How to Design a Participation Companion: A Conversational Interface to Foster Motivation and Support Participation

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Smart cities are no longer based only on technologies because it is their citizens who significantly influence the development. Lack of motivation plays a major role in the area of bottom-up participation. The digital transformation is creating new opportunities to support people in their participation process and increase motivation. Through the use of artificial intelligence, systems such as virtual companions can be improved further to create a valuable relationship between the human and the machine by incorporating interpersonal elements. A virtual companion that supports people in their participation process could be a solution to motivate people to participate. To provide a basis for deriving design knowledge for a Participation Companion this research starts by identifying the stakeholders' needs and problems based on literature reviews and interviews. It then follows an iterative, user centered prototype development and evaluation.

Keywords: conversational agent, participation, smart city, virtual companion, human-computer interaction

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1 Introduction

The growth of urban population presents challenges such as traffic congestion, waste management, resource access, and crime (Simonofski et al., 2021). Smart cities, initially based on IoT, cloud computing, and sensor networks, are considered as the answer to these challenges (Harrison and Donnelly, 2011; Perera et al., 2014). However, recent research emphasizes that smart cities should be driven by citizens' needs and expectations (Becker et al., 2022; Hollands, 2008; Vácha et al., 2016). Information and communication technologies (ICT) are integral to smart city concepts and support participation (Becker et al., 2022; Viale Pereira et al., 2017). Currently, design knowledge on participation information systems is limited, focusing on top-down digital solutions (Becker et al., 2022). Our suggestion is a shift towards a bottom-up approach by designing a Participation Companion (PaCo) based on the knowledge of artificial intelligence (AI) and Virtual Companions (VC), that helps people to participate and motivates them to seize participation opportunities. VC work with users to achieve a common goal while fostering valuable, long-term human-machine relationships (Krämer et al., 2015; Strohmann et al., 2022). Though chatbots and virtual assistants are explored in healthcare (Ahmad et al., 2022; Müller and Reuter-Oppermann, 2022) and education (Gubareva and Lopes, 2020), there is a lack of scientifically based design knowledge for virtual companions and other AI-based technologies aiming at encouraging and supporting participation. For this reason, the following research question (RQ) is to be answered: *How can a VC be designed to encourage and support good and purposeful participation?*

Our study adopts the design science research paradigm (Hevner et al., 2004) and, specifically, employs the reflective approach for generating design knowledge, as proposed by Möller et al. (2020). Initially, we conduct a structured literature research and interviews to gain a comprehensive understanding of the problem space. Based on this, we initiate an iterative artifact design process. Following the reflective approach, we first instantiate an artifact as a prototype, designed as a conversational interface, and extract design principles from our design process. Finally, we perform an exploratory study to gather feedback and promote participatory design with stakeholders. The scope of our study is related to the organization "Sandkasten" at the Technische Universität (TU) Braunschweig, which aims to support students in creating a sustainable and livable campus. By examining participation dynamics

within this context, we seek to generate knowledge applicable to promoting engagement in smart cities.

2 Theoretical Background

2.1 Participation and motivation

Simonefski et al. (2021) define a Smart City as "a city that provides innovative solutions, in collaboration with its citizens and with the support of technology, to solve the specific challenges of its territory" (Simonofski et al., 2021, p. 1). Therefore, citizen participation is crucial, and people require intrinsic or extrinsic motivation to engage. Intrinsically motivated people engage in an activity because they find it interesting and inherently satisfying (Alamri et al., 2020; Di Domenico and Ryan, 2017). On the other hand, extrinsically motivated people engage in an activity to achieve a consequence e.g., a reward (Di Domenico and Ryan, 2017). Our study is grounded on two kernel theories (KT) (Kuechler and Vaishnavi, 2008), that describe motivation. **KT1:** The Self-Determination Theory (SDT) by Ryan and Deci (2000) is a motivation theory that identifies three basic psychological needs that influence motivation: *Competence* describes the need for mastery and control over the outcome of a challenge. *Autonomy* means the need to overcome a challenge on one's own power. *Relatedness* describes the need to feel connected (Birk et al., 2016; Ryan and Deci, 2000). **KT2:** The theory of self-efficacy by Bandura (1977) describes that a person's expectation of an ability influences their perception of performance and promotes motivation to perform. To perform tasks, intrinsic motivation and the perception that success has been/can be achieved are needed (Bandura, 1977).

