

PARTICIPATION OF USERS IN RESEARCH: HUMAN-CENTRED DESIGN IN THE PROJECT SENSHOME

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abstract

People on the autism spectrum face challenges in different areas of life that can be supported by a smart home and interior design solution developed in the SENSHome project. A guideline is provided through the Human Centered Design approach, that includes methods and tools to assist the design process from the very beginning. Through workshops, the users and the context of use were considered in order to derive requirements for a comprehensive solution. Personas, which represent too a corresponding depiction of activities of daily living, risk factors, and mitigating measure served as a basis for the later development of the requirements and functionalities of the SENSHome environment.

keywords

Autism; Human Centered Design; Participatory Research; Smart Home; Interior Design.

Autism Spectrum and the need for Human Centered Design.

Autism spectrum diagnoses increased over the last decades, as reviews comparing prevalence rates from different studies conducted in the previous decades show. Research assumes that about 0,6% of the world population is affected by ASD (Elsabbagh et al., 2012) (Fombonne, 2009). Due to different effects of the spectrum, personal support is required that is provided by formal and/or informal caregivers in various activities of daily living and other situations like school, work or home life. People affected often have a different perception of the environment and thus different resources, needs, and requirements (Kamp-Becker & Bölte, 2014) regarding a supportive, smart home and interior design environment as it is designed in the SENSHome project. To design solutions tailored to the later users that are useful and usable and thus are accepted, the respective users must be included in the development process from the very beginning.

The Human Centered Design – HCD – approach places human needs, capacities and behavior first and then designs to accommodate those needs and capabilities. Using this research approach, designing inappropriate or bad usability technology can be avoided, instead enabling user-friendly and adequate technology (Norman, 2013). HCD is an iterative process that includes all relevant stakeholders in the development process from the beginning. (image 1) Following the content of (ISO 9241-210:2019, 2019), HCD is an approach to interactive systems development that aims to make systems usable and useful by:

- focusing on the users, their needs and requirements;
- applying human factors/ergonomics, and usability knowledge and techniques.

This approach:

- enhances effectiveness and efficiency;

- improves human well-being;
- user satisfaction;
- accessibility and sustainability;
- counteracts possible adverse effects of use on human health, safety and performance.

Using this participatory research approach is especially important for the target group of people on the autism spectrum, as requirements of a smart home and interior design solution might differ from neurotypical users in certain areas like the user interface or furniture functionalities.

Methods of HCD – in a pandemic.

The main framework of all user interactions conducted in SENSHome were workshops. These user interactions lasted around 1-2 hours, in which small working group or single persons intensively dealt with a specific topic, issue or question. To achieve concrete and sustainable outputs, it was crucial to define clear goals and an appropriate activity design and avoid unnecessary and pointless workload for the involved participants at the same time. All participants involved in the workshops were adequately informed about their participation and agreed to take part by signing an informed consent.

A challenging factor in this first phase of the project was the COVID-19 pandemic, as first lockdowns lead to a change in conventional participatory processes like workshops, interviews or focus groups. To overcome these challenges, digital tools were used to support the conduction of the user interactions.

In order to reduce social interactions and to ban the spread of the corona virus, we were forced to switch to remote work in the early months of 2020. This situation brought not only opportunities but also barriers equally. Online user interactions come with the advantage of not having to travel to a destination for participating at an event. We were able to set up time and resource efficient calls with the stakeholders which was a great opportunity. At the same time, it turned out to be very challenging to bring more stakeholders on one table, which resulted in more one to one discussion rather than group meetings.

To overcome the given barriers and challenges, one of the most used tools was MURAL, (1) which is a digital workspace for visual collaboration. It is a set of cloud-based shared, virtual whiteboards where teams can visually explore complex challenges, facilitate design thinking methods, and organize agile processes across any device. The work is performed within a mural where all kinds of content can be mapped. It is like a giant canvas that can be individually customized.

Before starting with user interactions, a stakeholder map helps to identify who are important user groups and participants to consider. The results of initial phases of the HCD process can be derived to personas and user days, which are two commonly used methods that were also used in SENSHome.

