix 7.5). This is how the user will be informed about gathered data and how they will be used. This informed consent shows the openness of the project. They can change their decision anytime. We'll collect user responses to the suggested activity dates that should be informed. For PWD, we'll define each consent form individually to approach the understanding of each patient. Dementia patients can forget the information they get, so the researcher should get their consent again. The researcher would do a live demonstration on-site to tell them what data are collected. The nearest family members and nursing staff will also informed so they can support PWD if there are any questions. They can also frequently explain them to hopefully create an understanding of the usage of their collected data.

Managing Familial Relationships in Research A participant is a person who is personally known to the researcher, e.g., a family member. The identity of the participant will not be made public in the research. It also does not explain the family relationship between the participant and the researcher, so people cannot guess who the participant is.

CHAPTER 4

Results

4.1 Data Analysis

This section contains all the collected data from interviews and observations that will be analyzed. The analyzed results will be used in the device's design. After the initial data collection phase, the device will be developed based on the results.

In the next step, another interview and observation session will be conducted to obtain feedback from the participant after device usage. The data collected at this step can be analyzed to determine whether the usage of the developed device changes the degree of activity of the participant and whether any changes are desired by the participant.

The collected data will be analyzed and used to change the device based on that, and again, the test will be made to see if the changes helped to increase the degree of activity compared to the last step.

4.1.1 Pre-Launch Data Collection & Analysis

This section collects data from the user in the pre-launch phase, before implementation of the AT. Based on these data, the collected data will be used to develop the AT in the pre-launch phase.

First Interview on Sunday 07.07.2024

The interview occurred at the nursing home cafeteria on Sunday Morning at 10:00. There is not much going on there. The transcription of the initial interview can be found in Appendix 7.5. At the beginning of the interview, the participant was informed about

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the subject of the interview, and a consent form was signed. During the interview, the participant felt gut, but the researcher noticed that the participant was worried that they were testing her cognitive situation and labeling her as not being in a suitable cognitive situation. It was clarified again, like at the beginning of the interview, that the purpose was to make her a product to support her in daily activities and not test her cognitive situation. The interviewee is 65 years old and has completed secondary school.

The interviewee said that the participant has just some small daily talks with her roommate; otherwise, the participant has no contact with the other residents. Her most social contact is with the caregivers daily, and her son visits her weekly. Here is the answer of the participant about the social activity:

> "With my neighbor Maybe three times a day. Once or twice a week Yes, bingo
> or a music course."

The interviewee's favorite activities are playing puzzles and sometimes drawing. The participant is interested in Bingo events, Music Courses, and playing puzzles. Here is a typical day and routines described by the participant:

> "I get up in the morning, then I go for breakfast, then I have sometimes I
> have physiotherapy and then I have lunch. Then I do something like bingo or
> a music class in the afternoon. "

The only recent technology the participant uses is her senior's cell phone, which is not touched. Sometimes, the participant forgets how to do certain things, and someone has to explain everything to her again. Here is the answer about the usage of new technologies:

> "I have to ask myself again, how exactly do some functions of my cellphone
> work, it's not so easy for me. My son should show me these functions again."

Regarding independence, the participant needs a walker but can do everything independently. The participant can independently find the rooms at a nursing home for different courses. The answers the participants about independence are here:

> "I just can't walk so well anymore walk. I used to be able to walk better, I
> used to walk a lot walking and going for walks. I can find the different event
> rooms in the nursing home independently."

The participant did not understand a touch display and preferred button-based products. When asked how she felt about new technologies, the participant said that she was not interested in learning them and that learning them made her nervous.

The whole impression of the interview has shown it could also be more helpful in this research to do more observation without any question and answer session because the participant was a bit overwhelmed and sometimes gave contradictory answers to the questions with the same direction. For example, I showed her prototypes with buttons (Figure 3.5, 3.6) and without buttons (Figure 3.4). The participant preferred a prototype with buttons at the bottom of the display (Figure 3.5), but as I asked her if you preferred a product with a button to have more choices, the participant said that the button made her more confused and I prefer a product without buttons (Figure 3.4).

After this information, I asked her about prototypes and which one the participant preferred. The interviewee told me that the participant preferred picture number 3. in figure 3.5. This prototype was designed with a button at the bottom to display the next events and the minutes until the start of the next event. As mentioned before, the participant changed her choice and said in another question that the participant prefers picture number 3. in figure 3.4. The participant mentioned that the colors are good and the participant understands the meaning behind the colors. The participant mentioned that her favorite singer is Leonard Cohen and is always happy to hear this music.

After that, the participant got some photos about the time, which are not any courses in the next near time to display (Figure 3.7 and 3.8). The participant liked the idea and said the participant would be happy to see cats or photos of her granddaughter. These are important data collected from the initial interview with the participant.

First Observation on Monday 15.07.2024 from 09:15 to 14:30

The first observation occurred Monday morning from 09:15 to 14:30 for 5 hours. It was a quiet time with only the participant and her roommate. The participant was again informed about the observation and gave her consent. During the observation, the participant was comfortable in her surroundings. The participant was calm and quiet. The participant occasionally interacted with her roommate, but most of the time, the roommate asked her something. The conversations were short. In a conversation with the roommate, the participant wants to open her Discman to change the CD. The participant mentioned, "I'm not that smart. I can't do that. I forgot to know how to do that." After the participant did not ask the caregivers to help her, she listened to the old CD and could not change the Disc.

She can use the electronic coffee machine and, after making coffee, spends 3 hours till lunchtime doing puzzles and reading gossip magazines. The participant used her walker to move around. The participant seemed to have no difficulty and moved confidently and independently. For lunchtime, the participant goes independently to the dining room on the ground floor. The participant noticed lunchtime without any help. After lunchtime, the caregiver asked her about her well-being and joked a little with her. The participant did not ask the caregiver any questions or understand her jokes.

At this time, the participant took an afternoon nap, and then the observation ended.

Second Observation on Wednesday 17.07.2024 from 16:00 to 20:00

The second observation took place on Wednesday from 16:00 to 20:00 for 4 hours. The participant was again informed about the observation and gave her consent. During the observation, the participant was calm and relaxed. As the participant was met, the participant was thinking a coffee and doing a crossword puzzle. Then, a caregiver informed her that the bingo game would start in 15 minutes if the participant wanted to play with other residents. The participant did not seem to remember the planned game, and the information made her participate in this event. The participants already knew the room in which they were playing the game. The participant found the game room independently on the other floor. The participant could concentrate and follow the game's rules but was not interested in talking with other residents. After the game, the participant returned to her room, where dinner was served. The participant did not eat much of her food and watched television while eating her meal. After that, the participant could change her clothes by herself and get prepared to go to sleep.

Third Observation on Friday from 19.07.2024 from 08:00 to 13:00

The third observation occurred on Friday morning from 08:00 to 13:00 for 5 hours. The researchers chose this time again because the participant had a weekly physical therapy appointment at 08:30. It was important to see whether the participant remembered the date or was surprised by it. The participant did not remember the date and was surprised by the physiotherapist coming. That hints that the participant could be more prepared for the medical appointment. After the treatment, another resident asked if the participant wanted to walk with her. The participant was happy and said yes to her. They walk in the garden and drink in the cafeteria with her friend. During the observation, the participant always said yes when somebody asked her to do some activity but was not actively seeking new activities.

Comparison of Interviews and Observations

The participant claims that the participant does everything independently using a walker, confirmed in the observation. The participant can navigate the nursing home and perform activities like making coffee or finding bingo or dining room. In the interview, the participant expressed that the participant plays puzzles and draws. The observation confirmed that the participant is engaged in puzzles and reading magazines. The interview and observation showed minimal interaction with other residents. Her interaction is mainly with her son and the caregivers. The observations show that the participant is interested in other activities when the caregivers ask her, but the participant does not look into other activities alone. The participant has an inconsistent Preference for technology usage because, in the interview, the participant said that the participant would like to have button-based interfaces, but the observation shows that the participant

struggled once with the Discman and preferred familiar devices. The participant also had an inconsistent Preference. At first, the participant preferred a button-based prototype but was later told that the button could confuse her.

The interview revealed the participant's anxiety about being tested on her cognitive abilities. Observations did not directly reveal this anxiety but noted her nervousness and occasional contradictory answers, suggesting underlying cognitive concerns. There are difficulties in remembering therapy appointments, which were highlighted in the interview and observations. The participant showed confidence in moving around the resident's room, which was the same result from interviews and observations.

The summary from the comparison of Interviews and Observations:

- Simple and intuitive design for assistive technologies.

- Regular prompts and reminders to encourage participation in activities.

- Supportive environments that reduce anxiety related to cognitive assessment.

- Enhancing social interaction through facilitated engagement.

Key Findings from Coding and Thematic Analysis

The result from the observations was more consistent than the interview. The interviewee gave the impression that the participant was afraid of being judged as unable to understand the usage of technologies. However, during the observation, the participant showed that the participant could use some technologies like her Discman, Television, and keypad mobile phone. The participant has shown that the participant can do everything independently but should be reminded of her tasks repeatedly; otherwise, the participant hardly does anything new in her everyday life. Here are the key themes from the initial data collection methods of one interview and three observations for the initial step for understanding the user needs better and testing the designed sketches and Wireframes:

- Anxiety about Cognitive Testing: The participant expressed concerns about being labeled due to her cognitive state. The observation sessions were much more pleasant for the observed participant. The participant was happy that someone was there and could finish her daily routine very calmly.

- Preference for Button-less Interfaces: Initially, the participant preferred prototypes with buttons but later indicated confusion due to additional choices. The participant preferred to change nothing in the device during usage because the participant was afraid of destroying the device.

- Limited Social Interaction: On weekly visits, the participant had minimal social interactions, primarily with caregivers and mainly with her son. The participant

tends to sit in her room all day if she is not reminded to go for a walk or attend classes. The participant does not participate in conversations unless someone speaks to her. The conversations are mostly short, and the participants don't have deep conversations with other people.

- Technology Aversion: The participant showed little interest in learning new technologies, preferring simple, familiar devices that the participant had already used over decades. Her son said the participant forgot the functionalities of the new devices. Her son mentioned that he has often taught her how to use a tablet, but the participant forgets how to use it again.

- Routine and Familiarity: The participant followed a structured routine, engaging in familiar activities like puzzles and reading. Her interests were mostly the same each day, but if the caregivers asked her if the participant wanted to participate in an event, she always accepted the suggestion during the observations.

- Challenges with Technology: The participant had a problem using her Discman, which she has known for decades. Difficulty operating the Discman highlighted the need for simpler, more intuitive technological interfaces.

- Independence: The participant can know her surroundings well and find her way in the retirement home. The participant can find the event rooms independently. That shows that informing her about the room number where the event takes place is enough for her to get there.

- Preference for Quiet and Familiar Activities: The participant preferred engaging in familiar activities like crossword puzzles and watching television.

- Memory Support Needs: The participant forgot her appointments, like physical therapy, and was surprised as the physiotherapist was there. A memory aid and remembering her should be proven if it helps.

- Social Interaction upon Invitation: The participant was willing to engage in social activities when invited. Whether ATs could facilitate such interactions should be proved.

4.1.2 Post-Launch User Feedback & Analysis

After implementing the AT, the researcher describes everything about the developed device and its usage for the participant. Then, the participant used the developed technology for one week. After at least one week of usage, an interview will be conducted to get feedback from the participant. A caregiver is also informed about using the AT and how it works. After at least one week of usage, interviews are conducted with a PWD and a caregiver to get feedback about the AT and if they see any changes in the daily routines of the participant. The interviewees are informed about how the collected data will be used. They have already signed the consent form.

At the end of the pre-launch iteration, it decided to include an event management page that makes it possible to change the events plan for caregivers and family members remotely or locally because it was time-saving for the researchers to drive to the caring home for each change in the weekly plan of the participant so in this section also interviewed with a caregiver who used this event management page to adjust the weekly plan to get feedback about this page.

Post-Launch Interview with PWD on Friday 06.09.2024

after the common routines at the beginning of the interview. The participant was asked if she had become more active after using the new product. Here is the answer:

> "Yes, sometimes my neighbor would pick me up. But now it's been more frequent—once or twice a week."

This answer shows that the participant is now more independent and can motivate herself to visit the courses.

The researcher then asked if she used the tap function on the screen. The researcher described the participant before using the AT that it is possible to loop between available events of the day by tapping on the screen. However, the participant said that she did not know about this functionality:

> "I'm not familiar with tapping on the screen to see the next event. I didn't use that feature."

