Transitioning from Conventional Emergency Devices to Interaction and Voice Assistance: A Case Study on Co-Creating an AI-Based Care Assistance and Multimodal Interaction System for Outpatient Care

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In addition to the health risks posed by advancing age, the elderly population faces additional challenges in global events such as the COVID-19 pandemic, affecting both themselves and their caregivers. This case study addresses the co-creation process for an AI-based care assistant—a hybrid multimodal interaction system—to assist in low-contact on-site care scenarios. The system will consist of three separate units: an AI-supported sensor system that combines the automatic analysis of optical (3D) and acoustic sensor data for activity and situation analysis in the home environment, a control unit (business logic) and a multi-modal interaction system with enhanced video, voice, and freehand gesture interaction. The interaction system uses the information from the sensor system to support care recipients autonomously (e.g. through motivational interaction) or in combination with caregivers in everyday activities. Bringing together different perspectives of stakeholders in both the research team and care providers together as early as possible, a variety of qualitative research methods has been and will be utilized (e.g. semi-standardized interviews, participatory observations, contextual interviews and co-creation workshops). Workshop topics include an activation model for care recipients, interface design and appropriate caregiving scenarios illustrating opportunities to support outpatient care. To date, several interviews and workshops with participants from the professional and informal outpatient care setting have been conducted, discussing predesigned use cases and scenarios, potential benefits and challenges for the outlined care support system and possible approaches for interaction between the system and participants in outpatient care.

Additional Key Words and Phrases: Co-Creation, Co-Design, Artificial Intelligence, multimodal Interaction

1 INTRODUCTION AND INITIAL SITUATION

Older people are often dependent on support in their daily lives, both informally (e.g. by relatives or volunteers) and formally (trained caregivers), due to the increasing fragility and associated comorbidity in old age [1]. Contrary to a steadily aging society, however, a decline in the number of employees in the care sector can also be observed at the same time, due to factors such as wage structures or the working conditions in the various care sectors [2]. If, in an already tense sector such as nursing, global events on a scale as the COVID19 pandemic then almost completely eliminate personal contact, the care process, and thus the health of everyone involved in it, is severely jeopardized. Versatile technological approaches are aiming to address this challenge (e.g. social or

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telepresence robots and related systems [3–5]). With its hybrid multi-modal interaction system, the KARE digital care assistant aims to support reduced-contact on-site health care and enable interpersonal interaction conducive to maintaining health, even in times where only a certain amount of personal contact is possible.

2 ENVISAGED SOLUTION

KARE, an acronym for the German phrasing of its full title - AI-supported assistance for hybrid interaction for home care - pursues a user-centered, participatory design and research approach for a hybrid interaction system and a home-care concept based on it. The combination of technology and human care is intended to support reduced-contact healthcare in the field, where appropriate, while still allowing for interpersonal interaction. KARE focuses on the needs of people with limited daily living skills who are cared for at home and have no or only minor physical impairments. The planned system consists of three subcomponents.

Fig. 1. Prototype 3D-Rendering of the envisioned interactive system: A very mechanical appearing social robot based on a robotic arm (compact 6-axis robotic arm) and a tablet computer. Depending on the desired mode, it can show two abstract stylized eyes (that can turn into different shapes and represent an abstraction of various facial expressions or emotions), as well as display video messages, live video streams or other relevant information.

2.1 Perception

As an AI-supported sensor system it combines the automatic analysis of optical (3D) and acoustic sensor data for activity and situation analysis in the home environment to enable an assessment of the social situation (awareness), such as whether everyday activities were performed independently, even without physical presence. From this, possible support needs (e.g. forgotten health care measures) as well as occasions for social interaction (e.g. reduced activity) are identified. This information is made available to family caregivers and helpers in the support network and also assists in organizing care during normal times.

2.2 Interaction

The envisaged AI-based care assistant aims to provide a seamless and intuitive natural user interface (NUI) and user experience (UX) for both care recipients and caregivers, with smart autonomous interactions, advanced video communication, and voice interactions for effective communication and (tele-)support. We approach

these challenges by the development of a NUI using simple social robotics with a robotic arm and a tablet computer (see Fig. 1). Leveraging information from AI-supported sensors, the main feature is providing care recipients with reminders and motivational instructions, empowering them to find solutions to non-critical situations independently. Reminders can cover medication intake, appointments and everyday tasks, and adjusts to individual requirements through voice instructions or visual cues - either subtly using calm technology [6] or explicitly. Personalized motivational instructions, such as videos of relatives or positive reinforcements like animations or music, are designed to inspire healthy behavior. In critical situations, the system switches to telecommunication or instantly calls emergency services. For non-critical situations without physical presence, telepresence capabilities foster social interaction and reduce isolation, enabling caregivers to provide support remotely.

