Improving Representativeness in Participatory Design Processes with Elderly

Jonas Sorgalla
Peter Schabsky
Sabine Sachweh
Dept. of Computer Science
Dortmund University of Applied Sciences and Arts
Dortmund, Germany
[jonas.sorgalla, peter.schabsky, sabine.sachweh]@fh-dortmund.de

Miriam Grates
Elisabeth Heite
Dept. of Applied Social Sciences
Dortmund University of Applied Sciences and Arts
Dortmund, Germany
[miriam.grates, elisabeth.heite]@fh-dortmund.de

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Abstract
This paper presents a novel approach for increasing the representativeness in participatory design in the context of an aging society. In the research project *QuartiersNETZ* we are facing the challenge of including a large and heterogeneous target group into a participatory design process to create software solutions, which foster an independent and self-determined life for a broad range of elderly. Regular formats like neighborhood meetings, which are used as spaces for participatory design, are only attended by a certain type of elderly people. Hence, we present our ongoing work of creating empirical life situation types and selecting corresponding representatives. Our approach combines methods from social science, requirements and usability engineering to especially include groups who are rather difficult to integrate into open participation formats increasing representativeness in the participatory design process.

Author Keywords
Older People; Participatory Design; User Representation; Co-Design.

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e. g., HCI)]: Miscellaneous

Figure 1: Location of the city of Gelsenkirchen in Germany

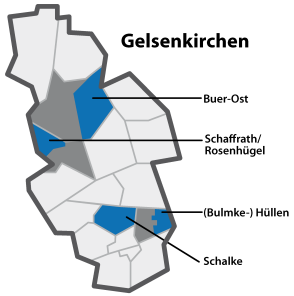

Figure 2: The four case study neighborhoods

Introduction

The number of people aged 60 years or older is steadily growing and is predicted to increase from globally 901 million in 2015 to more than 1.4 billions in 2030, which makes it the fastest growing age group [15]. To anticipate this demographic shift, it is inevitable to develop new solutions in areas such as health care, housing or social protection [15]. A part of these solutions is the promotion of well-being and independent living of elderly, especially in their known neighborhood.

This can be achieved with the help of modern *Information and Communications Technology* (ICT) [11]. However, the development of such technology for the target group of elderly holds several special accessibility and acceptability issues, which need to be addressed in particular [6]. Therefore, the participatory design methodology has been used in recent years to meet the expectations and needs of older users regarding technology development (e. g. [4], [6]). Originally, participatory design has its roots in the 1970s and 1980s in the Scandinavian workplace democracy movement [9], but is nowadays used for the design of all kinds of software systems [14]. The methodology belongs to the family of user-centered design but emphasizes the empowerment of users to actual decision makers [8]. One of the key challenges in utilizing participatory design is "designing for the 'other' " [10], i. e. participants may have a huge conceptual or cognitive distance to the later users, who were not able to attend the actual participatory design sessions. This applies in particular to designing with elderly as the experiences and capabilities in this stage of life vary a lot [18]. Hence, one of the most essential aspects in realizing participatory design for and with elderly is the recruitment of representatives, which cover the heterogeneity of an elderly user group [7]. To tackle this representation issue, previous research, e.g. Reeder et al. [12], purposed data-driven elderly personas for a user-centered design process. Following this approach, Wöckl et al. [17] proposed tooling for creating elderly personas based upon a specifically large representative data sample. However, we argue that the mere usage of (predefined) personas contradicts the participatory design inherent characteristic of involving elderly as actual decision makers and therefore falls short in terms of representing the heterogeneous group of elderly in the participatory design process. Hence, we present a new approach to identify and integrate underrepresented user groups in such a process. Our new approach is currently further developed and tested in our research project QuartiersNETZ, which serves as case study for the approach and is described in the following.

Project QuartiersNETZ

The interdisciplinary research project QuartiersNETZ[1][2], that connects computer scientists, social scientists and gerontologists, aims to enable an independent and self-determined life in old age by empowerment. For this purpose, among other measurements like promoting technical ambassadors for elderly, two software systems are developed. The first system is centered around the household and merges smart home technology with remote health care. The main goal is to increase a self-determined life in the home environment by facilitating elderly-specific interaction possibilities with household devices. The other system is a digital neighborhood platform. The platform enables elderly to keep in touch with friends, family, or neighbors and in addition makes it possible to access services from the neighborhood (e. g. supermarket or pharmacy delivery service) or to receive information about upcoming events (e. g. events at the local church) in the neighborhood area.

[1] English: NeighborhoodNET
[2] http://www.quartiersnetz.de/

A prototype of the platform is already available online[3].

It is a fundamental premise of the project that all relevant user groups should be included in the design process of these systems. Therefore, both are created following the participatory design methodology, actively involving elderly as decision-makers in the design process. The project is located in the city of Gelsenkirchen in the German Ruhr area (see Figure 1). We picked four of the twenty neighborhood quarters of the city, namely Buer-Ost, Schaffrath/Roselhügel, Hüllen, and Schalke, as case study regions for our design process (see Figure 2), because they are representative for the whole city in terms of population structure, infrastructure and supply situation.

