

Understanding User Needs, Persona Scenarios for Privacy-Preserving Visual System Development

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Abstract. As the world's population ages, the demand for active and assisted living technologies that can support older adults maintain their independence, health, and quality of life is increasing. Video monitoring cameras can provide a sense of safety and peace of mind for both older adults and their caregivers. However, these visual sensing systems come with major privacy concerns. Researchers have developed various visual privacy preservation filters that can be used for video-based monitoring technology, such as blurring, pixelation, silhouette, or avatar. To understand the user's needs and fine-tune the system to their preferences, the persona scenario method was employed in this study. The goal-directed approach to persona design was followed. This scenario-based technique involves creating fictitious persona archetypes that represent the unique characteristics, needs, and goals of the target user group and other stakeholders involved in the process of care provision. A set of eight personas were created based on the qualitative data collected through interviews and focus groups in Spain. Data from 62 participants were analyzed, which represented different contributor groups such as older adults, direct caregivers, healthcare experts, and other stakeholders. The final personas are accessible to the public on a Blueprint persona repository.

Keywords. Persona method, Active and Assisted Living, video-based technology, visual sensing systems, privacy, older adults, user-centered design, user needs.

1. Introduction

The world's population is aging, and this demographic shift is creating a growing demand for active and assisted living (AAL) technologies that can support older adults maintain their independence, health, and quality of life [1]. One such technology is video monitoring cameras, which can provide a sense of safety and peace of mind for both older adults and their caregivers [2]. However, privacy concerns are a significant barrier to the widespread adoption of video monitoring cameras in the context of AAL [3,4].

To address this matter, our research group has developed various visual privacy preservation filters which can be used for video-based monitoring technology [5]. The

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privacy-protective visualization models include blurring, pixelation, silhouette, skeleton, or avatar. Our team is working on refining a video-based AAL technology prototype that addresses privacy concerns by using the above-mentioned privacy filters that can be adjusted according to the user's preferences. At the first stage of this process, in order to better understand the user needs and fine-tune the system to their preferences we decided to employ a persona scenario approach, which then is followed by the prototype probing in a living lab setting. The use of persona scenarios is an increasing trend in the tech field aimed toward designing socially impactful products or systems [6]. The main goal of persona design is to understand the needs, preferences, and behaviors of the target audience and use this information to develop better products or services.

From several approaches to persona design we chose the goal-directed approach, originally offered by Cooper [7] and further refined in human-computer interaction settings [8,9]. It involves creating fictitious persona archetypes that represent the characteristics, needs, and goals of the target user group which makes the technology creator understand the user. The goal-directed persona creation method is a scenario-based approach to design, at the heart of which lies an archetype that is not portrayed as an average individual, but rather as a persona with unique characteristics [10]. Even if personas are user models that have fictional elements, they are based on studies of real or possible users. This approach has emerged with the aim of preventing the development of products that are influenced by stereotypes or biased models that exist in the minds of project teams. Such biased approaches can result in solutions that do not align with the actual needs of users, ultimately leading to a failure [11]. This approach can help the development of a technology that is tailored to the needs of the users and takes into account their specific preferences and concerns [10] and hence specifically fitted our goal of developing video-based AAL technology prototype suited to user needs.

The aim of this article is to present the use of the goal-directed persona scenario approach as a way to understand user needs in the process of developing a video-based monitoring system for older adults' care purposes.

2. Methods

Designing personas is a complex task that demands a profound comprehension of the intended audience. We were guided by the goal-directed design research manual in this process [12]. Alan Cooper advocates integrating various qualitative methods, such as literature review, interviews, focus groups, and ethnographic studies of the end users as well as possible stakeholders. This approach recognizes that personas must be based on real-world data, ensuring their authenticity and credibility.

After executing a scoping review on the acceptance and privacy perceptions toward video-based active and assisted living technologies [13], field research was carried out, which consisted of formal interviews, focus groups, and informal interviews.

2.1. Data Collection

Qualitative data collection in the forms of interviews and focus groups was conducted with different stakeholders involved in the process of care provision. All study procedures were approved by the Ethics Committee of the University of Alicante (Ethical Approval N UA-2022-10-16-1).