1. Stakeholder map. A common first step in the HCD process is to identify relevant stakeholders that can contribute to the respective topic. To understand and specify the context of use of SENSHome and to specify the user requirements, different groups of stakeholders were taken into consideration according to the quintuple helix model. This includes civil society users with the primary user group of people with ASD, business, research and education, public administration and the environment (Carayannis et al., 2012). (image 2)

2. Personas. Especially when working with HCD approach, the future user moves to the center of the development process. When people with various backgrounds and perspectives work together on a project, they may have different ideas and interpretations of the future users. This is where personas come into play. The “personas” method is suitable for developing a common, homogeneous image of the user. The user becomes tangible for everyone involved in

the project. The aim is to gain insight into a probable user profile. The method does not claim to depict reality completely, but represents a model of the user, which is based on the motives and goals of real users (Cooper, 2004) (Arnold et al., 2005).

Personas are an effective way of supporting the human centered design process and a powerful supplement to work user definitions. A persona is not an actual user but a hypothetical archetype. Personas are a well-known and successful technique for making users real (Hartson & Pyla, 2012). Benefits of using this method are ('Personas: Why Is It Important to Understand Your Users?', n.d.):

- project wide understanding of who the “primary” users are;
- understanding of users' needs and behavior;
- preventing project workers and contributors from talking about themselves, their friends or their family as the users;
- empathy with the user;
- clearer and better decision making focused on user needs/goals.

3. User Days. User days are derived from user stories (Cohn, 2004) and scenarios which are common methods in software engineering to meet the user's needs. Typically, scenarios describe everyday situations and routines. They are plausible stories about a Persona who will use a future technical solution in a particular situation. The scenarios contain a character – persona –, a challenge in everyday life that must be mastered, a specification of the need and an idealized conclusion. User stories describe the Persona's needs, which are presented in the respective scenario, to achieve a certain goal. They represent a software requirement formulated in everyday language, deliberately kept short. As a collective output of User involvement activities and the literature research, we created user days to present the integration of the future SENSHome system embedded in the ecosystem of the daily living of primary and secondary end-users.

Results and outcomes of the initial user interactions.

From January 2020 to April 2021, 25 workshops were held with different user groups: people on the autism spectrum; formal and informal caregivers; managing directors of care facilities; representatives of associations in the field of autism. The primary outcomes of the initial phase of the project were the description of the potential target group by means of three personas. These personas depict different types of users on the autism spectrum with different resources and needs in order to cover a broader spectrum of possible user types. Accompanying to the personas, user days were set up that show different scenarios during the day when a smart home solution like SENSHome can help. Furthermore, requirements of and functionalities for a smart home solution were gathered in the workshops and mock-ups of the central user interface designed within the workshops – these results are not presented in this work.

1. Persona Dominic. As one example of the three personas, the persona Dominic shows what type of information was gathered and brought together descriptively. (image 3) Next to an overview on the left side, that shows general characteristics of the persona, a detailed description of the autism spectrum, care needs, social life, education, occupation, hobbies and interests and other symptoms is provided. The needs and assistance part of the persona show first insights how SENSHome could support people in the autism spectrum.

2. One day in the life of Dominic. Extending the personas, we created user days to point out in which critical events can occur that might lead to dangerous situations and how SENSHome can foster autonomy and self-reliance of people with ASD and increase the comfort for residents in different housing situations.

The daily routine depicts how a common day of the persona Dominic could look like. (image 4) The curve shows the risk level for critical or dangerous events. It rises when stress-factors oc-

cur and falls when mitigating interventions are set. The functionalities of the SENSHome system are shown in the last row of the image and is split up into Case, Recognition and Measure. The Case describes the situation, in which the SENSHome system comes into effect. The Recognition is the sensory part of the system where certain parameters are measured. When the system's functionality is an interior design element, no Recognition is stated. The Measure is the reaction of the system on the detected parameter or, in case of interior design, the proposed architectural solution. The declared functionalities show an excerpt of possible functionalities of the SENSHome system. The SENSHome user days are a useful method of our HCD portfolio to make a typical day of our end users more tangible.

What's next in SENSHome.

