Citizen-Centered Design in Urban Planning: How Augmented Reality can be used in Citizen Participation Processes

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ABSTRACT

Most participation processes in urban planning offer poor incentives, especially for young citizens, hence important citizen's needs are excluded. Our work aims at identifying the degree to which Augmented Reality (AR) might motivate young people. We developed an AR-app with Unity3D to create new interaction concepts for use cases in urban planning. Building projects and environment changes are visualized, so citizens can contribute design ideas to the process. Using a human-centered design approach, we invited different stakeholders to participate. We conducted 40 interviews and a survey, then interaction concepts were evolved by citizens in four participatory design workshops. Our findings show that AR can motivate increased participation in urban planning. We also demonstrate a new approach to engaging low-tech users in designing high-tech solutions such as AR systems by using haptic 3D-tools like Lego or clay. Furthermore, we propose ways in which AR could be used collaboratively and embedded in existing participation processes.

CCS CONCEPTS

• **Human-centered computing**; • **Human computer interaction (HCI)**; • **Interaction paradigms**; • **Mixed / augmented reality**;

KEYWORDS

human-centered design, augmented reality, urban planning, citizen participation

ACM Reference Format:

Sheree May Saßmannshausen, Jörg Radtke, Nino Bohn, Hassan Hussein, Dave Randall, and Volkmar Pipek. 2021. Citizen-Centered Design in Urban Planning: How Augmented Reality can be used in Citizen Participation Processes. In *Designing Interactive Systems Conference 2021 (DIS '21)*, June

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DIS '21, June 28–July 02, 2021, Virtual Event, USA
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ACM ISBN 978-1-4503-8476-6/21/07.
<https://doi.org/10.1145/3461778.3462130>

28–July 02, 2021, Virtual Event, USA. ACM, New York, NY, USA, 16 pages.
<https://doi.org/10.1145/3461778.3462130>

1 INTRODUCTION

A growing interest in citizens' participation has been evident in the context of urban planning [1, 86, 87]. However, current participation formats, we suggest, offer few incentives, especially for younger citizens and tend to engage older populations. As a result, the needs of other citizens, often those most affected by urban planning, are not considered. A planning process which is comprehensive will enhance the legitimacy of decision-making [48, 66]. Conventional participation procedures such as town hall meetings are arguably less relevant in a more digitized society, allied to the effects of the COVID-19 pandemic [29]. In many cities in Germany, e-participation has already been successful largely because it makes it easier for diverse citizens to provide direct input [65]. Creative tools can offer more incentive, diversity, and potentially a better reflection of public opinion. The responsiveness of decisions can also be improved [7, 17, 53, 59]. The portfolio of participation channels and tools in urban e-planning is immense, even if much of it is not extensively used [77, 88, 98]. For the most part, increased use of photos, videos and voice messages, and based on social media, though often developed collaboratively, is typically limited to communication [72, 107]. Opportunities for input into redesign are seldom sufficiently realized. Our work is predicated on the examination of better visualizations in order to show urban planning comprehensibly and assess their effectiveness for citizens, and younger citizens in particular.

In the following, we focus on AR offerings in participatory community urban planning, especially for younger people. Research has shown firstly that youth is seldom involved in planning processes [71], secondly that they have a solid relationship to visual media technologies [50], and thirdly, that visualizations offer a radical new approach to urban planning [9]. In contrast to conventional methods, AR incorporates real surroundings, ensures comprehensibility, and can thus, in principle, increase the acceptance of planning projects. Also, the playful approach may increase motivation, especially among young people who are more familiar with this. AR offers the advantage of developing one's ideas or (re)design existing or new objects, which is not possible with web-based solutions such

as Google Street View. In urban and land-use planning, the failures of citizen participation become tangible when ongoing construction projects face resistance. We assume several reasons for these failures. Firstly, the question of timing of participation is crucial because, while a participation process necessarily needs to start to be able to incorporate its results into the design/planning process, it is not necessarily evident to citizens why it is now time to engage (“Collingridge Dilemma” [16, 57]). Secondly, the estimated outcome of a planning process is often not seen to be relevant to one’s own life. Therefore, participation seems to be not relevant. Thirdly there is scepticism about one’s influence as an individual on the planning results. Fourthly, the organizational and technological structures of participation in urban planning feel somewhat distant from everyday concerns.