2.2 Conversational Agents and Virtual Companions

Conversational Agents (CA) are digital systems based on natural language (McTear et al., 2016), interacting with users by text (as a chatbot) or voice (as a virtual assistant) (Gnewuch et al., 2017). CA can have different characteristics in terms of the scope of the task and the intensity of the relationship between the agent and the user (Janssen et al., 2020; Strohmann et al., 2022). Virtual Companions (VC) are emotionally and socially acting virtual collaboration partners (Krämer et al., 2011; Strohmann et al., 2022) with autonomous, proactive interactions (Strohmann et al., 2022). To develop a VC supporting participation, another relevant KT is

introduced: **KT3:** The Computers Are Social Actors-Theory (CASA) states that people transfer social heuristics to computers by assigning social attributes to the system. Despite recognizing the system as non-human, users form attachments through the social behavior of the system. (Nass et al., 1994; Nass and Moon, 2000)

3 Methodology/Design Science Research

The Design Science Research (DSR) paradigm enhances knowledge and understanding of a problem domain and potential solutions through designing and applying DSR artifacts (Hevner et al., 2004). Vom Brocke et al. (2020) assert that knowledge of a context-specific problem and knowledge about potential solutions can independently coexist. Therefore, design knowledge arises from the fact that the context and quality criteria dependent on it (problem space) as well as the representations of possible solutions and their development process (solution space) are related to each other via the evaluation of artifacts. Design knowledge can be either in the form of theoretically abstract knowledge (design theory), such as design principles, or in the form of instantiated artifacts (design entities) (Brocke et al., 2020). In the DSR, there are different strategic approaches to arrive at the design theoretical knowledge (Iivari, 2015; Möller et al., 2020). Möller et al. (2020) propose two possible approaches in their method for design principles development: *reflective* (instantiation first, then extract knowledge) and *supportive* (identify and synthesize knowledge, then instantiate). In our research approach, we want to use the reflective approach. In our design cycle, we focus on a very creative, participatory, and user-centered approach to instantiate a prototype in three stages and then extracting reflective design principles.

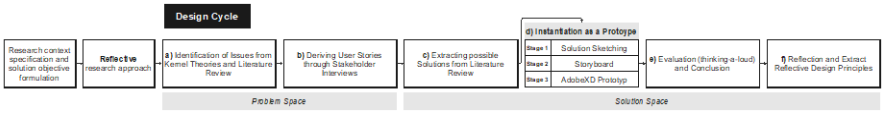

Figure 1: Design Cycle (Reflective Approach)

3.1 Problem Space

Understanding the problem space is crucial for generating design knowledge, comprising the four key components: needs, goals, requirements, and stakeholders (Maedche et al., 2019). In our approach we divide the process of understanding the problem space into the following three consecutive steps: (1) Identification of issues from kernel theories and literature review, (2) Deriving User Stories through stakeholder interviews and (3) Extracting possible solutions from literature review.

In the first step, interviews were conducted to identify the basic problems and needs of the stakeholders. Two systematic literature reviews based on the PRISMA Statement of Moher et al. (2009) were used to frame the questions for the interview. The databases selected for the literature search were Scopus, IEEE Xplore Digital Library, and ACM Digital Library to identify literature from two important categories (1) participation and (2) motivation. Accordingly, the final search query was as follows: *(participation OR e-participation OR collaboration) AND (service OR support OR experience OR benefit OR utility OR incentive OR gain OR inspiration OR encouragement OR interest)*. Furthermore, we aimed to gain insights into the general attitude of stakeholders towards VC. Using the same databases, we searched within the categories of (1) virtual companion and (2) service. The final search query was: *(virtual assistant OR virtual companion OR companion OR virtual collaborator OR artificial intelligence OR conversational agents) AND (service OR support OR experience OR benefit OR utility OR incentive OR gain OR inspiration OR encouragement OR interest).*

To capture user stories on VC and participation, we conducted additional interviews using an open questionnaire based on the literature. In the interviews, we explored experiences with virtual assistants, differentiating between assistants and companions, and defined "participation" in the context of TU Braunschweig's "Sandkasten" examining experiences, motives, and restraints. Finally, we introduced the PaCo concept to explore potential motivation and support methods. 30-minutes-interviews with six students were conducted, recorded, transcribed and coded to ensure a complete evaluation and identification of their problems and needs. The age range of interviewees was 21-28 years, with 66.6% male and 33.3% female participants. All interviewees are currently studying at the TU Braunschweig. For the

evaluation of the interviews, we used the text analysis software MAXQDA[1], that provides the option of assigning a code to individual text segments (coded segments). The codes were developed inductively and data-driven after reviewing the transcribed interviews, therefore the categories were created afterwards (Kuckartz and Rädiker, 2019).