This answer shows that the participant forgot about the only interactable functionality of AT and did not use it. The participant does not show any interest in learning something new.

The interviewee is then asked if she has any suggestions for improving the product.

"Maybe the text could be made a bit larger and the colors more contrasting.
I don't see very well, especially when the screen is farther away."

The participant suggests using bigger text and more contrast to make it easier to read from a distance.

The participant also mentioned that she did not forget her weekly physiotherapy session because the AT begins to remind her about the session two hours before it started.

If there are no events available for today, a random quote with a photo will be displayed as defined in Section 5.1:   If no further events are planned for the current day, a randomly selected motivational quote is displayed. If, on the other hand, there are events scheduled, the next event of the day is displayed. This motivational text is accompanied by an image of topics or people that are familiar and meaningful to the participant to increase engagement and provide a personalized experience.The participant also mentioned she liked the photos, but the motivational quotes got boring and were not motivating at all.

Key Findings & Refinements from PWD - Interview

This section describes the improvements detected in the post-launch interview from PWD. These findings will be implemented in the second round of the UCD process. These changes are based on feedback extracted via interviews from the participant about the events display page. The iterative process ensures that the user's real experiences are reflected in a product's design, which may help improve the general user experience. Here is the list of key findings for the improvement from the PWD for the events display page:

- The tapping function is not used or visible to the user, so its availability does not affect the user if it stays unused. The researcher let the tapping function be active.

- The Text size should be maximized to the screen size.

- change the contrast between text and background color to make it easier to read from a distance.

- The quotes pages will be removed. The picture display will also be removed. The display goes black if there is no event in the next two hours. The display automatically activates if there is a nearest event in the next two hours. In this way, can the AT just focus on its main function? The main function is to remind the user of the nearest appointment, and the quote display page will be removed.

Post-Launch Interview with a caregiver on Thursday 12.09.2024

After the normal interview routines, the caregiver is asked how the participant feels about the new management tools for planning activities.

> "The management tools are generally helpful, especially when it comes to keeping track of daily activities and residents' needs. The data can be changed via PC without going into their room. All the caregivers who have the link can access and adjust the events. However, it would be good if several users had a profile and login system for each person so that it is easier to keep an overview and not get confused."

The answer to this question shows the caregiver's overall acceptance of the AT. The caregiver mentioned that if there is more than one PWDs used the AT, there should be a profiling system to manage the events for each PWD separately.

The next question is about simplicity and understanding of the management page for the caregiver and who creates the events for the PWD. The interviewee found the heading of the tables somehow confusing and said the other functionalities were intuitive:

> "It was all intuitive after they showed me everything. But I would like to see better headings for the tables. I find them a bit confusing"

The caregiver did not notice big changes in PWD behavior pattern and mentioned being more careful about how the PWD do. The caregiver mentioned longer observation is necessary to give more exact feedback if there are any changes in the daily routines of the PWD.

The next question is important to know if the caregiver needs any changes in the event management page to make this administrative page easier to use:

> "I would like it to be possible to edit the events table on the management page. I think sorting by each column could be helpful. The start time in the add an event table could be centered and fit to content not so long."

The user's feedback on the user interface shows that the events display should be more interactive for the user, and unused empty areas in the tables and input forms should be prevented.

The last question is about the overall feeling of the caregiver about familiarity and acceptability of the new AT by PWD.

> "It seems to be well-liked by the participant. The individual placed it on the table where they spend most of their time."

Key Findings & Refinements from a Caregiver - Interview

Here are the key findings of the interview with a caregiver after using the product in the post-launch phase:

- The length of the start-time input field should be as long as the text length and not as long as the form length. The input time field should be centrized.

- The content of the event of the week table should be editable.

- The content should be sortable by each column.

- There should be a button to undo the last change or deletion.

- The titles of the table should be optimized.

- There should be a possibility to add the new event directly to the "weekly events" table. It should be tested in this iteration if this function should replace the "create event" table.

4.1.3 Final Feedback in the Post-Release Phase

The PWD and a caregiver have used the automated event manager for approximately six weeks. This phase aims to get final feedback through three last interviews: one with the participant, the caregiver, and a family member. All identified issues from the previous phase (Post-Launch) have been refined and now is the last phase, Post-Release, and the last iteration. This phase will focus on evaluating the long-term effectiveness of the system. These last interviews aim to analyze the results and determine whether the developed AT has successfully met the research objectives. Key research questions will be answered based on the feedback and ease of use for both the PWD and the caregiver.

Post-Release Interview with the PWD on Friday 11.10.2024

The first question was about the overall impression of the participant PWD about using the electronic calendar. The participant expressed that the calendar is helpful to be informed of what happens around her, but at the same time, it's strange sometimes to be told what to do:

> "Yes, I think it's... quite good. Sometimes, it's strange when it tells me what to do. But... yes, it helps me. I often forget things otherwise... yes, it's good."

This feedback shows that the participant is happy with the AT, but it's also sometimes uncomfortable to dictate her day schedule.

The second question was about ease of use, and the participant mentioned that the device is much simpler to use than her mobile phone. She mentioned much more difficulties with her mobile phone than the AT. She likes that there is no need to change anything in the device for the usage by:

> "Hmm, it wasn't... difficult. I didn't have to do much, which was good. I...
> often forget how to do things, but... it was easier than my phone. My phone
> is sometimes difficult, but the calendar... was easier."

The next question was whether the automated calendar helped her be more active and spend more time with others. The participant answered that, for example, she forgot to visit bingo, but the calendar reminded her about certain activities. She also said that she does not always follow the calendar suggestions and that, some days, she just wants to stay in her room.

> "Yes... maybe. Last week I... went to play Bingo, I would have forgotten that.
> But sometimes... I don't always want to do what it suggests. It's... okay, but
> I don't always want to do everything."

The next question focused on the effectiveness of reminders for scheduled events. The participant mentioned that the events could be more personalized. For example, the suggestion to go for a walk did not meet her preferences, as she does not enjoy walking. This indicates that she is not likely to engage in activities that do not interest her, even when the automated calendar suggests them. That shows that while reminders are helpful, they do not influence her personal preferences or motivate her to participate in activities that she does not enjoy.

> "Sometimes... it reminds me to go for a walk. But I don't like it much... I
> don't really enjoy walking. If I... don't want to, then I don't do it."

About the level of engagement in social activities after using the automated calendar. The participant mentioned that she participated in some social activities but still preferred to be alone, which shows the limited impact of AT on increasing social interaction. The interview also indicated that AT helped her visit more social events, but she is not interested in interacting more with others. In the first interview of this research at per-launch iteration, the participant mentioned that she visited bingo and music courses weekly, but just when somebody took her to the courses, she visited this event independently. The visiting course count is not more than the first interview before using AT.

> "Hmm... maybe once a week, sometimes twice. Bingo... or listening to music.
> But mostly... I prefer staying in my room. Yes... I like my room."

The participant was uncertain about memory or cognitive improvements but mentioned that the AT remembered her and helped her not to rely on others to remind her about upcoming events.

> "Yes... a little. It's good that... I don't always have to think about things. The calendar reminds me. Otherwise... I would have to keep asking. Now... I can do a bit more on my own."

At the end of the interview, the participant did not mention any suggestions for improving the device. This shows that the participant wants to use the automated calendar in the future and found it easy to use without feeling overwhelmed.

Post-Release Interview with a caregiver

the first question of the last interview with a caregiver is to get information about any suggestions to improve the Event-management page for creating events the PWD. The caregiver is satisfied with the user interface and mentioned that it's possible to easily create, edit, and delete events in a table. But it also mentioned that there should be separate Event-management pages for each resident if we want to plan the weeks for other residents:

> "It's pretty simple. The site is user-friendly and I can quickly plan and edit activities. However, if we had several residents, we would need separate calendars to organize everything better. Each user should have their own profile"

The second question is about the impact of the developed AT on the workload of the caregivers in retirement homes. The caregiver said it could help because we can not always remind each resident about their relevant personal events and courses in the retirement home. Then, the caregiver gave an example of forgetting to remind the participant about her haircut appointment in her room and the appointment time when she was not in her room. But with the new AT she would be informed about her appointments before beginning and it would be helpful for her.

The third question was whether they had seen any changes in the participant's routines since she started using the AT. The caregiver answered that it's not easy to judge that. We did not remind her about the appointments; she visited independently in Bingo and Musik lessons. I think she is more independent and maybe much more active than before.

> "Unfortunately I can't say exactly answer that because I'm not at every day here but we did not remind her about her appointments. She decided on herself what she wants to do. I think she is now more independent but but not really more active"

The next question is about whether the new AT helps caregivers better organize activities that meet the needs of each resident. The caregiver found that the management page

helps the caregivers stay better informed about each resident's weekly plan and helps optimize the planning and monitoring of each resident.

The last question was about the impact of using this AT on the participant's cognitive abilities. The caregiver answered that she is unsure about improvement in cognitive abilities, but the resident is more informed about what is happening in the retirement home. She can independently decide on her event participation and have a better overview of her daily plan.

> "Yes, it has helped her to find a better daily structure, which has improved her quality of life. Whether her cognitive abilities will improve cannot be said so quickly, and the product needs to be used for longer."

At the end of the interview, the caregiver mentioned again profiling's ability to manage each resident's weekly plan separately.

Post-Release Interview with a family member

The family member is a man in his thirties with a technical degree. The first question he asked was about the effectiveness of the event management page. He mentioned he already used to define an event when he plans to visit the PWD. He even sent her a message via the event-display page that she should charge her phone:

> "I even sent her a message once to tell her to charge her phone or if she was due to receive a delivery on that day."

The answer shows that the family member uses the reminder AT for reminding PWD about her daily activities and even messages that do not inform her just about courses but remind her to do something important like charging the mobile phone.

The family member mentioned that he did not need any introduction to use the event management page for the first time, which shows the high degree of ease of use. He also said he used the reminder to send short messages to the PWD.

The family member reported a missing functionality differentiating between defining weekly or once-used events. The event-management page should be extended to this functionality:

> "I think there is a lack of a function to differentiate between appointments that are repeated weekly and those that are only one-off for this week."

Another comment was about the AT getting the attention of the PWD and going more informed throughout the day and deciding between suggested events. Through the event manager table, the family is more informed about the daily plan of the PWD. The family members can ask her by visiting about the courses and motivate her to be more active.

4.1.4 Results of final evaluation based on last interviews including all Stakeholders

Here are the key findings and impression of the developed AT on the participant with dementia after six weeks of usage:

- The calendar helps keep track of events that are relevant for the participant personally.

- The participant is generally satisfied with the AT but sometimes feels uncomfortable to get her daily program dictated.

- The participant has no problem using the device. She said it was easier than her mobile phone.

- She appreciated that the device does not need any setting changes for usage. The AT is intuitive and less complicated.

- The participant mentioned the AT is helpful because it reminds her to visit her favorite courses in the retirement home.

- The participant is not satisfied with getting a notification about activities she is not interested in. For example, she is not interested in walking but being reminded to go for a walk.

- The participant visited some social activities while the calendar suggested these events, but she still preferred spending time alone.

- The helped her to be more independent, which the calendar reminds her to visit the events without caregivers reminding the participant. The participant should not rely on others to remember her events.

Here are the key findings and impression of the developed AT from a caregiver who observed the PWD during the automatic calendar usage period and the caregiver feedback to the event management page:

- The caregiver can easily create, edit, delete, and undo changes in one table. That shows the ease of use and simplicity.

- The caregiver mentioned a separately manageable event page for different PWDs. The caregiver has proposed a profiling system. Each user should have their Profile.

- The caregiver noted reduced workload because they should not remind the participants about their events.

- The AT helped the participant be more independent in visiting and choosing relevant events for her.

- The caregiver could not observe a clear indication of increased physical activity level.

- The caregiver could not observe a clear indication of increased social activity level.

- Through the usage of the AT, the participant has a better daily structure and stays informed about ongoing events.

CHAPTER 5

Application Design and Functionality

This chapter will describe and focus on User Interface (UI), establishing a robust technological framework. After getting feedback from the low-fidelity prototypes 3.3.3 in the first interview and observations 4.1.1 in the Pre-Launch phase, the collected data is used to design a functional prototype for the participant. The functional prototype ensures the application's functionality. Based on the user's feedback, the participant will test it and refine it in a second iteration. Here are the requirements, interface design based on collected data on the first interview, and observations 4.1.1 in the Pre-Launch phase and refined after each iteration to stay actual. It means from the Pre-Launch to the Post-Release phase.