In this paper, we address the options that might increase the interest and creativity of e-planning. These include methods of visualization, Augmented Reality (AR) and deliberations in virtual space [2, 15, 62, 63, 74]. We explore the potential of Augmented Reality for citizen participation in urban planning, paying attention to the benefits that may accrue from spatial and contextual cues. In sharing our experiences in designing an augmented reality app for citizen participation, we create new interaction concepts for use cases in urban planning. The central goals are to aim for a higher degree of interactivity in participation processes, to achieve greater acceptance through transparency, to share information and visualizations with citizens and to collect new ideas from citizens. Hence, we present options for using existing social media channels and integrating our participation tool in existing participation formats for a better diversity of offerings. [21]. We proceed as follows. Firstly, we discuss user needs and the potential of participation processes. Secondly, we create an interaction concept for an augmented reality participation tool for citizen-based practices with strong spatial references. Thirdly, we demonstrate a new design approach to engage low-tech users in the design of high-tech solutions such as AR systems through a participatory design approach using, e.g., Lego Prototyping and other haptic 3D tools. We conclude by proposing ways in which Augmented Reality might be used collaboratively and embedded in existing participation processes, and what the organizational and technical challenges and limitations are.

2 RELATED WORK

E-participation as a dynamic and increasingly explored topic of interest, is often discussed. Conditions for success are evaluated, but it appears that participation is highly context-dependent and has to be assessed for individual cases [80]. Less studied is e-planning, in particular, augmented reality in e-planning. In principle, AR and 3D visualization methods are suitable to provide citizens with optimal access to objects, buildings, and environments, which offer a much better idea of urban plans than 2D-representations. Many new ways of supporting participation through technology are currently explored in research and design, from online tools and mobile applications to ubiquitous technologies embedded in the *smart* cityscape. One promising new technology is augmented reality, which adds a digital layer of information to reality, e.g., by overlaying images on a display. This fusion of real and the virtual information, makes

AR interesting for political projects that involve physical transformations, such as changes to the environment. AR can visualize ideas for improving the city, not only in virtual representations but also in a way that includes spatial experience and contextual information. Therefore, it seems reasonable to overcome the gap between experience in virtual space and place of participation by directly coupling 3D-experience and input. There are still very few practical approaches and research work on this [74].

2.1 Technology in Urban Planning

The potential of ICT in relation to planning processes and citizen deliberation has been discussed extensively. Various applications have been considered (see e.g. [5, 36, 85, 106]). More recently, Fredericks and Foth [31], for instance, show how Web 2.0 tools enhanced public participation in four Australian contexts. Houghton [42] similarly, through interviews and focus groups, assess the potential affordances of mobile devices and social media in the planning process. Schroeter [83] examine the role of public displays as a means to enhance civic engagement. Mallan [64] demonstrate the role that Second Life might play in citizen deliberations, especially younger students. Gonsalves [32], using an urban informatics lens, look more specifically at how ‘placemaking’ can be encouraged among more marginalized groups, creating community resilience. Shared virtual and augmented reality apps which allow users to generate, manipulate and interact with smart objects are also the subject of increased attention [100, 108]. Zheng shows that AR possibilities offer citizens the chance to participate in urban design and better prepare their suggestions for decision-makers and urban planners. Participants in a shared reality study [103] showed increased awareness of their surroundings, problems, and potential for improvement. AR systems seem to provide useful and motivating visual support for planning processes. A significantly higher willingness to participate in urban planning projects was observed in the general population by Allen et al. [3]. Other studies suggest that such visualizations help participants to see better and feel more informed about construction projects than traditional methods such as paper models, blueprints, or photomontages [3, 25, 39, 51, 103]. An improved information situation for participants is expected to have positive effects on decision-making processes. There is a positive correlation between analytical, practical, and creative performance with visuo-spatial ideas, which can be specifically promoted through virtual visualizations [8]. The concept of augmented deliberation [34], on the other hand, involves real-time participation supported by interactive virtual models. A particularly innovative contribution is to be found in a study by Foth et al. [30]. Participants were able to share feedback by drawing, moving, or changing parts of a 3D model and commenting live in the virtual environment while discussing their suggestions with planners and other participants. This approach facilitates co-design, supported by VR and AR technology, and promotes the long-term engagement of public and private partners. The “Finding Places” case study demonstrates an innovative range of design and decision-making tools in the field of urban development and adds participatory elements to the planning process [81]. The results suggest that such a tool will enable stakeholders to design urban environments from the ground up [46]. Further findings show that VR technology users show significantly higher engagement than those who viewed 2D plans on

paper or 360° images on a computer [100]. In summary, AR and VR technologies can improve public participation and interaction between all stakeholders of a project and local communities [35].