2.1.1. Participants

Participants in the study were drawn from a convenience sample in a way that fitted different sociodemographic profiles of a diversity of stakeholders suited for the study. The recruitment was executed with the help of the case manager from a healthcare center in Alicante, Spain. The total number of participants in the study was 65 out of which three participants were excluded: one older adult did not wish to sign the consent form, however, they were happy to attend the focus group discussion; two healthcare expert participant data were excluded because of incompleteness. The remaining 62 participants represent different stakeholder groups: older adults or direct care receivers (N=17), direct caregivers (N=18), healthcare experts (N=17), and other stakeholders (N=10). Figure 1 summarizes the data collection carried out for the persona design, where different stakeholder group compositions are displayed in greater detail.

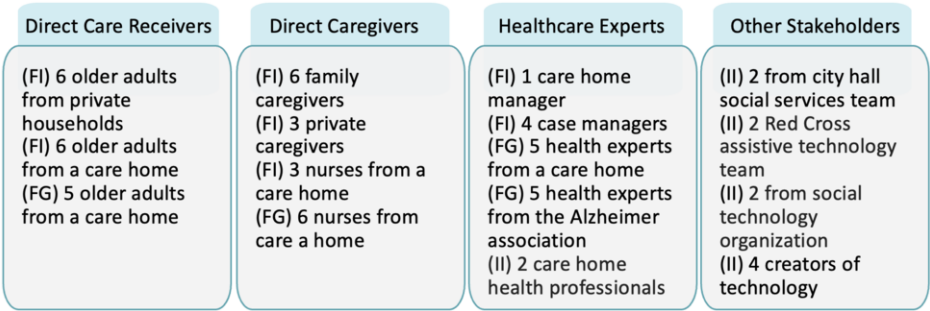


Figure 1. Qualitative data collection for the persona design. Four stakeholder category compositions are given together with the data collection tool used for each composite group: Formal Interview (FI), Focus Group (FG), Informal Interview (II).

2.1.2. Procedure

The data collection procedure was directed by Cooper’s goal-directed design research [12], which gives a step by step guidance on how to conduct interviews and focus groups for persona design.

Participants were visited in their natural environments, which was their living space in the case of the older adults - researchers visited them in their private households and care homes, and work environment in the case of the caregivers, healthcare experts, and other stakeholders. All data collection was executed face-to-face, except for the interview with the two participants from a social technology organization, which was held online.

Semi-structured interviews, semi-structured focus groups and informal interviews were the main methods of the data collection. The employed method for each participant group is displayed in Figure 1. Formal interviews and focus groups started off by introducing the goal of the research to the participants and filling out the consent forms, which were followed by the main body of questions and ended with sociodemographic questionnaires. These sessions were audio recorded. Informal interviews followed a different protocol which did not include sociodemographic questionnaires and neither were audio recorded. Hence, the sociodemographic characteristics of the participants who provided data through formal interviews and focus groups are displayed in Figure 2.

	Direct Care Receivers N=17	Direct Caregivers N=18	Healthcare Experts N=15
Age Median [Min; Max]	80 [66; 87]	54 [29; 73]	53 [34; 63]
Sex	12 Females, 5 Males	13 Females, 5 Males	11 Females, 4 Males
Education	6 Primary 5 Secondary 5 Professional 1 University	9 Secondary 6 Professional 3 University	15 University
TechPH Median [Min; Max]	2.4 [2.1; 3.1]	NA	NA
CDS score Median [Min; Max]	64 [50; 70]	NA	NA
ATI Median [Min; Max]	NA	3.9 [2.2; 5.4]	5.4 [3.7; 5.7]
Experience in healthcare, Years Median [Min; Max]	NA	8 [3; 23]	17 [7; 35]

Figure 2. The sociodemographic characteristics of the participants who provided data through formal interviews and focus groups. TechPH - Older People’s Attitudes Toward Technology Score from 1 to 5, from lowest to highest technophilia. CDS - Care Dependency Scale, $CDS_{sumscore} \leq 68$ were classified as care-dependent, all others as independent. ATI - Affinity for Technology Interaction Score from 1 to 6, from lowest to highest affinity.