Based on these initial results of the first project phase, the requirements for the sensor system and the furniture elements were derived and developed in iterative workshops. The requirements were transformed into functionalities the SENSHome system would later comprise. Next to autism-specific functionalities like a crowd warning, where the system informs about – too – many people in certain areas, e.g. the entrance or the recognition of loud noises, general security and wellbeing functions were integrated into the solution. These are, for example, a fire or fall detection or the measurement of the temperature with automatic adjustment – if possible from an actuator side. The interior design elements include autism-friendly furniture like a shelter seat or a table with dividers to provide privacy when needed. The SENSHome environment will be tested in two different labs in Italy and Austria and evaluated by people on the autism spectrum and caregivers. The results will give insights into the acceptance of a smart home solution for people on the autism spectrum.

notes

(1) <https://mural.co/>

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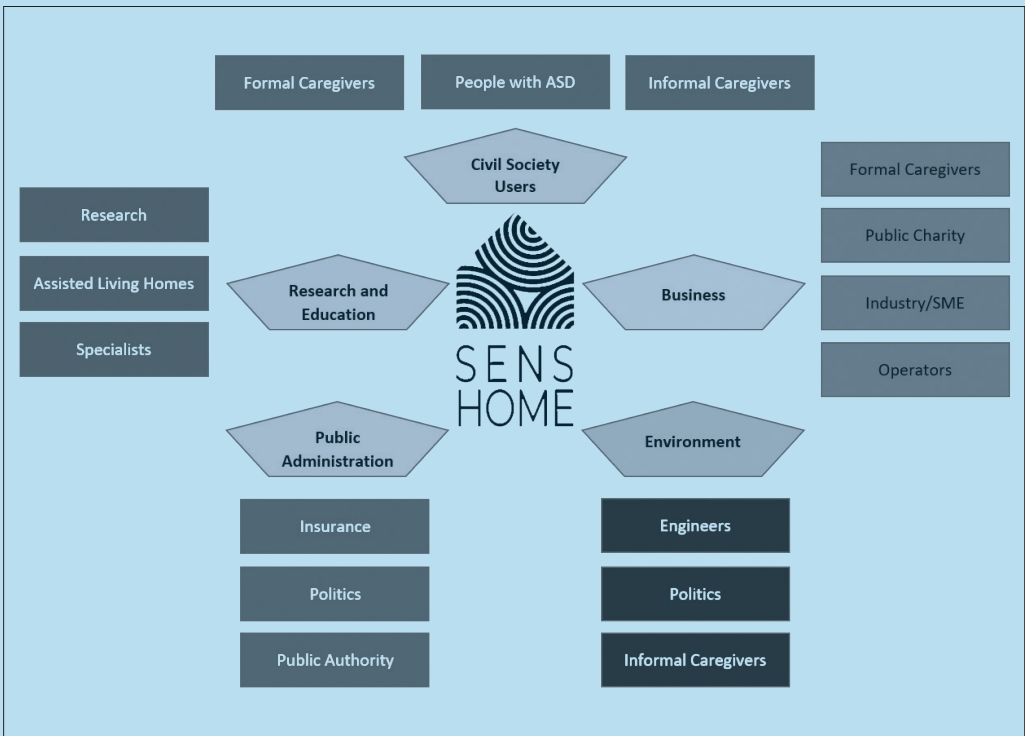
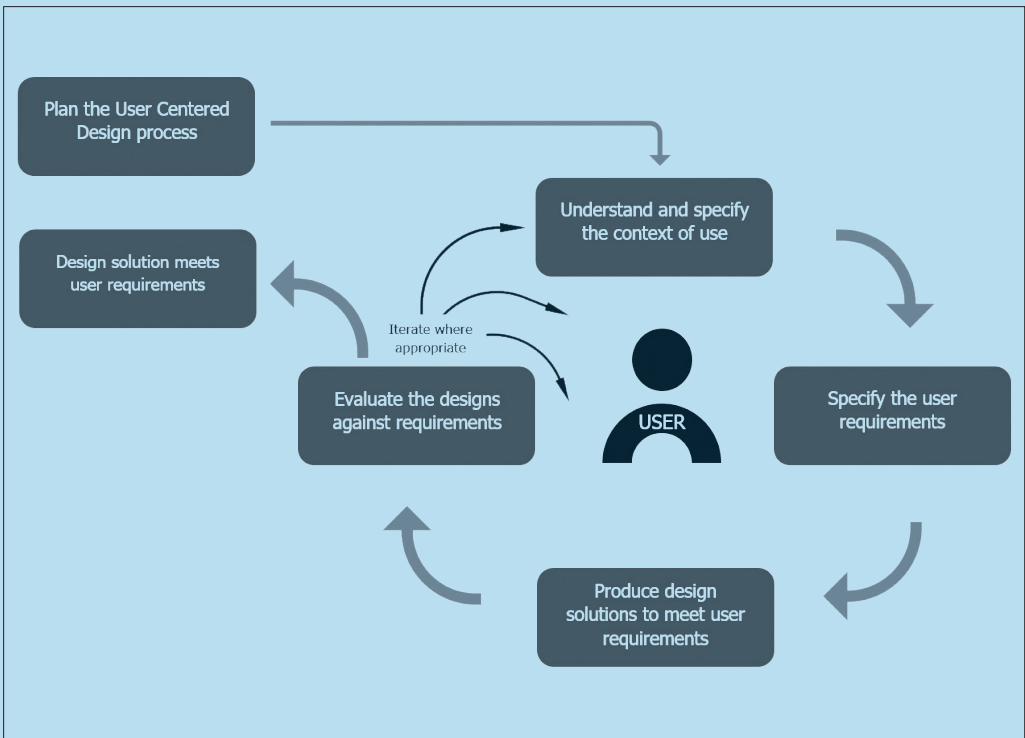
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(image 1) Human Centered Design Process (ISO 9241-210:2019, 2019).