2.2 Motivating Young People with Augmented Reality

As AR is still not widely used, and relatively little literature can be found specifically on AR and political youth participation. Hence, we explored related fields such as VR education. Motivating effects which can, in principle, be enhanced by AR, are already shown in various studies. Motivating factors for young people include teamwork, challenges (e.g., competitions), and exploration of the environment [60]. These factors increase perceived self-efficiency, which positively affects motivation and engagement [12, 54, 84, 89]. These findings are not surprising, given the popularity of AR and VR entertainment among youth, especially location-based Augmented Reality Games (ARG) that connect the natural environment with virtual experiences, such as *PokemonGo*. Game-based approaches (gamification) are sometimes discussed as special incentives for citizens [8, 37, 38, 94], which in the planning context could be a kind of augmented playfulness for engagement, motivation and empowerment for citizens [95–97]. AR, it is suggested, can be a promising option especially for young people who are still underrepresented participants [24, 78, 109]. A core element of these ARGs is the collaborative exploration of public spaces enriched by a virtual layer and its potential for urban design and urban planning was explored in [75]. As a result, the merging of digital and physical public spaces, which profoundly impacts how people experience and interact in and with them, is becoming more common. This indicates that ARGs and their underlying technology open up numerous opportunities for urban planners and designers. Location-based AR technology offers a wide range of options, from simple text information, the identification of buildings, to the multi-perspective visualization of objects, which can be enriched by users with various media. AR can improve the daily communication of architects and planners and enable non-professionals, e. g. young citizens, to inform themselves and to shape their own opinion about building projects [40, 49].

2.3 Human-Centered Design for Augmented Reality

Limited research utilizing human-centered approaches with AR in urban planning exists [26–28]. The core issue is, of course, to make the technology usable and useful. That involves not only a vivid experience in virtual space, but also expanding the possibilities for optimal virtual interaction and articulation. This includes designing an outcome that can be evaluated and used by decision-makers, citizens and other stakeholders. There are still relatively few approaches to designing specifically for AR. Several prototyping methods are employed that result in prototypes of varying fidelity, such as simple and economical paper prototypes [58] and some which provide a degree of interactivity by integrating software and hardware [68]. Low-fidelity (Low-fi) prototypes allow designers to gain real user insights in the earliest stages of the design process, while decisions remain open and modifications are still possible. Many studies compare low-fidelity prototypes to higher fidelity

ones and find that both are equally suitable for identifying major usability flaws [82, 102]. So far, only a few attempts at developing efficient methods of low-fidelity prototyping and testing for AR exist. These combine users' imagination, Wizard of Oz techniques, paper prototyping, and usability testing [43]. For modeling purposes, Lego prototyping is sometimes utilized in participatory design [91]. Besides the cost advantage, these established low-fidelity prototyping methods offer several benefits. The literature contains several approaches for developing guidelines, which are often based on long-established heuristics [23, 56], e.g. heuristics of Nielsen and Molich [70]. But these heuristics were 1990 initially developed out of website evaluations and, therefore defined for 2D-screens. Considerations of spatial awareness and 3D are still rare. However, AR should be standardized according to UX aspects [47, 79], because smartphone-based AR systems require an understanding of the relationship between technology and interactions with it. For instance, it is essential to point the camera at the correct AR marker or at the correct position of the panoramic scene [73]. Thus, user interface design must be targeted to enable the user's attention on the task and reduce the cognitive load induced by interaction [23]. The same applies to AR systems with novel and not yet established interaction metaphors. The cognitive load may be lower for experts and designers of the specific system, but this cannot be assumed for inexperienced users. The barrier to use must remain as low as possible, also for users such as young people, who should first be motivated to participate and use augmented reality as a tool and motivational incentive. Therefore, it is essential for successful and usable AR systems that suitable design methods for AR are used and that user studies are conducted early to obtain user feedback [20, 23]. Participatory Design (PD) is an approach to involve users in the design process at an early stage and let them participate as full participants in activities of the development processes [67]. Teli et al. [93] have used the synergetic potential of PD workshops in various settings (including participatory urbanism and citizen co-creation) to design a digital platform. Crewe [18] shows in her study about integrating citizen input for urban design, that 97% of her interviewees appreciate the value of citizen input as positive, claiming aesthetic contributions were overall beneficial.