Design Process

When utilizing participatory design for systems intended to be used by a large group of people like the elderly in the city of Gelsenkirchen, it is necessary to find a way of transferring the knowledge of smaller design groups to a larger audience [5]. Accordingly, we organized three kinds of regular meeting formats to participatory work with the elderly in the case study regions: (i) NeighborhoodNET Meetings; (ii) Neighborhood Meetings and (iii) Focus Groups. These meetings work as the basis of our design process, which is depicted in Figure 3. The process is an participatory implementation of the user-centered design process [2] and consists of four stages, namely Participation, Refinement, Development and Design, which are explained in the following.

Participation

The participation stage aggregates a variety of meeting formats which we organize to participatory design our software solutions for and with elderly.

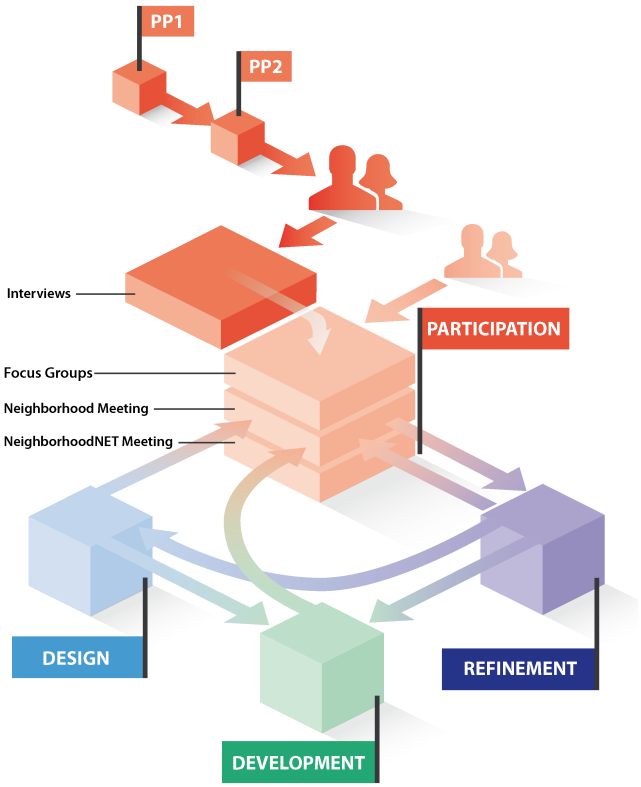

Figure 3: Participatory design process in the QuartiersNETZ project

[3] http://buer.quartiersnetz.de/

NeighborhoodNET Meetings are open for every citizen and held biannually with an average attendance of 200 participants. In the course of every meeting, keynotes and groups for project-related topics, e. g. our software solutions, are organized. We use these groups to gain initial requirements and evaluate the current development state.

Neighborhood Meetings are held once per quarter for each of the four reference neighborhoods with attendance of approximately 40 to 50 participants. In contrast to the NeighborhoodNET Meetings, the topics are created together with the attendees. This results in a more open and innovative exchange, although not all discussions can be directly used in the project. We use this format to (i) motivate the participants for further cooperation; (ii) foster empowerment and (iii) gain disruptive requirements.

Focus Groups usually consist of around 6 to 9 people and are held once a month. Here we participatory work with a small team of elderly on our designs (e. g. frontend of the neighborhood platform). The participants are recruited in the other meeting formats.

Since we develop software for and with people who did not grow accustomed to computers, smartphones and software in general, invitations are always sent by post and email. Additionally, we use personal invitation of local actors. The result of the participation phase is generally an informal set of requirements (e. g. in forms of protocols, user stories, sketches or storyboards [7]).

Refinement
Based upon the results of the prior participation stage the refinement stage is executed by professionals from social science and requirements engineering. The refinement works as gateway for formalizing and delegating the participatory designed artifacts. Incoming requirements are refined and depending on the type forwarded to our software development or design team. Additionally, unclear requirements are returned into the participatory formats for clarification and further development.

Design
The design stage consists of professional designers and usability experts who create the graphical user interface for the software solutions. To do so, they use the artifacts, e. g. sketches or mockups, from the refinement stage and iteratively create more detailed prototypes, which are regularly evaluated, extended and improved in our participation formats. Designs which are approved for release by our elderly participants are then passed to the development team.

Development
Non-graphical requirements from the refinement stage and released artifacts from the design stage are forwarded to software development. In this stage functionality gets realized and iteratively verified in the participation formats. We use a Scrum-like [13] agile development process to be able to handle continuously incoming requirements while building a steadily growing software on prototype basis.