2.3 System

The proposed software solution employs a distributed system architecture, integrating various components. Perceptive systems supply situational awareness information, connecting to a rule-based business logic via API. The logic processes data, controls UI, sends emergency messages, starts video calls, and triggers robot behavior. The distributed system allows flexibility to adapt to future requirements.

3 CO-CREATING MEANINGFUL INTERACTIONS

Building on insights gathered in interviews with the intended target group during the needs assessment, an initial workshop with stakeholders from the formal care setting was planned. The main goals of the workshop were on the one hand to get to know the activities and interactions involved in different situations of the setting living with service. On the other hand, the focus was also set on the purpose of these activities and interactions, and what goals and motives are pursued with them.

3.1 Workshop on Interactions in Assisted Living Facilities

In assisted living interactions between care staff and care recipients are of crucial importance. They play a decisive role in providing quality care and support. In order to develop a user-centered supportive hybrid interaction system, it is essential to understand the interactions that take place on site and how they work, as well as desirable but missing interactions. The primary objectives of the workshop were as follows:

- Explore the activities involving interactions in various situations in assisted living facilities.
- Identify the purposes and motivations behind each activity/interaction.

After an introduction to methodologies such as Activity Theory, HCI fundamentals, human-to-human communication and interaction, and non-verbal communication, two activity blocks (activities, interactions) were addressed with participants from facility management, social services, nursing management, and caregiving using various creative techniques (note and vote, mind maps, role-playing, empathy maps etc., see Fig. 2).

- Activity Block 1: Noting Activities and Interactions - In the first activity block, participants, in pairs, brainstormed activities and interactions that occur during on-site visits to care recipients. They also noted the goal of each activity/interaction. Subsequently, sticky notes were used to mark the most relevant notes, which were then placed on a pinboard and discussed to organize them by relevance and context. Finally, collective mind mapping summarized the key points.
- Activity Block 2: Role-playing Scenarios - In the second activity block, five scenarios were extracted from the 15 highest-voted topics. Groups of four participants, including a KARE team member, were formed. In role-playing, two participants acted out each of the presented situations and then switched roles for the next situation. The two participants who were not part of the role-playing made notes on the respective

Fig. 2. Impressions during the interaction workshop: a) Activities map with "Voting Points" classified by frequency and concern; b) Human interaction for "getting to know each other" in a relaxed workshop atmosphere; c) Clustered results of brainstorming; d) Sticky note on a window.

situations using "Empathy Maps." In the internal group discourse after each of the five role-plays, possible difficulties and improvements in the interaction were discussed.

3.2 Early Results and Insights So Far

The workshop provided insights into the relevant work processes. Thus, results can be useful for the development of a hybrid interaction system. A list of scenarios, activities and interactions in assisted living that take place when visiting a person in need of care on site, their goals, values and motives, as well as their impact on the quality of care is one of the important outcomes of the workshop. The activities were mainly related to the areas of dealing with potential emergency situations (e.g. rapid response or situation assessment) and social interaction between participants in the care process (e.g. general exchange or sharing of information). Further workshops and explorations are planned to gain a more detailed understanding of the role of non-verbal communication and human-to-human interaction in providing care and support of persons in need of care in living with service and to be able to include relevant factors in the development of the AI system.

Prior to the workshop, the research team decided to use role-playing or enactment methods as one of the central elements. Enactements are used, especially in specific forms such as techno-mimesis [7], to sharpen the understanding of and reflection by specific audiences on pre-defined situations and facts. Here, the focus was on consciously experiencing and examining one's own understanding of relevant care situations, which were to be re-enacted by the participants in small groups. The situations were discussed directly afterwards within the small group and documented by two participants in an observer role with the help of slightly modified empathy maps [8]. Although the group of participants in the first workshop comprised a very heterogeneous composition from different hierarchical levels of the care sector, a discussion on a level playing field very quickly emerged. This allowed to give both the participating technical partners of the project team and the participants from the care sector space for dissemination of their expertise as well as for questions into the opposing subject areas. The theories and methods envisioned for the workshop were largely well received, despite initial skepticism from some participants. Reflecting the workshop, some aspects emerged that we consider challenging. One aspect concerns differences in the degree of abstration. While both the technological vision and the needs expressed

from the field (e.g. lack of time and resources) are expressed in a comparatively abtract way, the co-creation for the interaction design must be negotiated at the level of specific activities and practices which may seem rather insignificant. Additionally, when discussing current practices, there is a risk of neglecting opportunities for change. Another aspect is related to the matching between technical feasibility and practical needs or added value to care practice. While this a common issue in user-centered design, a specific challenge arises from the AI parts of the system and their dependency on the availability of training data. Developers struggle to assess ethical implications, bias risks, feasibility and efforts associated with data collection. Bridging these gaps will be one of the central challenges in the further co-creation process.

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