5.1 Application Requirements

Here are all the requirements, which include all functions of the AT. Some of these functions are deprecated and are noticed in the text, and they are removed or replaced based on users' needs.

- **Events and Quotes Display:**

  - **Display no events - quotes (deprecated):** A randomly selected motivational quote is displayed in the Pre-Launch Phase if no further events are planned for the current day. If, on the other hand, there are events scheduled, the next event of the day is displayed. This motivational text is accompanied by an image of topics or people that are familiar and meaningful to the participant to increase engagement and provide a personalized experience. After

the Pre-Launch Phase, the quotes display is removed, and it's decided that the screen goes black if there are no more events in the next two hours and automatically goes on if an event starts in less than one hour and fifty-nine minutes.

– **Regular quote change (Deleted after Pre-Launch phase):** The quote should change every 10 minutes if the quote mode is active. The quote page is active if there are no more events available for today and the time is between start-time and end-time

- **Events Navigation:**

  – **Navigation through events and quotes (loop):** There is a navigation loop for events and quotes you can navigate through by tapping or clicking, regardless of whether the event is more than two hours in the future.

  – **Restrictions in the loop between events and quotes:** It should not be possible to switch from quote mode to event mode if no more events are scheduled for the day. A new random quote should continue to be displayed in quote mode.

- **Event Display and Behaviors:**

  – **Text animation in the last minutes of an event:** If there are 0 minutes left to an event, the text should flash at the last minute, alternately getting bigger and smaller to attract attention.

  – **Automatic change after event end:** When an event is due and over, it should automatically switch to the next closest event from today. If there are no more events for today, the display goes black.

- **Design for Older People - Colors and Contrasts:**

  – **Color change with 10-30 minutes remaining until the event:** When between 10 and 30 minutes remain until the next event, the background of the TimeLine element line should be **yellow** to ensure good contrast for older people. The text should appear in black.

  – **Color change with 0-10 minutes remaining until the event:** When between 0 and 10 minutes remain until the next event, the background of the TimeLine element line should be **red** to provide good contrast for older people with black text. Figure 5.1 is an example of the design displaying for the nearest event.

  – **Standard color change when more than 30 minutes remain:** If more than 30 minutes remain until the next event, the background of the TimeLine element line should be **green**. This shade of green should also be easy to read for older people with black lettering.

- **Layout Optimization for a 7-Inch Screen:**

- **Optimization of text and images for a 7-inch screen:** The text and images on the `events.html` page should be designed to be optimized for a 7-inch screen. Everything should be easy to read and visually pleasing for older people.

- **Dynamic resizing in quote mode:** The size of images in quote mode should automatically adjust to the size of the window to ensure that they are displayed clearly.

- **Display remaining minutes:** Based on the interview results, the participant prefers displaying the remaining minutes until the next event if it's shorter than one hour to the next event. It will be displayed in hours and minutes format if it's more than one hour until the next event.

- **Screen Management and Automatic Controls:**

  - **Black screen outside operating hours:** The screen should go black between the specified `endTime` and `startTime`. As soon as the `startTime` is reached, the screen should be switched on again automatically.

  - **Black screen when no more events available for the day:** The screen should go black if no more events are available for the actual day.

  - **Black screen when no more events available in the next two hours:** The screen should go black if no events are available in the next two hours. There is an event in 1 hour and 59 minutes, and the screen goes on automatically.

- **Additional Functions for Events:**

  - **Icon next to event name:** An icon should be displayed next to the event name to provide additional visual cues.

  - **Sound effect on color change:** Each time the TimeLine element line changes color, a cat sound should be played to add an extra audible notification.

- **Interactive Controls and Sequence:**

  - **Automatic switching between events and quotes (deprecated):** The events and quotes should change automatically. When an event is over, the next event should be displayed after one minute. If there are no further events for the day, the system should switch to quote mode. As soon as another event is due, it should be displayed automatically.

  - **Manual navigation remains independent of the automatic change:** Manual navigation through events remains possible without interrupting the automatic change of events and quotes. This can be triggered by tapping or clicking to explore the day's events.

- **Events Management Page for caregivers and family members:**

– **Define a type of activity:** In this form, users can define activities such as yoga, jogging, puzzles, etc. The activity definition needs a name and a black-and-white symbol for the activity. The list of symbols is predefined and can be chosen from a folder. The name should be short and up to two words to prevent confusion for the PWD.

– **Define a new schedule (deprecated):** The product's first version had an extra form for defining a new schedule. The user could choose a day of the week, start time, room, and type of activity. Based on the user's feedback, this part of the event management page has been removed. Users can now define and edit schedules directly in the weekly event plan table.

– **Weekly schedule table:** Users can see the weekly plan of the PWD in this table. This table has five columns: day, start time, activity, room, and actions. Users can sort the table based on each column. Each row in the activity can be edited or removed. At the bottom of the table are two buttons for undoing the last changes and inserting a new event.

5.1.1 Interface Design based on Pre-Launch user preferences

The first design and prototypes are based on interviews and observations. The design decisions can be changed based on the user's needs in the next iterations.

Low-Fidelity Prototypes based on Pre-Launch phase:

For the design of this research project, the following are some chosen design elements based on the related Work in Section 2.2 **large text** to ensure that elderly people can see and use them easily. The user interface will be **simplified** to minimize the confusion. **simplified language** to improve the understanding. **Engaging elements** to ensure that they see the prompts, for example, trying to have gamification and activity reminders. To prevent the need **Battery management by the participant**, there will be no built-in battery, and the device will always receive power via a cable. For the **Ease of maintenance** for caregivers and family to update, the content of the devices is remotely accessible.

Despite research in Section 2.2, this research chose a **touch display** based on the observations and interview results. Because the buttons on devices like Discman confused her, the participant could go through the next events by touching the display like a loop. The device does not let the participant do something otherwise, moving to the next event, which is feedback to confirm the action was recognized. It's also not possible to close the application by touching the display. The application is always in fullscreen mode.

The observations showed that the participant Forgot the next appointments and could not memorize them. This is why to show **just one nearest appointment** before starting.

For the **iconography** during the interview, the participant chose a wireframe that had a symbol for each event. In the UI, the product will display a symbol for each event at the beginning of the text. For example, a painting event is a symbol of a brush, as in figure 5.1, which makes the interface more intuitive.

Figure 5.1: An example of displaying an event 10 minutes before start.

A **cat sound** will be played 5 times 30 minutes before the start of the event and again 10 minutes before the start of the event. The cat sound was chosen based on the participant's answers to the interview. Here is the source of the cat sound The participant can hear very well, and to draw the participant's attention to the display, the device will trigger a **sound of her favorite animal**. Based on the interview, the participant's favorite animal is a cat 15 and is played for 4 seconds 20 minutes before the events start.

If there are no appointments today, the display shows pictures of granddaughter or cats in combination with a motivating sentence like figure 5.2 for the participant to motivate them to do something or feel better. At night after 21:00, the **display will go black** to not disturb the user's light during sleep. This feature is removed after the first UCD iteration based on the user's feedback in section 4.1.
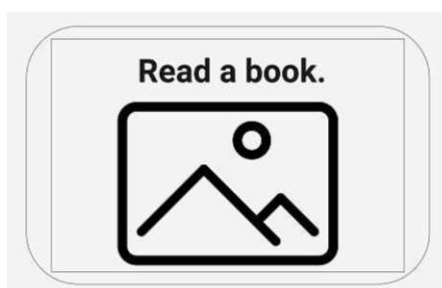
Figure 5.2: An example of the screen when there is no event in the next 2 hours.

For the Typography, the **size of the text** will be between 130 and 145 points so that it can be easily read from a distance of 2 meters. For easy reading, the chosen font is **Arial**.

Developing the first version of the AT based on users need:

At the end of the first loop, the product has two pages, one for displaying events and one for event management. The event display page is developed based on the collected data from PWD, and the event management page is designed by the researcher and will be refined based on the caregiver's feedback in the next iteration.

The first version of the event display page is in figure 5.3 to see. The icon is on the top of the event's name, and the text is in different colors. The size of the text is not maximized, and it can be much bigger.

The first version of the event management page consists of three parts, as in figure 5.4. From left to right, the first one defines the type of activity. In the middle, defining a schedule for the week and the right image are planned events of the week.

Figure 5.3: First version on the event display page for the PWD

Figure 5.4: First version on the event management page for the caregivers and family members

5.1.2 Refinements in the Post-Launch iteration

In the pre-launch phase, there were weekly changes in the event plan, and it was not easy for the researcher to drive each change in the event display page to the nursing home and update the event planning for the week. For this reason, an event management page has been set up so that caregivers or family members can change the events displayed remotely or locally. In this section, the defined designs and changes for the event management page and event display page are updated during the iterations.

Event Display page: All the functions are like the last section, but the changes are as follows. For the event display Page, the text size will be automatically maximized to the screen size to improve accessibility. The event image is displayed at the top of the event, and the title is on the left side of the display. The colors are slightly changed to refine the contrast for better readability. The comparison in figure 5.5 between the two images makes it easier to see the changes.

Event Management page: The event management page is designed in the pre-launch phase without including the caregivers and family members in the design. These
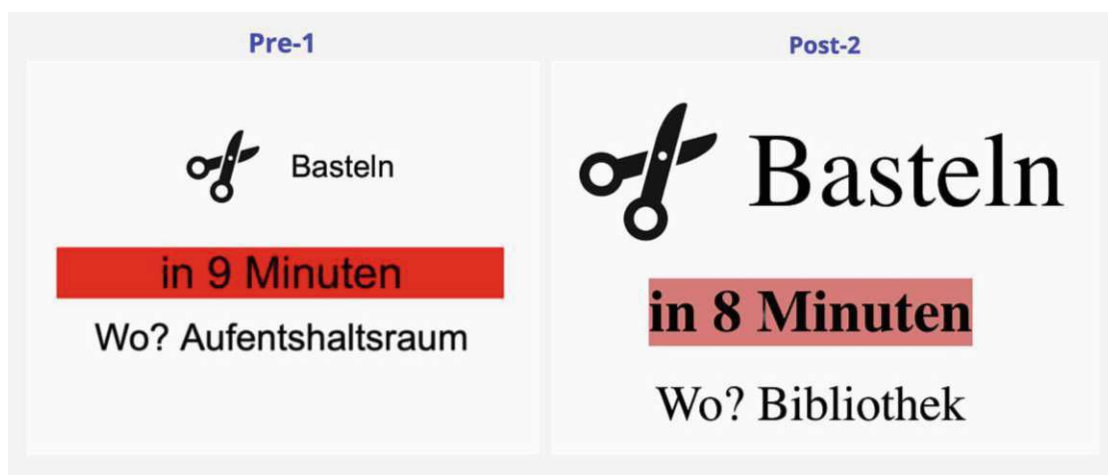
Figure 5.5: An example of the difference between the event display page in the Pre-Launch (Pre-1) and Post-Launch phase (Post-2)

stakeholders are included in the second post-launch phase to give feedback on the event management page designed by the researcher during the pre-launch phase. Here are the changed user interface elements based on feedback from these stakeholders.

The table german titles have been refined for better user understanding:

- From "Neue Aktivität hinzufügen" to "Aktivität erstellen"

- From "Neuen Zeitplan hinzufügen" to "Zeitplan erstellen"

- From "Geplante Events der Woche" to "Wöchentliche Events"

Based on the interview results, the first form, the Create activity form, is not changing. In the second form, "Create event", the start-time input field is centerised and fits the text value that the character length is fixed to five lengths. Figure 5.6 displays the difference between the creating event form in pre-launch and post-launch. After the post-launch, whether to add an extra form to add a new event or include this functionality in the weekly event table as the image Post-2 in figure 5.7.

The weekly events table will be sortable based on a caregiver's feedback. The content of the table is editable. Delete and edit actions can be can be reversed. Users can directly insert an event into the table with a button. This functionality can be tested in the post-launch phase to decide whether to replace the "create event" table 5.6. In the figure 5.7, it is possible to see the difference between the "weekly event" table from pre-launch and post-launch. The new functions are edit, delete, undo, and add a new event by clicking the add new event button.