Finally, a literature review was conducted to identify approaches for motivating individuals in other areas, searching the same databases for the categories (1) motivation and (2) encouragement. The search query was: *(develop OR increase OR attract OR motivate OR animate) AND ("intrinsic motivation" OR "intrinsic encouragement").*

3.2 Solution Space

The resulting proposal features a prototype of a VC assisting students in participation activities and adapting to their needs. To ensure a user centered development and practical relevance, three students (1 female, 2 male) participated in shaping the solution space within the scope of an innovation project at the TU Braunschweig. In order to generate design knowledge, we followed two main steps: (1) Iterative artifact design based on the design sprint approach (Knapp et al., 2016) and (2) Explorative Evaluation with stakeholders.

The first step included three substeps, inspired by the design sprint approach by Knapp et al. (2016): (a) *Sketching and evaluating possible solutions within the problem space:* We started by generating ideas for motivating individuals to participate by a VC. Every co-creator sketched eight individual ideas each, resulting in a total of 24 ideas. To prepare for the next substep, the ideas were then voted, to decide on the three best solutions. (b) *Creating and evaluating final solutions and decide on the best*: In the second substep, every co-creator created a storyboard using one of the top-three-solutions developed in substep a). The storyboards aimed to show the stakeholders' problem, the possible solutions and the desired goal in a comic-like way. In the end the three storyboards were evaluated by the co-creators and three additional students (2 female, 1 male) via dot voting, to decide on the final solution. (c) *Development of a testable prototype:* We started by developing a conversational path for an interaction

[1] www.maxqda.com

between the PaCo and a potential user based on the final solution (see step b). Based on the conversational path we created a clickable prototype-chat using AdobeXD[2].

The second step involved an explorative evaluation with 26 students to collect and analyze early feedback. The user test took approximately 20 minutes, and the students were encouraged to speak their thoughts aloud while using the prototype. The thoughts were collected in keywords, to create a relaxed scenario by not using an audio recording device and transcribing every spoken word. The age range of interviewees was 19-33 years, with 58% male and 42% female participants, with everyone currently studying at the TU Braunschweig.

4 Designing a Participation Companion

4.1 Deriving User Stories for Participation Companions

In total, during the analysis of the transcribed interviews in MAXQDA we collected and evaluated 104 passages of text, with 14 codes. The results were then classified into three main categories: (1) Participation, (2) Virtual Companion and (3) Participation Companion. In the next step, the codes were further sorted within these categories and assigned to experiences, challenges, and value. The results represent three main reasons for the lack of motivation to participate among students: lack of interest, lack of knowledge and lack of time. First, the lack of interest was identified, which refers to both missing interest in participation and in the projects offered by the "Sandkasten". Furthermore, it was found that most of the students are unaware of the projects or lack knowledge on how to participate. Furthermore, the students cited their preference for other activities as the reason for their limited time and lack of participation. In addition to identifying the main reasons for the lack motivation to participate, we were able to develop 12 user stories (US) for the categories *support*, *purpose*, *behaviour* and *safety* from the interviews. In summary users desire the PaCo to introduce and connect them to projects, clarify participation goals and meaning, and suggest supportable activities. They expect the PaCo to understand them, display (or not display) emotions, and provide motivation. Users also prioritize establishing (or avoiding) a relationship with the PaCo and ensuring personal data protection. The following literature research aimed to identify

[2] www.adobe.com/products/xd

possible solutions, that can increase motivation and can be used for our next steps of developing a prototype. The identified literature is primarily from the fields of education, sports, and work. An excerpt about the main findings is given in Table 1.

Table 1: Excerpt from motivating activities from literature review

#	Applicable motivating activities from literature review	Notable KT
S1	The motivating person should be self-motivated and authentic (Bejtic, 2021; Brophy, 1972; Hanke, 2019).	KT3
S2	Content and tasks should be manageable, but not too easy or repetitive (Bejtic, 2021).	KT2
S3	Verbal praise and positive feedback increase motivation (Cameron and Pierce, 1994; Taylor and Alla, 2019).	KT3
S4	By solving a task and/or improving social skills, the possibility of professional development arises, which promotes motivation (Chen et al., 2019).	KT1, KT2
S5	Gamification, i.e. the application of the game idea and its basic mechanisms in non-game contexts can promote motivation (Aditya et al., 2018; Birk et al., 2016; Helmefalk et al., 2020).	-
S6	Task should have a clear goal and structure (Pange et al., 2018).	KT1, KT2
S7	Deciding on their own which task to fulfill, increases motivation (Koskialho, 2017; Pange et al., 2018; Syahril et al., 2021).	KT1