2.1.3. Data collection instrument

The data collection instrument was inspired by the Technology Acceptance (TAC) Toolkit [14,15] and Blueprint Persona framework [16]. The Technology Acceptance (TAC) Toolkit [15] is a research-based approach that helps design health technologies by looking at the user journey as a unique evolving trajectory. This work seeks to facilitate the application of Technology Acceptance Theory [17] in design practice through the toolkit comprising 16 cards, 3 personas, and 3 scenarios. It also allows a generation of one’s own temporal scenarios with user personas. The Blueprint on Digital Transformation of Health and Care for the Ageing Society [16] is an initiative that guides the efforts on how innovation can transform health and care provision in our aging society. As part of the Blueprint, a set of personas was created by a team of experts with varied backgrounds to identify the health and care needs of the population. They also created a venue for continuing their work by further persona construction and dissemination. Hence the interview/focus group guide was created according to the TAC research foundations and Blueprint Persona framework. The guide consisted of three main thematic parts: care provision, technological solutions for care, and privacy-associated risks of technology. Questions of each thematic part were tailored according to respondent profile: older adults or direct care receivers, direct caregivers, healthcare experts, and other stakeholders. Apart from the main body of questions the interview guide also included a sociodemographic questionnaire.

2.2. Persona creation

The manual Approach to the Qualitative Persona Clustering Method was used for the persona creation [18]. This involves techniques such as affinity diagrams, card sorting exercises, empathy mapping, and thematic analysis to develop thematic clusters based on goals, a combination of behaviors and attitudes [19,20,14,21]. Researchers advocate the manual approach to clustering when it comes to the rich qualitative data from interviews

[18]. This method creates a deeper understanding of user profiles, however, it is also criticized for difficulty in making objective judgments [22]. Even so, taking into account the goal-directed approach to the persona design, at the heart of which lies an archetype that is not portrayed as an average individual, but rather as a persona with unique characteristics, the manual approach to clustering emerges as the most suitable option [12]. As a result, a framework analysis [23] in combination with affinity mapping and empathy mapping was used for persona creation using Dovetail software[24]. Framework analysis takes a deductive approach to thematic analysis, the coding process is guided by existing theory or a set of preconceived themes [25,26], which in our case was a framework offered by the Blueprint personas [16]. The same framework guided us for data clustering in empathy maps and affinity diagrams to create a visual representation of the target audience's needs, goals, emotions, and behaviors.

3. Results

A total of eight persona scenarios were developed based on the collected data using the Blueprint persona framework. Three of them represent the care receiver group: an older adult living alone, an older adult living with a spouse, and an older adult from a care home. Two personas portray direct caretaker groups: a family caregiver and a care home nurse. And lastly, three of the personas depict other stakeholders involved in the care provision: a healthcare expert - case manager, a care home manager, and a technology creator. In accordance with the goal-oriented design rationale, our personas were developed by incorporating actual data and specific attributes of the target stakeholder group, including factors like age, health condition, and lifestyle. These personas shall not be taken as an average representation of the target group, but rather as a persona with unique characteristics. Example variables for defining persona clusters are given in Figure 3.



Figure 3. Example variables for defining persona clusters.

An example persona, Sergio is displayed in Figure 4, followed by a Customized Empathy Map for him in Figure 5. All eight personas can be accessed on the Blueprint persona repository: Spin-off Personas and are available for public use,

<https://blueprint-personas.eu/>. The Blueprint website also offers sorting tools for easier filtering of desired persona profiles.