Figure 5.6: Difference between creating evening form in Pre-Launch (Pre-1) phase and Post-Launch (Post-2) phase

Figure 5.7: Difference between weekly event table in Pre-Launch (Pre-1) phase and Post-Launch (Post-2) phase

Here is an example of developed AT for the PWD in figure 5.8 at the end of the post-launch phase. The displayed event is beginning in just 11 minutes. Because of that, the time to event is displayed with a softly yellow background.

Figure 5.8: Displaying an event for PWD which begins in 11 minutes. The event display page at the end of the post-launch phase.

Refinements planned for the future works - After Post-Release:

After the last iteration, user feedback is collected and can be used for future works in developing the reminder AT for PWD. Caregiver mentioned if more than one PWD is going to use the reminder AT, there should be a profiling system to be able to manage each PWD separately. A family member mentioned it would be better to be able to differentiate between weekly and once-happening events like hairdresser appointments or family visits. This function can also help to send the PWD short messages like a charge phone to remind her to do something. The PWD did not mention any wishes in the user interface at the last iteration.

5.2 Technological Framework

This section contains an overview of the used technology stack in developing this AT.

Hardware components in figure 5.9:

- Raspberry Pi 3 Model B+: The chosen Raspberry Pi model has a 64-bit Quad Core processor, clocked at 1.4 GHz with 1 GB RAM (LPDDR2 SDRAM). The Raspberry Pi model has WLAN, Bluetooth, and 4 x USB 2.0 Ports.

- 16GB flash memory card used for storing information.

- 7" Touch display

- The Black Display frame is the same color as the display and looks borderless.

Figure 5.9: Hardware components

Here are the software components of the AT:

- Programming Languages: Python 3.11.6 for the Back-end logic, database handling, and server routes. HyperText Markup Language (HTML) to define the structure of the web pages. Cascading Style Sheets (CSS) defines the styling and layout of the web pages. JavaScript defines the Front-end interactions and updates the web content dynamically. SQLite. SQLite provides the database and uses Python for database operations.

- Frameworks and Libraries: Flask, which is a light web framework to build the Backend of the application. For the sound playback, the Pygame library is chosen.

- Operating System: The Application is in a macOS-developed program and used in Raspberry Pi OS (64-bit).

Development Environment:

- The used IDE is Pycharm to develop the application and execution of the project.

5.3 Implementation Process

The major part of the code follows the Procedural Programming structure and contains different functions that implement specific tasks. For example, the method gets today_events() sends all today events from the Backend to the Frontend or add_activity() that inserts a new type of activity to the database 5.3. The Part of HTML and CSS code is Declarative programming. The implementation begins first from the backed development, which starts with building a server and defining the relative path to make the application usage in other systems possible 5.3.

```python
1  from flask import Flask
2  app = Flask(__name__)
3  UPLOAD_FOLDER = 'static/uploads'
4  app.config['UPLOAD_FOLDER'] = UPLOAD_FOLDER
5  if __name__ == '__main__':
6      app.run(debug=True)
```

After defining the server, Application Programming Interfaces (APIs) is determined to send data in the form of JSON from the Backend to the Frontend and vice versa. An Example of the defined API is adding an activity to the database 5.3.

```python
1   @app.route('/add_activity', methods=['POST'])
2   def add_activity():
3       name = request.form['name']
4       file = request.files['image']
5       if file and allowed_file(file.filename):
6           filename = secure_filename(file.filename)
7           file.save(os.path.join(app.config['UPLOAD_FOLDER'], filename))
8           add_activity_to_db(name, filename)
9           flash('Aktivität erfolgreich hinzugefügt!')
10      else:
11          flash('Ungültiges Dateiformat. Bitte laden Sie ein Bild hoch.')
12      return redirect(url_for('index'))
```

Here is an example of adding activity API at frontend 5.3. The Application begins with database initialization at the beginning of the program, after the server has started. It checks if a database exists; if no database is already defined, a new database with an empty schedule table and an empty activities table will be added.

```html
1       <div class="form-wrapper">
2          <h2>Neue Aktivität hinzufügen</h2>
3          <form action="/add_activity" method="POST" enctype="
              multipart/form-data">
4          <div class="form-group">
5              <label for="name">Name der Aktivität:</label>
6              <input type="text" id="name" name="name" required>
7          </div>
8          <div class="form-group">
9              <label for="image">Bild hochladen:</label>
10             <input type="file" id="image" name="image" accept="
                  image/*" required>
11         </div>
12         <button type="submit">Hinzufügen</button>
13         </form>
14     </div>
```

To support the application's functionality, two tables are defined in the database: one for the type of activities and the second for the weeks' schedules. The Figure 5.10 is the UML diagram of the database.
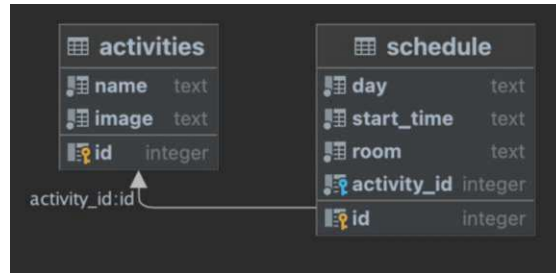

Figure 5.10: UML of the database, which contains activities and schedule tables.

In the Raspberry Pi, a script starts the program automatically at the start. This script 5.3 ensures that the program starts automatically at every restart, and the participant or caregiver does not have to worry about starting the program manually on each restart.

```
# Start the Python application
python3 ~/Desktop/devent/main.py &
# Wait for the Python server to start
sleep 10
# Launch Chromium in fullscreen (kiosk) mode and load the URL
/usr/bin/chromium-browser --kiosk --noerrdialogs --disable-restore-
    session-state --disable-infobars --disable-session-crashed-bubble
    --incognito http://127.0.0.1:5000/events
```

5.4 Description of the Application

This section will describe the declared application. The application will start automatically on each start in full-screen mode. The Application has two different pages. As mentioned, the quote display page is removed at the end of the pre-launch phase to keep the application interesting for the user and focus on the main function, suggesting personalized, interesting events for the participant. Here is the description of each page of the application:

1. Event management page. The caregivers or family members can access this page to change the plan of the day and week or define new activities.

2. Event Display page to show the actual events of the day defined in the event management page. The page displays the nearest event of the day, which begins in less than two hours. The display will stay black if there is no event in the next two hours.

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3. (Deprecated) Quote Display page will be activated if no more available events today are available. It was available in the Pre-Launch phase and removed in the Post-Launch UCD iterations.

5.4.1 Event management page

The event management page contains two different forms. The first forms make it possible to define new types of activities (Figure 5.11) based on user preferences, for example, jogging, physiotherapy, family visits, etc. The user should also add an icon to the defined activity, which will be displayed next to the event's name. The application provides various icons that can be selected from a default selected folder path.

Figure 5.11: Add a new activity type.

The second part of the event management page displays the participant's weekly events calendar in figure 5.12. This table has different options for the user, like Add a new event, edit, delete, undo, or sort, as in figure 5.12. The table contains five different columns. The first column is the day of the event. The second column shows when the event is starting. The third column is the activity type. The fourth column shows the room of the activity. The fifth column contains edit and delete functions for an event. Users can add a new event by clicking the add new event button at the bottom of the table. Users can undo the changes in the session with the undo button or add a new schedule button at the bottom of the table. The table is sortable based on each column.

5.4.2 Event Display page

This page shows the next nearest event of the day and changes the status based on minutes to the event as defined in section 5. Less than two hours before the event begins, the event will start displaying with a green background (image 1 in figure 5.3). Less than 30 Minutes before the event begins, the event will display with a yellow background (image 2 in figure 5.3). Less than 10 Minutes before the event begins, the event will

Figure 5.12: Events of the week with add a new event, edit, delete, undo, or sorting options

display with a red background (image 3 in figure 5.13). With each background color change, a cat's voice will play for three seconds to get the participant's attention. At the last minute, until the event starts, the minute's text blinks to get the participant's attention. Users can loop through the events of the day by tapping on the screen to see which events are available for today, after one minute it will back to the nearest event.

Figure 5.13: Display nearest event of the day.

Discussion

6.1 Linking Results to Existing Literature

At the beginning of this study, in section 2.2 are collected insights about the AT for PWD. This section connects, confirms, challenges, or extends the findings of this study with studies in section 2.2 and other actual related literature on this field of ATs for PWD. This research demonstrates that personalized ATs can help PWD to be more engaged in social and physical activities independently. The aging society brings socioeconomic challenges, and caregivers and families are burdened by too much work [64]. In section 4.1.4, this research shows that the developed automated event manager device reduces the workload of the caregivers so that they should not remember the PWD to visit the courses at the nursing home. They can update the weekly event table through the event management page, designed based on the caregiver's needs. The PWD are informed about the events created by the caregivers two hours before they begin and are repeatedly reminded of the upcoming event with different visual and auditory cues.

Based on the results of interviews in 4.1, the PWD mentioned that it's not satisfying to be notified about uninteresting events and feel uncomfortable. So, it shows the importance of adaptability and personalization in acceptance of the new technology as in the research from Etemad-Sajadi and Santos [24]. The end product of this study provided caregivers with the option to define and adapt the events based on user needs to increase acceptance of the reminder technology, and the visual and auditory cues are also personalized to the user's interests. Both stakeholders (the caregiver and the PWD) mentioned in 4.1 that the developed AT is much easier to use compared to other technologies like mobile phones as the PWD mentioned. A high degree of user-friendliness and intuitive design helped to maximize the usability of the AT among the older generation, as already mentioned in research by Harada et al. [32].

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In section 2.1, studies like a study from Parasuraman and Riley [67] and Lee-Cheong et al. [44] show that older adults are accepting and integrating new technologies not easily in their daily lives. The degree of acceptance can be significantly affected by different socio-demographic characteristics of elderly people, such as gender, age, educational background, digital literacy, and previous technological experience [44]. Research from 2.2 shows that older adults with lower levels of education and limited exposure to digital technologies tend to show lower acceptance of new devices, particularly when the functions appear unfamiliar or unnecessary in their daily routines [64, 24]. The PWD of this study was a 68-year-old woman without an academic degree and limited experience with digital technologies. During the observations and interviews 4.1, it became clear that the participant was not very interested in exploring and learning new technologies and devices. Also, the technologies she has used for years, such as her Discman, could be a struggle. The automated event manager is provided the option to loop between events by tapping on the screen. This was the only option that the PWD could change the state of the reminder AT. Despite more time explaining, this feature was never used by the participant 4.1. The participant's limited engagement with the interactive functions of the reminder AT suggests that unfamiliarity with the technology and a low desire to explore new digital tools may hinder the effective use of more adjustable features on the user side for a PWD. The AT should be based on a one-sided interaction from the AT to the user to prevent confusion and a higher chance of integration in the PWD daily life.

In section 2.1, the study Etemad-Sajadi and Santos [24] mentioned that the technologies should be adaptable to individual needs to get higher acceptance by the users. In this study, the caregivers or family members can define each participant's personal, relevant events. For example, personal events like hairdresser or physiotherapist appointments as mentioned in 5.4. That could also increase the user's interest in this developed technology.

A study from the year 2021 Nishiura et al. [57] that also developed an electronic calendar for PWD got negative comments from the users because of battery charging and the user challenge of creating schedules by users without dementia. However, in this study, the Acceptance and Trust of the developed reminder AT was less complicated because the caregivers and family members who defined the events were included in the designing process of the user interface, which has increased user-friendliness for defining the new schedules. The other factor in this research that provided a better user interface was displaying just one event at the moment to prevent user confusion. There is no need to recharge the reminder. The device started the program automatically at each start. There is no button to turn on or turn off the device. These refined features increased the acceptance and made integrating into the participants' daily lives easier.

In section 1.1, it is mentioned that mental stimulation like puzzles, chess, reading, or learning something new can improve brain function and mental health, and cognitive training can also slow dementia progression as in study Livingston et al. [47]. The result of this study in section 4.1 shows that encouraging PWD can increase the participation of PWD in cognitive and social activities. This study can not confirm that using this automated event manager can slow dementia progression because of the limited

observation period, which was about two months, and no medical experts in this study to confirm any changes medically. Both stakeholders could not observe relevant changes in PWD 's amount of participation in physical and social activities. The short observation period could be the reason for this. A longer observation time could give a better answer if significant user behavior changes exist. All stakeholders mentioned more independence and more structured daily life of the PWD because she was more informed about what happened at a nursing home and could decide about participating in these events by her own choice.