Including Previously Non-participating People

While performing our design process (cf. Figure 3), we noticed that certain types of elderly are more represented in our participation formats than others belonging to handicapped or underprivileged subgroups, e. g. people with mobility limitations or below-standard socio-economic status. Therefore, our premise of including all relevant users into our process was insufficiently fulfilled, which increases the risk of not capturing requirements in their necessary en-

Characteristic		Type 1 (n=134)	Type 2 (n=74)	Type 3 (n=54)
Life situation dimension	Socio-Economic Status	High	Rather low	Low
	Health	Good	Moderate-bad	Moderate-bad
	Household	Cohabiting with spouse	Cohabiting with spouse	Living alone, widowed
	Social Relationships	Many and varied	Moderate	Moderate
	Indoor environment quality	Moderate	Moderate	Moderate
	Employment status	Working full-time or retired	Retired	Retired, unemployed or housewife
Further attributes	Life satisfaction	High	Moderate	Partly low
	Interest in ICT	Moderate-high	Rather low	Low
	Sex	male or female	male	female

Table 1: Excerpt of QuartiersNETZ-specific life situation types

tirety. To overcome this limitation, we enhanced our participatory design process to measure the heterogeneity of the user group by the members' different types of life situations. Thus, we extended the process by a preliminary phase that involves (i) identification of the group's different types of life situations (Preliminary Phase 1; PP1); (ii) integration of the identified types into the following phases of the participatory design process as depicted in Figure 3 (Preliminary Phase 2; PP2). In the following, we first describe the general execution of PP1 and PP2 and later give a concrete example based upon our case study region.

PP1 comprises the elicitation of representative quantitative data and a hierarchical cluster analysis [1], which is used to identify life situation types. Thereby, each type corresponds to exactly one cluster. Thus, a life situation type is based on general life situation dimensions (e. g. financial resources) and project-specific characteristics (e. g. ICT usage). It represents a profile of a certain type of user. In contrast to full-fledged data-driven personas, e. g. developed with the grounded persona method by Faily and Flechais [3], our life situation types are modeled without narrative elements. Therefore, a life situation type can be viewed as an aggregation of characteristics with defined value ranges, e. g. one of the several characteristics could be a monthly net income between 800 and 1200 USD.

PP2 summarizes the integration of life situation types, which are identified in PP1, into an existing design process. Initially, the already integrated users in the process need to be compared to the life situation types. This allows to deduce which representatives are missing. After the underrepresented life situation types are identified, corresponding users who are willing to participate must be found. Finally,

these newfound representatives must be included in the existing process, which may demand the addition of new methods to the already used participatory design methods.

In the following, we explain how PP1 and PP2 are realized in our research project. For PP1 we conducted a representative survey within the case study neighborhoods with a random sample of 4,000 residents aged 50 years and older. We received 1,186 valid responses (response rate: 29.7%), which we used to perform a hierarchical cluster analysis leveraging the complete-linkage method [1]. We identified nine life situation types i. a. based on the following characteristics: socio-economic status, health, social relationships and indoor environment quality [16]. Due to lack of space we postpone the detailed composition of the characteristics and the listing of all identified types for future publication. Table 1 exemplary shows three of our nine life situation types. For example, Type 1 consists of 134 responses and can be characterized with a high education level, high income, self-assessed good health, many and various social relationships and a generally self-assessed high interest in modern technology.

For realizing PP2, we compared the people who attended our participatory design formats to the identified types. We noticed that most of the participants can be assigned to Type 1 and several other types like Type 2 and 3 are currently not participating. With the help of local actors (social worker, nursing services), we were able to find selected representatives for each type who are willing to participate in the development process.

Because our participatory design formats are currently not attended by this kind of participants, we plan to extend our design process to include regular qualitative interviews with the newfound representatives (cf. Figure 3). Initially, we plan a semistructured interview and in the following we plan to do private design sessions based on the prototypes which are created in the focus group.

Discussion and Future Work

In this paper we presented an approach to identify and include previously unknown and missing groups of people in the context of participatory design with the usage of a cluster analysis. In the QuartiersNETZ project we were able to identify nine life situation types based upon a representative survey for our reference regions. In the following we used these types as profiles for recruiting representatives to enrich our design process. We are currently in the stage of pretesting the semistructured interview guide to initially include the newfound representatives. Until now the approach helped us to realize that we were developing our software solutions only with a certain type of users and were risking to overlook types of users who are also intended to benefit from our software (e. g. immobilized people). However, performing a representative user survey to identify the life situation types is very resource intensive. This raises the question whether already identified life situation types are transferable to other cities or even countries and if so to what extend? Additionally, we were in the comfortable position of having the support of the local government and a nursing service, which was very beneficial for finding participants matching the life situation type.

Based upon the experience with our approach in our project, we plan to formalize it as a reusable method in the future. Also, we are aiming to publish the detailed composition of our life situation dimensions and a review of how the newly included participants influenced our overall design.

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