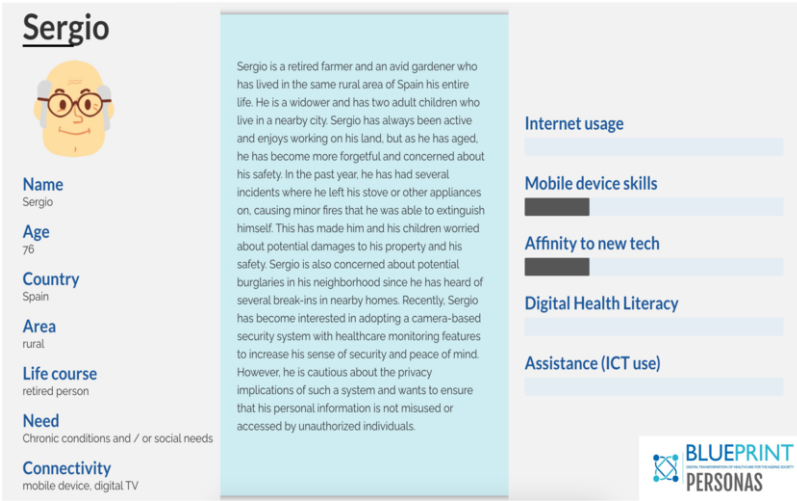


Figure 4. An example persona, Sergio

The set of personas draws a picture of different stakeholder perspectives in order to better understand the user needs in the process of the development of privacy-preserving visual systems. They serve as an empathy tool that facilitates communication between the healthcare sector, technology design teams, and older adults as the main target users. We specifically tried to spot challenges and potential conflicts of interest between the needs and aims of different stakeholders, which arise in the process of the implementation of the monitoring system, and convey them through the persona scenarios.

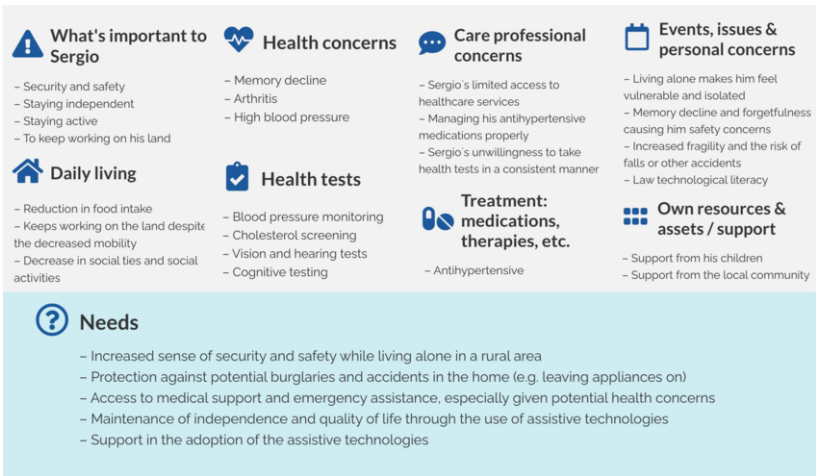


Figure 5. Customized Empathy Map for the example persona - Sergio

4. Discussion

We have presented how the goal-directed persona scenario approach can be utilized to comprehend user requirements for an AAL system development, specifically a video-based monitoring system intended for the care of older adults in this case. This approach to persona design emphasizes that interaction is driven by users' motives and goals and acts as an empathy tool in the system development process. It's worth noting that personas should not be a substitute for direct involvement and engagement with end users. Instead, they serve as a structured and targeted approach to comprehending and conveying user requirements during the product development process. For that reason, the current stage of the design involves user testing of the prototype in a realistic environment of a living lab setting. Different stakeholders represented in the eight personas are part of the user testing. This experience has demonstrated to us that, while personas contain the fundamental information required for designing the proposed system for older adults, they may not encompass all the diverse elements that become evident during user testing. New details and even new core personas are emerging in the process of the prototype probing with diverse stakeholders.

It is also important to note that personas as a design tool are a rather costly and time-consuming approach, which is also often criticized for its transient nature. The majority of personas that are created are tailored to a particular project and design problem, and cannot be applied to different contexts, making it unique in its application [11]. Likewise, the proposed personas represent a very specific context of the proposed system application - older adults living in Spain, which makes it very difficult to generalize the setting and reuse the personas. On the other hand, this approach is beneficial when targeting a very specific audience where, instead, generalization could be counter-effective. Indeed the developed personas serve our goal of advancing an AAL system for the specific Spanish context. We also consider that research teams working on visual sensing AAL technology can be inspired by the use of this tool, and the Blueprint persona repository, which is open to the public, can serve this aim.

In conclusion, video-based active and assisted living technology has the potential to improve the quality of life of older adults, however, privacy considerations need to be taken into account. The use of persona scenarios has helped us in the design process to address privacy concerns and ensure that the technology meets the needs of the target user group. The study findings inform the development of the video-based AAL technological system that is tailored to the needs of the intended audience and can enhance the quality of life for older adults while taking into account their privacy considerations.

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