Ethical concerns and data privacy of this study are defined in 3.4 and 3.2.5, which aligns with the ethical principles of informed consent and user autonomy from Morsink [56]. Before the data was collected, the participant was informed with oral and textual information that detailed how their information would be handled (Appendix 7.5). To ensure informed consent, the participant, a caregiver, and a family member were fully informed about the purpose of the data collection and their rights to withdraw consent at any time. During the first interview in section 4.1 with the participant, the PWD was worried about whether the research evaluated her skills and marked her as incapable. The research ensured her that this study would encourage her to be more active and is not a medical evaluation. The participant's personal information was anonymized in all documentation and reports to reach the protected identity, per the ethical standards mentioned in section 3.4 and reference Hodge et al. [34]. The participant also has difficulty understanding some privacy terms, which shows that the privacy terms should be simplified, especially for PWD.

The developed AT, which is an "automated event manager," can be categorized as memory Aids or Daily activity support like a study Szabó et al. [79] from the year 2023. Both studies are essential in helping PWD to maintain their independence and increase their QOL. The result of the research in 4.1 shows that the reminder system helps the participant to manage and remember upcoming activities. The reminder AT notifies the participants visibly and audibly at different intervals. This supports the cognitive needs of PWD by reducing the burden of remembering events and helping the user independently engage in social and physical activities. In addition to memory assistance, it can increase the QOL of PWD because of more independent participation in physical and social activities at the nursing home as shown in the Results section (Section 4.1), the participants responded positively to the reminder features, which helped increase the independent participation of the PWD in group activities and remind the daily schedule effectively.

The process of this study is followed by UCD [36] principle in section 3.1.1. The UCD involved the continuous feedback from the participant and a caregiver. These iterations helped to refine and meet users' needs better. This study confirms previous findings that emphasize the value of user-centered and personalized design in increasing the acceptance and usability of assistive technologies for older adults. For example, research from Etemad-Sajadi and Santos [24] highlights that adaptable technologies are more easily integrated into user's lives. This adaptability is achieved in an "automated event

manager" by allowing caregivers or family members to define custom events in which the participant is interested. Furthermore, Muse-Based Design from Khaled [39] defined in section 3.1.1 showed that iterative user involvement in the development of the product could increase the higher engagement and satisfaction with the final product. Muse-based design helps to reach the personalized approach better and overcome the integrating challenges mentioned in studies from Parasuraman and Riley [67] and Nishiura et al. [57], which highlight the resistance older adults often show toward unfamiliar digital tools.

The practical implication of the work lies particularly in reducing caregiver burden through the automation of event suggestions for the PWD. The PWD are informed about upcoming relevant events without needing assistance from caregivers or other individuals. The caregivers should not suggest each person in the caring home visit the events or remember their events, which will reduce their workload. Theoretically, this study confirms that the personalized AT can increase independent engagement in cognitive and social activities, even for participants with limited technological familiarity, as the results show in section 4.1.

6.2 Discussion and Interpretation of Results

This section will outline briefly the summary of the findings. The main outcomes of the study based on the section 4.1 are increasing the independence of the PWD. The user is satisfied with using the AT because it's not complicated and does not need any configuration on the PWD side. It also reduced the caregiver's workload because they should not personally remind the PWD about their events. This study aligns with prior research in this area regarding AT for PWD like the study from Nishiura et al. [57] (2021), where simple designs were preferred by older adults. This study showed, like a study from Boada et al. [10] (2021), the AT can reduce the caregiver's workload. The other aspect that is proved by this research is the importance of the personalization of Events and design, like a study from Nishiura et al. [57] (2022) that emphasized the personalized AT. In this study, the user interface of the event display and event management page is designed based on the user's needs, but the participant mentioned that events should also be more personalized to meet the user's interests. For example, walking should not be offered to the PWD because it could make them feel pushed to do something they are not interested in.

The divergence of this study from the existing literature is due to these points. A study from Livingston et al. [47] (2020) showed that AT could increase the social engagement of the PWD. But the result of this reminder AT did not increase the social or physical engagements, and she still preferred to stay alone in her room. That shows the AT can make the cognitive support easier but maybe can not increase the engagement in every case. The study from Nishiura et al. [57] (2021) designed a reminder AT for the PWD in them they could define the events by themselves, but they do not involve the user in the design and development process. In this study, all stakeholders are involved in

several designs and refinements iterations by developing reminder AT. This increased the participant's ease of use and user acceptability. However, the caregiver should know the preferences of the PWD; otherwise, the user's satisfaction can be affected negatively. Users should not care about battery charging or starting the reminder AT like in the study from Nishiura et al. [57] (2021). It starts automatically when the power cable is connected. The Nishiura et al. [57] also did not mention anything about personalized activities, but in this research, the result shows the chosen activity should meet the interest of the PWD. This Study also uses different personalized cues to get the attention of PWD for the nearest event.

There were some challenges in the adoption that the PWD mentioned some discomfort about some suggested activities, and there is no significant change in the quantity of engagement of the PWD in social and physical activities. But the PWD got more independent and visited her favorite events without others reminding her to visit these events.

The limitations of this study are maybe the short observation Period, which was about two months, and the medical expert who measures the cognitive status of the PWD before and after this study to prove if there is a change between these two results. For future studies in this field, it could be helpful to increase observation time and create a profiling system for multiple PWDs and test it on more users.

<div align="right">

CHAPTER 7

</div>

Conclusion

7.1 Summary of Results

This section summarizes the key findings of this study's three AT iterations (Pre-Launch, Post-Launch, and Post-Release). The results focus on the impact of the developed AT on the participant's daily routine, independence, and caregiver and family member's workload.

At the beginning of the study, the PWD shows minimal social interaction with other inhabitants in the retirement home and participates in some events like Bingo, Music, or Puzzles just when someone reminds her about these events. One or two times a week, just only when reminded by caregivers. The PWD has a twice-weekly physiotherapist appointment, but she was not prepared for the appointment and was surprised. That shows she is forgetting her appointments and cannot remember them independently. The PWD shows independence toward navigating the nursing home.

During the observation sessions, the participant demonstrated low interest in new technologies and struggled to use devices they were already familiar with, such as Discman or mobile phones. The participant was unfamiliar with the different technologies and was anxious about being labeled incapable because of them. She has been reassured that this research just wants to help her be more active in social and physical events.

The pre-launch phase focuses more on user needs and designs the product based on them. The participant was asked about her design preferences. Initially, she chose a button-based interface to navigate the daily events, but later, she leaned toward an interface without any buttons. That may refer to her being afraid to use new products and unfamiliar with digital products.

After the initial observations and interview in the Pre-Launch phase, an AT is designed and implemented to remind the PWD of her daily appointments. Then, the post-launch

phase is started by installing the developed device in the room of the PWD at the nursing home, where she can look at the display best. Then, the PWD tested the device for about two weeks before getting feedback. The maintenance of the events was troublesome because for each change in the weekly plan, the researcher had to change the plan locally in the database at the nursing home, and the calendar was not updated. This was inefficient, so the researcher designed an event management page so the caregivers could update the weekly plan of the PWD easily in a web-based application remotely. This designed event management page is tested by a caregiver for at least two weeks before getting feedback about the usage. The feedback phase of the post-launch phase from the PWD and caregiver was more focused on the feedback about the designed product, the ease of use, impact on daily activities, workload, and areas for improvement. The feedback shows that the PWD feels more independent because the caregivers are not reminding her of the events, and she is visiting her favorite events independently. The PWD reported some usability issues, which were refined after the feedback. as follows. The PWD requested larger text and higher contrast for better readability from a distance. This shows that the participant was interested in the displayed event. The PWD mentioned discomfort with the reminder when she gets suggestions for activities she is not enjoying. She feels dictated by her daily schedule. That shows the caregiver and family member should ask the PWD about their interests before defining the weekly plans for the first time. The participant did not use the tapping function to iterate between the next events of the day. She forgot about the usage even though she was informed about it by caregivers, family members, and the researcher. This indicates a lack of understanding or interest in the only interactive feature of the AT. A Quotes page was also defined for the days without any events to display motivational quotes and personalized images. The PWD appreciated the images, but for her, were, the quotes boring. This feature distracted the participant from the true purpose of the assistive technology, which is to remind them of upcoming events. Based on this feedback, the quotes pages have been removed from the electronic calendar. The PWD expressed an increase in her independence because she visited the events without external reminders. However, she had not visited many more courses before the electronic calendar and mentioned visiting courses once or twice weekly.

In the post-launch phase, a caregiver gave feedback to the event management page and the PWD behavior after using the AT. The caregiver found the event management page helpful because of the ability to adjust the events remotely without visiting the participant's room. The caregiver suggests enhancing the title of tables and expanding the management to add, remove, edit, delete, and undo the changes all in one table as in figure 5.12. The caregiver did not notice any significant changes in PWD's behavior and mentioned that it requires a longer observation period to judge that.

After refining the product based on the stakeholders' feedback, the product in the last post-release phase was provided for the stakeholders and then tested for about six weeks by the PWD and a caregiver. Here is the final feedback, which aims to determine the impact of the AT on the participant's daily life, social engagement, and physical activity

of the PWD and the caregiver's workload.

The PWD in the last post-release mentioned that the device is easier than her mobile phone to use, and she is satisfied with the product because she should not configure anything. The device turns on automatically when the power cable is connected, and nobody has to start anything. The simplicity of the interface was a positive aspect of the AT. However, the participant mentioned that she is not always following the calendar suggestions and prefers not to get informed about activities that are not enjoyable for her. So the caregivers are informed after this to get periodic feedback from PWD in which activities they are interested in defining the activities based on PWD interests. This could avoid the PWD feeling pushed to do something they are not interested in. The PWD is more independent in visiting the events at a nursing home and is not surprised about, for example, medical appointments or Hairdressing appointments in her room. She gets a better overview and a more structured daily program. Based on the feedback of the caregiver and the PWD, she visited one or two events weekly, which shows the frequency of visiting events is not getting much more than before using the AT. The result shows that the frequency has not changed, but the caregiver's workload is now less because they should not remind the PWD about the appointments, and the PWD is more independent because she visits the interesting events for her without others reminding.

The caregiver gave positive feedback on the ease of use of the event management page and mentioned that the page is intuitive and simple for creating an event. However, extending the product to manage events for multiple residents separately should also be considered, like a profiling system. The caregiver also mentioned a reduced workload because they should not remind the PWD about their event. This automated system is more reliable because sometimes the caregiver forgets to remind the residents about their appointments.

In conclusion, the designed and developed event manager AT proved effective in supporting participants' independence and reducing caregivers' workload with more reliable results in reminding the PWD about their upcoming events. The final product provides a more structured daily routine for the participant. Still, there were limited changes in the frequency and type of events that the PWD visited weekly before and after using the developed AT. The participant's future development iteration of this product should focus on expanding the technology to manage the weekly of multiple residents, for example, by designing a profiling system. The other improvement is offering just events to PWD that are relevant and interesting for them to prevent the feeling of getting pushed to do something.

7.2 Answering the Research Questions

- What are the short-term effects of using personalized reminder AT on the daily routines of a dementia patient in residential care settings?

The three UCD iterations result that the designed product for a PWD should have minimal interaction and complexity, and fully personalized events should be suggested. Here are the key design features of the developed AT. The participant was overwhelmed and forgot to use the loop between events option by tapping on the screen. That shows the design should be a **Button-less interface** with **minimal physical interaction options** between the device and the PWD, which means the device should be a passive reminder that does not need any input from PWD. Feedback from the user highlighter the need for **bigger font size** with more **high contrasting colors** to get the attention of the PWD and better readability.

The participant preferred the simple **minimalistic design** and **using symbols** that can be interpreted without the need to read the text. **Symbolic Cues** can provide a simple and clear visual interpretation. To get the attention of the user, the product used different cues. Providing **Textual Cues** with displaying clear, readable short text. Using **Colors** to signify the urgency and remaining time to event. To the time of the event, the timing information will start to **Blinking**. The other type of used cues is the **auditory cues**. Each color changing in the display is combined with a preferred **familiar sounds** as an auditory cue. The last defined cue is a **temporal cue** to give the user information about the time left before an event begins. This combination of different cues helps to get the attention of the user.

The design should prevent the display of too much data. Just one nearest event should be displayed at the moment. The PWD appreciated the design because there is **no need for technical knowledge** to use the device and mentioned, especially compared to her mobile phone, that it's easier to use the automation event calendar.