4.2 Designing of the artifact

The artifact design process was based on the design sprint approach (see Figure 2). We started by generating 24 ideas inspired by our findings from literature review and internet search. Afterwards, the co-creators voted for the 3 best solutions, which can be divided into 3 phases: (1) attract attention, (2) facilitate participation process and (3) stay involved. The first phase consisted of a push-notification combined with an extrinsic motivator, to attract attention. The second phase included the subdivision of the main goal into subgoals, to ease the participation process. The third phase targets the moment, when the participation is over and the competition among friends can keep people stay involved.

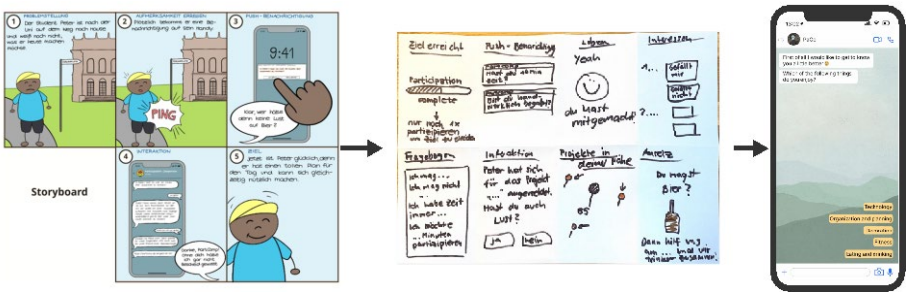

Figure 2: Process of the design sprint

The ideas were then refined and drawn in five comic-style slides using storyboards that depicted the stakeholders' problem, the possible solution, and the desired goal. Subsequently, the storyboards were voted by the co-creators which led to the final choice: the facilitation of the participation process by subdividing the main goal into subgoals. For the final solution motivating activities from literature and internet searches were integrated into the storyboard, along with the matching task assignment based on the stakeholder interviews. To represent the assignment to a task, a fictional project was developed and divided into subtasks that were assigned to interests and time slots. By creating a conversational path, which outlines a rough flow for the interaction between the user and the PaCo, we specified the steps required for the prototype implementation. Using the Virtual Companion Canvas (Strohmann et al., 2019), we framed the PaCo's behavior and appearance as friendly and courteous, with a neutral humanlike avatar. The prototype was designed as a clickable interface in AdobeXD (see Figure 3). To simulate the assignment of the matching task, different click paths were created that lead to the correct task according to the previously selected interests. The participants had to choose from prefabricated answers as the prototype wasn't able to provide individual messages.

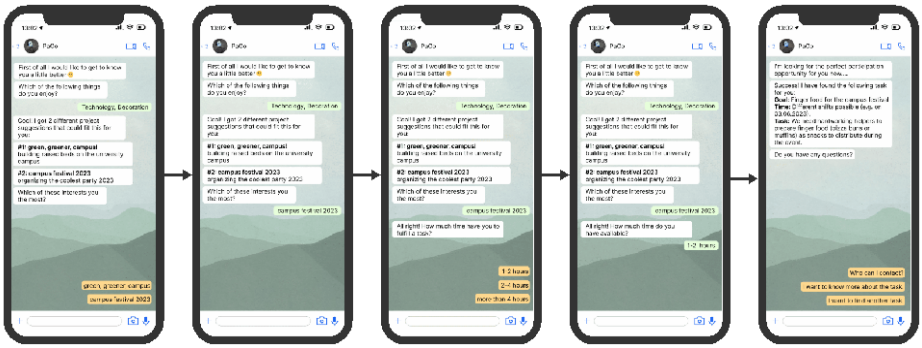

Figure 3: Conversation Flow of the Prototype

5 Explorative evaluation

The explorative evaluation of the prototype had the goal of obtaining feedback for further developments as early as possible. While using the prototype the participants phrased their thoughts about the PaCo, which led to results outlining first impressions of the stakeholders. Participants expressed some thoughts on the language, particularly related to the design of the PaCo's text messages, that should be shorter, more structured, use emojis and hyperlinks. The appearance of the PaCo was partially criticized, as it was perceived as strange and uncanny. But in general, the human-like appearance was perceived as positive. Regarding the capabilities, it was noted that the PaCo should communicate in a goal-oriented and open manner to ensure transparency. In the area of participation, the participants would like to see clear goals and motives, as these motivate them to participate.