(image 2) Stakeholder Map (Carayannis et al., 2012).

(image 3) Persona Dominic.

(image 4) User day for Persona Dominic.



DOMINIC



Age 35

Residence Assisted Living

Region Carinthia

Severity of autism



Care needs



Communication skills



Autism spectrum and care needs

ASD



Dominic was diagnosed with autism spectrum disorder at the age of five. Prior to that, noticeable problems like repetitive motion of his hands and a delayed speech and language development were observed. Dominic needs assistance in almost all activities of daily living (ADL). For security reasons, a caregiver must be present 24 hours a day. Single activities he can perform autonomously (eating prepared meals, dressing, using the toilet). Daily routines are very important for Dominic.

Social life and communication

Dominic has one person from the assisted living facility he shares interests with, other than that, he only has social contacts with the caregivers from the assisted living facility and with his family, which he meets regularly. His communication skills are very limited. He only communicates on factual level. He can barely express his needs and has massive issues with interpersonal contact and the interpretation of nonverbal signals.



Education and occupation



Dominic attended a special education school until ninth grade. He is neither able to write nor to read. Currently he is engaged in a supported employment close to the assisted living facility where he lives. He is working in a workshop where he is doing manual work. He enjoys hand-crafting wood and is also very skilled in that particular field. An apprenticeship as a carpenter was not possible due to his autism spectrum disorder.

Interests

He is highly interested in nature, especially in forests where he also likes to go for walks and collect limbs of trees or cones, which he can use and work with in the supported employment. Furthermore, he is well versed in public transport vehicles like busses and memorized many timetables. He would like to use public transport alone, what is not possible for him because of his autism spectrum disorder.



Comorbidities and other symptoms



Dominic suffers from attention deficit hyperactivity disorder (ADHD), a common comorbidity of ASD. He also has problems switching activities. Aggressive behavior against other occurs regularly that is mainly triggered by interrupted daily routines, when his needs are not satisfied or when he feels overcharged. It is very important for Dominic to have the same daily routine every day.

Needs

Through his deficits in communication, he wishes that his needs are understood better and quicker. Dominic would like to spend more time alone in his room because he enjoys the silence. Due to his aggressive behavior, that can be avoided by detecting preliminary signs, the time that he can spend alone is very limited.



Assistance



Before aggressive behavior occurs, there are preliminary signs that indicate this behavior. As an example, stereotypical movements of arms or swaying back and forth with the upper body can be detected. If these signs are recognized, caregivers can be informed.

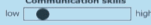


Dominic, 35

Severity of autism



Care needs



Communication skills



Assisted Living



5 persons household



24h assistance