The main positive impact of this reminder AT is increasing the **independence** of the PWD. The participant is not relying anymore on caregivers or neighbors to remind her of the next nearest activities of the participant. She visits her favorite activities like bingo and music without relying on another person, which she would otherwise have forgotten. The developed reminder AT provides a more **structured daily plan** for the PWD. The person is not surprised by, for example, her medical appointments and is always informed about what will happen.

There was **a limited change in the physical activities** of the participants. The reminder suggested different physical activities during the day to the participant. The participant's feedback to these suggestions was mostly negative, and she felt pushed to do something she was not interested in. The participant preferred to get information only about the interesting events for her. The reminder also suggested daily social activities to help the participant get more social, but these recommendations did not change the frequency of visiting the social events, and the participant still **preferred being in her room alone**.

The main positive result of the developed reminder AT is structuring the participant's day and improving her QOL by increasing independence and feeling more

control of her schedule. However, it does not significantly change her cognitive abilities and frequency of visiting social and physical events. The participant also shows disinterest in some suggested activities that are not interesting for her, and this reduced the satisfaction level by using the AT.

The feedback from the post-launch and post-release phases indicated the participant had a better overview of her daily schedule, and the caregivers had a lower workload in reminding the participant about her events and suggesting that she visit available courses at the nursing home. The QOL is improved overall because the PWD is more informed about what will happen in her day, for example, important events like physiotherapy, and can choose between coming events. The reminder **improved the routine and structure** of the day. The other improvement, as already mentioned, is **independence in decision-Making**. The PWD can choose between suggested events. However, the PWD mentioned that she preferred to get information about relevant interesting events. There are no observable changes in the participant's cognitive abilities, and she is not more physically or socially active. Also, further adaption would be needed to significantly boost physical activity and social interaction and improve cognitive operation.

- What benefits do caregivers, and family members experience with using personalized reminder AT?

  The personalized reminder AT developed as part of this study aims to structure the daily routine of people with dementia and promote users' independence. The Automated reminder technology affects the daily life of the PWD, caregivers, and family members. Caregiver reporting reduces workload because they can now update event schedules remotely. There is no need for unreliable in-person updates, which can be easily forgotten. This allows them to focus on other important tasks. The caregiver reported that PWD is now more independent in attending events and more informed about what happened in the caring home, which reduces the pressure to monitor the daily routines of the PWD. The better-planned daily structure reduces confusion for the PWD and gives a better feeling that the caregiver is working more effectively and reliably. For example, the PWD is not surprised anymore if the caregivers forgot to remind her about the physiotherapy appointment.

  The family members mentioned it's satisfactory for them to see what possibilities are available in the nursing home for PWD and how much possibility the PWD got to be more active in their daily lives. It's not anymore, so they have no idea about the weekly plans of PWD at the nursing home. The family member also used reminder technology to send a short message, such as charging her phone and noticing upcoming visits from the family members. The family member can also edit and reduce the activities to the activities that the PWD are more interested in because family members know the PWD and their interests better than caregivers.

  The caregiver and family members appreciate the simplicity and user-friendliness of the reminder AT, which helped the PWD to manage the daily routines.

7.3   Outlook on Future Research

Literature shows that cognitive training can help slow the progression of dementia, as revealed in section 2.2. This research focused on one PWD to get cognitively more active by reminding her to participate in different events at nursing homes. The participants visited the courses more independently after this study, but the frequency of visits to the events did not increase significantly. This study's PWDs showed little interest in events that did not personally appeal to her but were important for her cognitive and personal training to be more active. It could be interesting to find out in future work how other PWDs respond to personalized events that can help them be more socially, cognitively, and physically active.

Another possible future research direction could include some gamification elements in the developed reminder system. For example, users can collect points for visiting different events and spend them on various rewards. This type of system could be tested to find out if such a rewarding system motivates people with mild dementia to get them more active.

Future research could also focus on the long-term effects of using this automatic reminder system on different PWDs. It could be interesting to see if there are any significant changes in the social, cognitive, and physical situation of people with mild dementia. The focus of this research should be on more than one person to be able to compare the results. The reminder system should be expanded to provide a profiling system. This system should define personalized events for different PWDs.

In summary, the future of the ATs in dementia is important because, as this study proves, it can have some impact on PWDs behavior. It can also reduce the workload of caregivers depending on the type of the ATs. Enhancing personalization is important to meet the needs of each user and make the ATs interesting for the stakeholders. Future research can refine this tool to have a profiling system for different users to suggest events based on the needs of each user. It could also include gamification to test if this can help increase participation in different events and evaluate the long-term impact of these products on individuals with mild dementia in residential care settings.

7.4   Limitations

This section summarizes the primary limitations faced during the research. Defining these limitations can help understand the findings and inform future studies about these limitations. One of the study's limitations was a **single participant**. This single participating method is chosen to define and make the application based on the needs of a person with mild dementia. The design is so personalized that it can also be helpful for other PWDs, and the events can be changed based on each user's needs. Future research can include more users to prove the applicability and impact of this developed

technology. The next limitation of this study was challenges with **technology Aversion and learning limitations** of the participant. She did not use even one time the only physical interactive feature on the ATs, which was tapping on the screen to loop between the next events of the day. It could be interesting to find alternative ways to overcome this technology aversion. The developed reminding system successfully reminds the participant, and the participant is visiting her favorite events independently, where she used to be reminded by a third person before developing this ATs. But there is **no significant change in the frequency of visiting different courses**. Maybe motivational cues like gamified elements or rewarding systems can help to make the participant more active.

In summary, while the research makes significant contributions, these limitations highlight the need for further studies involving larger participant groups, longer evaluation periods, and additional interaction methods to ensure that AT for dementia care can be broadly effective and adaptable to diverse user needs.

7.5 Summary of Scientific Contributions

In this section, the key scientific contributions of this research are summarised. This section will also highlight the new insights revealed based on the findings of this study. One of the main contributions of this study was designing a user-centered AT for a PWD that was refined in several iterations. The stakeholders of this study were the participant, caregiver, and a family member. The resulting product is tailored to the specific need of the PWD, which **prioritizes simplicity, accessibility, and intuitive interaction**. The research aims to find how this electronic reminder affects the behavior of PWD in different social, physical, and cognitive aspects. The result shows that the user visited the courses **more independently** compared to before but sometimes felt that getting the courses dictated. Also, if the reminder reminded her about events the participant was interested in, there was no chance to motivate her to do something new. Future studies can integrate gamification and a rewarding system to see if it can change the opinion of the PWD about visiting new events and not feeling pushed. This study also revealed that just by reminding the activities PWD could not be persuaded to participate in new activities that she otherwise would not have joined much more before using the neu reminding AT. This result revealed the future AT for PWD should **find a balance to meet emotional comfort by usage**, which increases the acceptance. The study provides an event management page for the caregiver and family member to remotely add, edit, or delete events for the participant. Based on a caregiver and family member's feedback. This reduced their workload so that they would not remind the participant manually about the participant's event. This shows that the AT for PWD can **reduce caregivers workload**. A combination of different cues can **get the attention of the PWD** for example, Symbolic, Textual, Colors, sounds, and temporal cues. The participant is always informed about the next event and can decide whether to visit it.

In summary, this research makes several significant scientific contributions, advancing the understanding of how AT can be designed, implemented, and evaluated to support people with mild dementia, the nursing staff, and family members. By addressing all stakeholder's needs and providing practical design insights, this study sets a foundation for future advancements in AT that can improve the quality of life for individuals with dementia while easing the burden on caregivers in residential care environments.

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Acronyms

AAL Ambient Assisted Living. 5, 6

AD Alzheimer's Disease. 1

API Application Programming Interface. 66

AT Assistive Technology. 1–10, 13, 15–18, 21, 23–29, 32, 33, 35–39, 44–53, 55, 60, 63–65, 71–75, 77–85

CSS Cascading Style Sheets. 65

GPS Global Positioning System. 8, 9

HCI Human-Computer Interaction. 19

HRI Human-Robot Interaction. 37

HTML HyperText Markup Language. 65

MCI mild cognitive impairment. 1, 9

PWD Person With Dementia. 1–3, 5–13, 15, 16, 18, 20–25, 27, 28, 32–34, 36–38, 45–48, 50–52, 58, 60, 61, 63, 64, 71–75, 77–83, 85, 87

QOL Quality Of Life. 2, 3, 13, 35, 73, 80, 81

SAR Socially Assistive Robotics. 36, 37, 85

UCD User-Centered Design. 4, 16–18, 21, 25, 46, 60, 68, 73, 80, 85

UI User Interface. 55, 59

UNICEF United Nations International Children´s Emergency Fund. 1

UX User Experience. 19

WHO World Health Organization. 1, 8, 36, 87

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Overview of Generative AI Tools Used

1. **Google Translate**

   - Usage: Was used to translate more complex ideas from the native language into the thesis language
   - Place of use: Whole thesis

2. **Grammarly Pro Version**

   - Usage: Was used for grammar and spell-checking
   - Place of use: Whole thesis

3. **ChatGPT**

   - Usage: was used to reformulate some sentences to improve readability
   - Place of use: Whole thesis

Consent Form

Einverständniserklärung zur Teilnahme an der Studie

Titel des Projekts

Förderung der Aktivität von Menschen mit Demenz durch eine unterstützende Technologie: Ein umfassender Ansatz von der Konzeption bis zur Systementwicklung

Projektleiter

Nasim Rezaei

Einrichtung

TU Wien - Visual Computing and Human-Centered Technology

Kontaktinformationen

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Einführung

Sie sind eingeladen, an einer von Nasim Rezaei durchgeführten Forschungsstudie teilzunehmen. Bevor Sie sich für eine Teilnahme entscheiden, sollten Sie die folgenden Informationen sorgfältig lesen. In dieser Einverständniserklärung werden der Zweck der Studie, die Verpflichtungen sowie die mit Ihrer Teilnahme verbundenen möglichen Risiken und Vorteile erläutert.

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Zweck der Studie

Diese Studie zielt darauf ab, die Aufgabenbewältigung und Errinerungen in der stationären Pflege von Menschen mit Demenz zu verbessern, indem ein errinerung unterstützendes Technologiesystem entwickelt und bewertet wird. Mit dieser Forschung soll ein System geschaffen werden, dass die Lebensqualität von Demenzkranken verbessert, damit sie an den im Altenheim angebotenen ofter und selbständiger Aktivitäten teilnehmen können. Ihre Teilnahme wird wesentliche Erkenntnisse über die Entwicklung und Wirksamkeit dieser unterstützenden Technologien liefern und letztendlich zu einer unterstützenden und bessere Pflegeumgebung für personen mit demenz beitragen.

Verfahren

Der Ansatz sieht folgendermaßen aus: Zunächst wird ein Design für das unterstützenden technischen Systems entwickelt. Die Betroffenen, darunter auch Demenzpatienten, werden in den Entwurfsprozess einbezogen, um sicherzustellen, dass das System ihren Bedürfnissen entspricht. Anschließend werden Qualitätssicherungssitzungen durchgeführt, um Feedback einzuholen und notwendige Anpassungen am Design vorzunehmen. Anschließend wird das System entsprechend dem endgültigen Entwurf entwickelt. Nach der Entwicklung wird das System an Demenzpatienten in einer realen Umgebung getestet. Nach der Implementierung werden Qualitätssicherungssitzungen durchgeführt, um Rückmeldungen über die Leistung und die Benutzerfreundlichkeit des Systems zu sammeln. Schließlich wird das System auf der Grundlage des Feedbacks von Nutzern und Interessengruppen verbessert. Dieses Verfahren wird in drei iterationen durchgeführt um ein verbesserte Ergebniss zu kriegen.

Risiken und Unannehmlichkeiten

Diese Studie birgt minimale Risiken für die Teilnehmer. Einige Teilnehmer könnten Unbehagen oder Schwierigkeiten bei der Nutzung des neuen technischen Systems haben. Es wird jegliche Unannehmlichkeiten während der Nutzung vermieden. Es werden während der gesamten Studie eine umfassende Schulung und Unterstützung angeboten. Darüber hinaus wird das System benutzerfreundlich gestaltet sein, um eine einfache Handhabung zu gewährleisten. Alle erhobenen Daten werden anonymisiert, um die Privatsphäre der Teilnehmer zu schützen. Wenn sich ein Teilnehmer unwohl fühlt, kann er ohne Konsequenzen aus der Studie aussteigen.