In addition to the collection of the participants thoughts, we developed a post-test questionnaire to assess the participants' experience with the task assignment of the PaCo. The questionnaire covered questions about the task assignment, the purpose, the use and the sustainability. We rated all items on a five-point Likert-scale. A summary of the results of the post-test questionnaire can be found in Table 2. Looking at the descriptive data, the assignment of the task by the PaCo was generally rated as positive. Especially the low standard deviation (0,49) for the first question also indicates, that the participants agree that the task assignment facilitates the entry

into the project. Furthermore, it can be stated that the participants are aware of the goal and the benefit of the task and would recommend the PaCo to friends.

Table 2: Results of the Post-test Questionnaire

Category	Question	Mean	SD
Task-assignment	PaCo's assignment of a task made it easier for me to get started in the project.	4,60	0,49
	The structuring of the project into tasks by PaCo makes it easier for me to get started with the project.	4,48	0,57
	I can identify with my assigned task.	4,28	0,78
Purpose	It is clear to me what goal I am supposed to achieve with my task.	4,56	0,70
Use	My activity in the project has a clear use.	4,40	0,80
Sustainability	After my first experience, I would recommend the participation opportunity to friends	4,16	0,83

6 Discussion

Based on the findings of the explorative evaluation, there are some notes for further adjustments of the PaCo prototype: The study's participants highlighted the importance of clear, interactive, and engaging communication in the PaCo, ensuring that the language used by the PaCo facilitates understanding of the information being conveyed. The design of the PaCo should be non-prejudiced, customizable, and human-like to foster relatability and emphasize the importance of humanity in participation. This can enhance the user experience and creates a sense of connection between the user and the PaCo, thus encouraging participation. To foster transparency and trust, there is the need for openly communicating the benefits and capabilities of PaCo, clarifying goals and background of tasks early on, and providing precise details on time commitments. Clarifying goals, creating motives for participation, and providing value to users when compared to internet research is an essential feature.

According to the reflective approach (Möller et al., 2020) we first instantiated the prototype and then derived five reflective design principles (see Table 3). These design principles cover areas such as information transparency (DP1), motivating people to participate through matching algorithms and subtasks (DP2, DP3), implementing a systematic conversation structure (DP4), and providing valuable interactions compared to traditional internet research (DP5).

Table 3: Derivation of Reflective Design Principles

#	Reflective Design Principle (DP)
DP1	For designers and developers to design a Participation Companion (PaCo) that promotes transparency and purposefulness, clear information must be given about the goal, the time required, and the content of the participation opportunity.
DP2	For designers and developers to design a PaCo that promotes autonomy, relatedness and competence, a matching algorithm can be integrated that suggests different participation opportunities based on interests, skills, and available time.
DP3	For designers and developers to design a PaCo that supports self-efficancy and autonomy, participation tasks need to be divided into sub-steps that are clearly defined and explained in order to make participation understandable and accessible.
DP4	For designers and developers to design a PaCo that introduces the participation scenario to the user the conversation must be designed systematically, logically and intuitively by explaining the functions and contents of the PaCo, introducing the participation project and then asking about the user's interests and skills.
DP5	For designers and developers to design a PaCo that enhances the value and motivation for participation, goals must be articulated clearly, incentives (e.g., community, commitment, certificates) must be created and a unique value proposition compared to traditional internet research must be offered.

Our study has some limitations that should be acknowledged. First the sample size of the user test was relatively small. Additionally, the participants in the study were mainly students, which may not fully represent the diverse range of potential users of the PaCo. Second, the prototype's limited interactive capabilities, with users choosing prefabricated answers, may have affected feedback due to the lack of personalized conversations.

7 Conclusion

To address the lack of design knowledge for VC supporting bottom-up participation, we identified stakeholder needs and motivational issues. Based on possible solutions from literature, a prototype, designed as a conversational interface, was developed and evaluated in an iterative, user-oriented process. In the final step five reflective DP were derived, that cover areas such as information transparency, motivating people to participate through matching algorithms and subtasks, implementing a systematic conversation structure, and providing valuable interactions compared to traditional internet research. The DP contribute to the to the body of knowledge on designing a VC supporting participation and provide guidance for designers in developing a PaCo. Although our research focuses on students, its findings on the potential of a PaCo in promoting engagement and motivation can contribute to municipal participation. More research is needed to determine how our DP can be extended to urban contexts. In addition, future research should refine the DP as well as develop an advanced prototype, and investigate the long-term effects of the PaCo on user engagement and motivation for participation.

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