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Vorteile

Die Teilnahme an dieser Studie bringt vorteile. Zum Beispiel sie werden automatisch an Ihre Termin errinnert. Ihre Teilnahme kann Menschen mit Demenz helfen, ein besseres Leben zu führen, indem Sie sie ofter und selbständiger in verschiedene Aktivitäten teilnehemen, was das Ziel dieser Studie ist.

Vertraulichkeit

Alle bereitgestellten Informationen werden streng vertraulich behandelt. Ihre Daten werden anonymisiert und ausschließlich für Forschungszwecke verwendet. Die Daten sind nur für einen anderen Forscher der Universität zugänglich. Die gesammelten Daten werden anonymisiert, um sicherzustellen, dass Ihre Identität nicht mit den Daten in Verbindung gebracht werden kann. Ihre Identität wird in keinem veröffentlichten Bericht oder Dokument bekannt gegeben.

Freiwilligkeit

Die Teilnahme an dieser Studie ist freiwillig. Sie können jederzeit ohne Angabe von Gründen von der Studie zurücktreten. Ihnen entstehen keine Nachteile, wenn Sie sich gegen eine Teilnahme entscheiden oder Ihre Teilnahme zurückziehen.

Zustimmung

Mit Ihrer Unterschrift auf diesem Formular bestätigen Sie, dass Sie die Informationen gelesen und verstanden haben und freiwillig in die Teilnahme an dieser Studie einwilligen. Eine Kopie dieser Einverständniserklärung wird für Ihre Unterlagen zur Verfügung gestellt.

Teilnehmer

Name: _____

Unterschrift: _____

Datum: _____

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Researcher

Name: [Your Name]

Unterschrift: _____

Datum: _____

Transcriptions

Pre-Implementation Initial Interview

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 1  Interviewer: Welche Aktivitäten machen Ihnen am meisten Spaß?
 2  Participant: Am liebsten spiele ich Puzzles und zeichne manchmal.
 3
 4  Interviewer: Kommunizieren Sie mit anderen Menschen im Pflegeheim?
        Wie oft?
 5  Participant: Ja, mit meiner Nachbarin. Vielleicht dreimal am Tag und
        so.
 6
 7  Interviewer: Mit wem haben Sie regelmäßig Kontakt? Familie, Freunde,
        Betreuer?
 8  Participant: Ja, mit meinem Sohn, meiner Tochter und den Betreuern
        hier vielleicht kommen auch alte vewante mich besuchen.
 9
10  Interviewer: Wie oft nehmen Sie an sozialen Aktivitäten oder
        Gruppenveranstaltungen teil?
11  Participant: Einmal bis zweimal die Woche gehe ich hin. Zum Beispiel
        Bingo oder Musikkurse wie ich will.
12
13  Interviewer: Welche Art von Unterstützung erhalten Sie von anderen,
        wie zum Beispiel von Ihrem Sohn?
14  Participant: Mein Sohn kümmert sich um einige Dinge bei mir, aber ich
         kann viel selbst machen.
15
16  Interviewer: Benutzen Sie derzeit Hilfsmittel oder Technologien?
17  Participant: Nein, nur meinen Rollator sonst nix. Ohne Rollator kann
        ich nicht mehr so gut gehen.
18
19  Interviewer: Wie effektiv finden Sie Technologien wie das Handy?
20  Participant: Ich bin nicht gut mit Technik oder sowas. Ich frage oft
        jemanden, wie es funktioniert wenn ich es nicht kann.
21
22  Interviewer: Können Sie Touchscreens gut benutzen?
23  Participant: Was ist ein Touchscreen pauh? Ich benutze Knöpfe auf
        meinem Handy da kenne ich mich aus.
24
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25  Interviewer: Wie würden Sie Ihre körperliche Gesundheit beschreiben?
26  Participant: Früher konnte ich viel besser gehen, aber heute sind
        meine Beine schwächer und brauche immer meine Rollator.
27
28  Interviewer: Wie würden Sie Ihre kognitive Funktion und Stimmung im
        Allgemeinen beschreiben?
29  Participant: Ich versuche immer, positiv zu sein. Kognitiv komme ich
        im Heim gut zurecht und habe alle gut gemacht.
30
31  Interviewer: Haben Sie Bedenken hinsichtlich der Nutzung neuer
        Technologien?
32  Participant: Ich verstehe nicht viel von Technologie, aber den
        Fernseher kann ich benutzen.
33
34  Interviewer: Ich werde Ihnen jetzt einige Bilder zeigen. Sagen Sie
        mir, welches Ihnen am besten gefällt.
35  Participant: Mir gefallen die bunten Bilder besser. Bild drei finde
        ich am besten, weil es groß und gut erkennbar ist.
36
37  Interviewer: Welche Symbole finden Sie besser? Die, die die Zeit bis
        zum nächsten Event anzeigen oder die Uhrzeit?
38  Participant: Mir gefällt es besser, wenn die Zeit in Minuten
        angezeigt wird.
39
40  Interviewer: Wie finden Sie die Position der Knöpfe? Lieber unten
        oder an der Seite?
41  Participant: Unten gefällt mir besser.
42
43  Interviewer: Was würden Sie in der Zeit sehen, wenn es keine Events
        gibt? Katzenfotos oder Bilder Ihrer Familie?
44  Participant: Katzenfotos finde ich gut. Aber Fotos von meiner Familie
        wären auch schön.
45
46  Interviewer: Möchten Sie Vorschläge bekommen, was Sie tun könnten,
        wenn es keine Events gibt?
47  Participant: Ja, das wäre gut.
48
49  Interviewer: Wie finden Sie die Anzeige von Uhrzeit und Wetter?
50  Participant: Das ist gut, aber ich möchte es auf Deutsch sehen.
51
52  Interviewer: Was sind Ihre ersten Eindrücke von dieser Technologie?
53  Participant: Es klingt kompliziert. Muss ich etwas machen?
54
55  Interviewer: Nein, Sie werden nur benachrichtigt, wenn es etwas Neues
        gibt.
56  Participant: Okay, solange ich nichts kaputtmachen kann. Es ist nicht
        gut wenn es was kaputt wird.
57
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58  Interviewer: Wie einfach finden Sie es, den Text auf dem Bildschirm
        zu lesen?
59  Participant: Das konnte ich gut lesen. Die Größe war in Ordnung.
60
61  Interviewer: Welche Farben gefallen Ihnen am besten?
62  Participant: Die Farben im Prototypen gefallen mir gut.
63
64  Interviewer: Haben Sie Schwierigkeiten, Tasten auf dem Bildschirm zu
        drücken?
65  Participant: Ja, es ist nicht ganz leicht für mich. Mein Sohn hat es
        mir schon erklärt, aber ich habe es nicht gleich verstanden und
        vergessen.
66
67  Interviewer: Gibt es bestimmte Geräusche oder Musik, die Sie
        beruhigend finden?
68  Participant: Ja, Leonard Cohen mag ich sehr.
69
70  Interviewer: Zu welcher Tageszeit fühlen Sie sich am wohlsten?
71  Participant: Am Vormittag fühle ich mich am besten mache nicht viel
        am Tag.
72
73  Interviewer: Wäre es hilfreich, wenn die Anwendung Erinnerungen oder
        Benachrichtigungen senden würde?
74  Participant: Ja, vielleicht. Aber keine lauten Weckergeräusche oder
        Katzen die sind meine lieblingstiere.
75
76  Interviewer: Gibt es bestimmte Aufgaben oder Aktivitäten, bei denen
        Ihnen die Anwendung helfen könnte?
77  Participant: Ja, vielleicht könnte sie mich daran erinnern wie es war,
         etwas Sport zu machen.
78
79  Interviewer: Vielen Dank für Ihre Zeit!
80  Participant: Bitte, gerne.
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Pre-Lauch Interview (Person with Dementia)

```
1  Interviewer: Hallo, guten Tag.
2  Participant: Guten Tag.
3
4  Interviewer: Danke, dass Sie sich die Zeit nehmen. Wie gut hat Ihnen
       das Produkt geholfen, aktiver zu werden? Sind Sie aktiver geworden
       ?
5  Participant: Ja, es hat mich schon manchmal daran erinnert, dass ich
       vielleicht mehr machen sollte aber ich habe oft kein Lust auf was
       zu machen.
6
7  Interviewer: Und wie oft haben Sie an den Aktivitäten teilgenommen?
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 8 │Participant: Na, nicht ganz jeden Tag. Vielleicht einmal. ich
   │    vetgesse of was ich gemacht habe.
 9 │
10 │Interviewer: Einmal in der Woche?
11 │Participant: Ja, oder vielleicht zweimal aber ich mag mehr sachen
   │    machen das wurde mir gut gefallen.
12 │
13 │Interviewer: Und wie war das früher? Haben Sie früher auch einmal die
   │    Woche teilgenommen?
14 │Participant: Ja, manchmal, wenn mich die Nachbarin abgeholt hat. Aber
   │    jetzt war es mehr. Ja, es war schon mehr ohne das sie da war habe
   │    ich sachen gemacht.
15 │
16 │Interviewer: Gab es Funktionen, die Sie weniger hilfreich fanden oder
   │    die Sie nicht genutzt haben wie tippen auf dem Bildschirm?
17 │Participant: Zum Beispiel das Tippen auf dem Bildschirm, um das nä
   │    chste Ereignis zu sehen, kenne ich nicht was du gesagt hast. Das
   │    habe ich nicht verwendet. ich mag es nicht anfassen.
18 │
19 │Interviewer: Hatten Sie technische Schwierigkeiten bei der Nutzung
   │    des Produkts?
20 │Participant: Nein, ich bin zwar nicht so technisch begabt, aber es
   │    hat gut funktioniert weil ich da nichts einstellen oder ändern
   │    musste. Das hat mir gefallen.
21 │
22 │Interviewer: Wie leicht war es für Sie, das Produkt in Ihren
   │    Tagesablauf zu integrieren?
23 │Participant: Es war nicht schwer. Ich konnte es gut sehen und
   │    benutzen. Die gräuche und farben haben mir gut gefallen.
24 │
25 │Interviewer: Es gab manchmal Motivationsbilder, wenn keine Events
   │    angezeigt wurden. Wie hat Ihnen das gefallen?
26 │Participant: Die Bilder von meiner Enkelin haben mir sehr gut
   │    gefallen. Aber die Sprüche fand ich nicht so toll. Es war manchmal
   │    zu viel auf dem Bildschirm und ich möchte das nicht immer ansehen.
   │    Das lenkt auch ab wenn wichtige Termine gibt es dannach.
27 │
28 │Interviewer: Wie fanden Sie die Benachrichtigungsfunktion, z.B. das
   │    Blinken in grün, rot und gelb?
29 │Participant: Das fand ich sehr hilfreich, besonders die Farben, weil
   │    man gleich sieht, wie viel Zeit man noch hat. Die Katzen haben mir
   │    auch gefallen. Ich liebe Katzen. Aber vielleicht waren es ein
   │    bisschen zu viele Geräusche für einen Termin.
30 │
31 │Interviewer: Haben Sie Vorschläge, wie man das Produkt verbessern kö
   │    nnte?
32 │Participantin: Hm... vielleicht die Schrift... größer? Ja, größer wä
   │    re gut. Und. dann die Farben... manchmal sehe ich sie nicht so gut.
   │    Besonders... wenn der Bildschirm weiter weg ist da auf dem Tisch
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33 | is besser zu sehen.

34 | Interviewer: Haben Sie Veränderungen in Ihren körperlichen Aktivitä
    ten oder im sozialen Verhalten bemerkt, seit Sie das Produkt
    nutzen?

35 | Participantin: Ja... ich glaube schon. Ich habe... öfter bei Aktivitä
    ten mitgemacht niemand hat mich daran errinert nur diese Fernseher.
    Einmal oder zweimal... bin ich auch alleine hingegangen.

36 |

37 | Interviewer: Zum Beispiel zu Ihren Physiotherapiestunden?

38 | Participantin: Ja... ja, die habe ich gesehen. Ich wusste gleich dass
    ich einen Termin habe. sonst habe ich oft vergessen. Und dann...
    hab ich mich darauf vorbereitet... ja.

POST-Lauch Interview (Caregiver)

1 | 12.09.2024

2 |

3 | Interviewer: Wie empfinden Sie die aktuellen Verwaltungstools zur
    Planung von Aktivitäten und zur Betreuung der Bewohner?

4 | Teilnehmer: Die Verwaltungstools sind im Großen und Ganzen hilfreich
    sehr hilfreich für unsere Arbeit, vor allem wenn es darum geht,
    den Überblick über die täglichen Aktivitäten und die Bedürfnisse
    der Bewohner zu behalten und richtig behandeln. Die Daten können ü
    ber PC geändert werden ohne dass man ins welchen Zimmer hingehen
    muss. Das kann bei jeden Mitarbeiter der den Link hat aufgerufen
    und angepasst werden oder neue Sachen dazu machen. Es wäre aber
    dann gut wenn für mehrere diese Patientinnen sind vershiedene ein
    Profil und login system für jeder person gibt damit man besser den
    überblick hat und nicht verwechselt wm was gehört.

5 |

6 | Interviewer: Gibt es Bereiche, die für Sie besonders hilfreich oder
    schwierig sind?

7 | Teilnehmer: Es war alles intuitive für mich nach dem sie es mir alles
    gezeigt haben und was es klar. Ich wünsche mir aber bessere ü
    berschriften für die Tabellen die sind etwas lang und nicht gut
    gemacht. Die sind etwas verwirrend finde ich und mag ich nicht.

8 |

9 | Interviewer: Haben Sie Veränderungen bei den Bewohnern bemerkt, seit
    assistive Technologien eingeführt wurden?

10 | Teilnehmer: dirket nicht ehrlich gesagt nichts. ich habe nicht
    aufgepasst ob eine änderung wie sich der Benutzer ändert und im
    verhaltens muster etwas andres ist. ich finde es interssant das
    ich es ohne hingehen mussen sie infomieren was als nächstes im
    haus passiert was für sie intressant sein könnte.

11 |

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12  Interviewer: Welche Verbesserungen würden Sie sich in den
        Verwaltungssystemen wünschen, um Ihre Arbeit zu erleichtern?
13  Teilnehmer: Ich wünsche mir dass es möglich ist alles in der tabelle
        in management page zu bearbeiten oder rückgängig mache. Ich finde
        sortierung nach collumn könnte ist für uns sehr hilfreich. Die
        Startzeit in zeit hinzufügen tabelle könnte zentriert und andere
        sachen auch sein und fit to content nicht so lang ist.
14
15  Interviewer: Gibt es Funktionen, die fehlen oder besser umgesetzt
        werden könnten?
16  Teilnehmer: Wie ich schon gesagt habe user profil haben ist so und
        die überschrifften verbessern alles.
17
18  Interviewer: Hat sich Ihrer Meinung nach das Wohlbefinden der
        Bewohner durch die Nutzung der Technologie verbessert?
19  Teilnehmer: Damit ich über das beurteilen sollte das Produkt länger
        verwendet werden und kann nicht so schnell sagen. Ich kann noch
        nicht beurteilen ob es sich was geändert hat aber es war auf jeden
         fall positiv.
20
21  Interviewer: Wie reagieren die Bewohner mit Demenz auf die neuen
        technischen Hilfsmittel?
22  Teilnehmer: Ich glaub es gefällt dem Bewohner gut. sie muss nicht stä
        dnfig an verschiedene sachen errinert werden dafür haben wir nie
        Zeit. Sie hat es auf dem Tisch wo sie sich die meiste Zeit
        befindet. Es kann von ihr nicht übersehen werden.
23
24  Interviewer: Vielen Dank für Ihre Zeit.
25  Teilnehmer: Sehr gern es war sehr intressant für uns alle im heim.
```

POST-Release Interview (Person with Dementia)

```
1  11.10.2024
2
3  Interviewer: Was halten Sie von der Verwendung des elektronischen
       Kalenders?
4  Participant: Ja, ich finde den Kalender.ganz gut gefäll mit. Manchmal
        ist es seltsam, wenn er mir sagt, was ich tun soll, ich mach
       nicht immer was es mir vorgeschlagen wird wie ich will. Aber.ja er
        hilft mir. Ich vergesse sonst oft Dinge zum Beispiel
       Friseurtermin oder Physiotherapeut auf jeden fall. ja, das ist gut.
        Das hilft mir immer wissen was im Altersheim los ist nicht wie fü
       hrer.
5
6  Interviewer: War es einfach oder schwierig, den elektronischen
       Kalender zu benutzen?
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7   Participant: Hm, es war... nicht schwierig. Ich musste nicht viel
        machen, das war gut das ich nicht kaputt machen kann. Ich.
        vergesse oft, wie man Dinge macht, aber... das war einfacher als
        mein Handy. Mein Handy ist manchmal schwierig es macht mir
        probleme mit so viele knopfe, aber der Kalender. war einfacher
        dass ich nichts ändern musste dann wird auch nicht kapputt.

8

9   Interviewer: Hat der elektronische Kalender Ihnen geholfen, aktiver
        zu werden und mehr Zeit mit anderen zu verbringen?

10 Participant: Ja. vielleicht Letzte Woche bin ich. Bingo spielen
        gegangen das micht mir spass, das hätte ich allein vergessen.
        Niemand anderer hat mich auch daran erinnert ich war alleine. Aber
         manchmal möchte ich nicht immer machen, was er vorschlägt. Ich
        mag aber immer noch lieber alleine sein die andreren kenne ich
        nicht.

11

12 Interviewer: Hat es Ihnen geholfen, aktiver zu sein und sich mehr zu
        bewegen?

13 Participant: Manchmal.. erinnert er mich daran spazieren zu gehen
        wenn es schoner wetter ist mache ich es. Aber ich mag das nicht so
         gerne spazieren gehen. mit stocke bin ich so langsam. Wenn ich
        nicht will, dann mache ich das nicht auch. Es hilft mir aber
        besser durch den Tag gehen und nicht überrascht werde durch den
        Besuch von anderen Leute.

14

15 Interviewer: Wie oft nehmen Sie an sozialen Aktivitäten und
        Gruppenveranstaltungen teil?

16 Participant: Hm vielleicht einmal in der Woche, manchmal auch zweimal
         aber nicht mehr glaube ich. Bingo mache ich oder Musik hören.
        Aber meistens bleibe ich lieber in meinem Zimmer da bin ich gemü
        tlich. Ja ich mag mein Zimmer lieber als garten. Letzte Zeit habe
        ich immer selber entschieden ob ich hingehe oder nicht keine kann
        mich zwingen.

17

18 Interviewer: Fühlen Sie sich dadurch mehr mit anderen Menschen
        verbunden?

19 Participant: Ein bisschen ja er erinnert mich an Bingo und andere
        Kurse das gefällt mir. Aber. ich spreche nicht viel mit anderen
        die muss ich erst kennen lernen. Nur wenn.es sein muss. Ja mag
        nicht sehr mit anderen in Altersheim reden die sind alle so alt
        und oft komisch.

20

21 Interviewer: Glauben Sie, dass es Ihr Gedächtnis oder Ihre Denkfä
        higkeit verbessert hat?

22 Participant: Ich weiß nicht. Ich glaube es hilft mir, mich zu
        erinnern. Dinge, die ich. vergessen hätte wieder zu machen. Aber
        ob mein Gedächtnis besser ist? Ich weiß es nicht nein. Ich bin
        aber mehr vorbereitet auf den Tag.

23

24 | Interviewer: Hat sich Ihr Alltag durch den Einsatz der Software
     verbessert? Inwiefern?
25 | Participant: Ja ein bisschen. Es ist gut, dass.ich nicht immer daran
     denken muss. Der Kalender erinnert mich an gute sachen. Sonst mü
     sste ich immer fragen oder mich auf anderen verlasse und sie
     machen es nicht. Jetzt.kann ich ein bisschen mehr alleine machen
     und entscheiden. Ich bin unabhängiger.
26 |
27 | Interviewer: Gibt es etwas, das Sie ändern würden, um die Technologie
     für Sie besser zu machen?
28 | Participant: Nein ich glaube, es ist gut so. Es ist nicht zu viel.
     Das ist gut ja, das ist gut ja aja.

POST-Release Interview (Caregiver)

1 | 15.10.2024
2 |
3 | Interviewer: Wie einfach oder schwierig ist es für Sie, die Event-
     Management-Seite zu nutzen, um Aktivitäten für eine Bewohnerin zu
     planen?
4 | Caregiver: Es ist ziemlich einfach alles zu benutzen. Die Seite ist
     benutzerfreundlich, und ich kann schnell Aktivitäten planen und
     bearbeiten ohne probleme sehr schnell wie ich will. Wenn wir
     jedoch mehrere Bewohnerinnen hätten, bräuchten wir separate
     Kalender für jeder eine o ist besser, um alles besser zu
     organisieren gettrent. Jeder Benutzer sollte eigene Profil haben
     um management zu erleichtern.
5 |
6 | Interviewer: Sind die Erinnerungen und Aktivitätsvorschläge für eine
     Bewohnerin klar und leicht zu verwalten?
7 | Caregiver: Ja, die Erinnerungen sind klar und leicht zu verwalten. Es
     war sehr schnell fertig mit events machen. Für eine Bewohnerin
     funktioniert das gut sie scheint glücklich sein. Bei mehreren
     Bewohnerinnen wäre es jedoch hilfreich die Termine zu haben, die
     Erinnerungen pro person trennen und verwalten wird es leichter
     gemachr.
8 |
9 | Interviewer: War es für sie weniger arbeit, dass sie die Frau xxx
     nicht an ihrer termine zu errinern mussten?
10 | Caregiver: Ja, es war einfacher und ich finde es immer schade, dass
     die bewohner nicht immer errinert werden können über angebote,
     dass es im altersheim gibt. Wir haben nicht immer Zeit sie daran
     zu errinerrn. Letztes Mal war die Frisurin wie wir einem Termin
     gemacht haben im Zimmer aber die Frau xxx war nicht in Ihrem
     Zimmer und hat Ihr Termin verpasst weil sie vergessen gehabt hat.
     Jetzt kann sie rechtszeitig an Ihrer Termin errinert werden und

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kann sie selber entscheiden obvds sie da teilnehmen will oder nicht.

11

12 Interviewer: Haben Sie Veränderungen in der Teilnahme der Bewohnerin an Aktivitäten bemerkt, seit Sie die Event-Management-Seite verwenden?

13 Caregiver: Ja, ich kann leider nicht genau so sagen weil ich nicht jeden Tsg bin aber wir müssen sie nicht ständig daran erinner. Wir können machen was andres. können um , aber es ist auch nicht so, dass sie überall teilnimmt. Sie entscheidet selbst, was ihr mehr spaß macht.

14

15 Interviewer: Hilft das System Ihnen, Aktivitäten besser zu organisieren, die den Bedürfnissen einer Bewohnerin entsprechen?

16 Caregiver: Ja, es hilft, die Aktivitäten besser auf sie abzustimmen dafür müüsen wir sie besser kennen.. In der Zukunft wäre es jedoch wichtig die Planung für mehrere Bewohnerinnen zu optimieren woe es besser ist, um ihre individuellen Bedürfnisse abzudecke. Die Plannung Seite gefällt mir sehr gut jetzt ist viel übersichtlicher muss nicht viel herumklicken um einen Termin zu machen.

17

18 Interviewer: Haben Sie Verbesserungen bei der körperlichen oder sozialen Aktivität der Bewohnerin seit der Nutzung der Event-Erinnerungen bemerkt?

19 Caregiver: Nein ich glaub nicht, dass sie sozialer oder viel aktiver geworden ist wie immer. Sie ist aber über jeden Termin informiert und darf selber aussuchen was Sie machen will und zum Beispiel verpasst den Friseur besuch in dem Zimmer nicht weil sie schon zwei Stunden davor informiert ist wird nicht wegehen.

20

21 Interviewer: Glauben Sie, dass die Nutzung dieses Systems einen positiven Effekt auf die kognitiven Fähigkeiten oder die Lebensqualität der Bewohnerin hatte?

22 Caregiver: Ja, es hat ihr geholfen der tages ablauf zu vervessern, eine bessere Tagesstruktur zu finden, was ihre Lebensqualität verbessert hat neulich. Ob sich ihre kognitiven Fähigkeiten verbessern, kann ich nicht so schnell beurteilens und muss das Produkt länger von benuzer verwendet werden.

23

24 Interviewer: Welche Vorschläge haben Sie, um die Event-Management-Seite für Pflegekräfte oder Familienmitglieder zu verbessern, insbesondere wenn Sie mehrere Bewohnerinnen betreuen?

25 Caregiver: Ich denke, es wäre gut, wie ich schon gesagt haben für jede Bewohnerin einen eigenen Kalender und ein eigenes Profil zu haben für besseres verwanlten.