While current research already involves approaches for e-participation, there are only a few AR offerings for participatory urban planning, especially for young people. AR has the potential to present city planning and ideas in a comprehensible way through visualizations in real-world environments and to motivate especially young citizens through a playful approach. Of course, it is one candidate among many as a form of technological mediation and we saw our task as identifying whether and if it conferred specific advantages in this context. Below we address its potential to facilitate different levels of participation, such as informing citizens, co-determination, and co-design.

3 RESEARCH APPROACH AND DESIGN METHODOLOGY

Our main approach was qualitative. We collected data in various cities in Germany. Our studies entailed 40 interviews [44], surveys (n=83) focus groups, and observations, all of which combined helped us to gain a deep understanding of different user needs. The

purpose of the interviews was to gain insights about experiences and attitudes regarding citizen participation processes among different stakeholders and to identify what role digital tools, social media, and technologies might play in this context. The first set of interviews was with politicians, the government administration, and citizens (19 participants, max. duration 90 min.), the second set of interviews (21 participants, max. duration 20 min.) were conducted as "street interviews" with citizens in the city. So, on the one hand, the interview partners were specifically researched and acquired (e.g., via digital portals) and on the other hand, we also interviewed random citizens on the street in their natural environment. In total, we interviewed 26 citizens, nine politicians, and five government employees. Metadata (gender, age, role) of the interviewees are tabulated in the Appendix in Table 1. The participant IDs are: G = Government employee, P = Politician, C = Citizen. We also conducted a survey with 83 citizens aged 8 - 77 (average: 46.77 years). The respondents were predominantly male (65.06%) and academic (31.33%). We collected findings on computer literacy, experience of (online) participation processes, political engagement, and current use of tools for information and exchange opportunities along with social media use. We obtained our results through a thematic analysis of e.g., the digital (online) potential for citizen participation and requirements for a possible participation tool. We collected more data by conducting different focus groups through Contextual Inquiry and group discussions with 25 participants (in sum). The findings from the empirical studies in terms of the interviews, surveys, and focus groups served mainly as the basis for Participatory Design Workshops. We presented the collected requirements to the participants to enable the citizens to develop design concepts and ensure a straightforward process. By conducting four participatory design workshops, we were able to co-create individual design solutions with users by using haptic materials like Lego or clay. During the workshops, we observed participants interacting with each other, and developing, and sharing their ideas in collaboration. We also informally asked the participants about their actions, thoughts and motivations during the process. Considering the participants concepts, the implementation was iteratively conceptualized with Adobe Aero and Adobe Experience Design and implemented in Unity3D with Vuforia and ARFoundation.

The data we collected were analyzed thematically in order to get a detailed understanding of the context of use and to define requirements for a digital participation tool [22]. Our design approach oriented to the human-centered design (HCD) process defined by the international standard laid down by DIN ISO 9241-210 for human-centered design. This standard is intended to ensure that interactive systems are developed with usability in mind, by focusing on the user, their needs and requirements. By adopting human-centered design and considering the context of use, we frame our approach as citizen-centered design. With this term, we would like to express our orientation towards the human-centered design approach but adapt it to our specific context of use. We use the concept of citizen-centered design in order to concretely specify the context in which citizen participation can take place. We focus on specific design case studies. The principles of HCD were used in the following way: To understand the context of use comprehensively, we adopted a mixed-methods approach, but emphasized the qualitative. By applying participatory design principles, users

were involved *during* the design process. In considering different use cases, the design solutions were continually refined iteratively together with real users. Based on ongoing human-centered evaluations, new requirements emerged. We considered the entire user experience by analyzing user needs and expectations *before* use and evaluating them *during* use. Furthermore, the user experience was also analyzed *after* use in evaluations and appropriation processes. Furthermore, as an interdisciplinary design team consisting of HCI professionals, computer scientists, political scientists, and a software development company, "multidisciplinary knowledge and perspectives are represented" [21].

Our research approach leads to the following research questions:

- How far can Augmented Reality support citizen participation and motivate young people (<30 years) in particular?
- What does the design process for Augmented Reality in that context look like?
- How can Augmented Reality be integrated into existing participation processes?
- What are challenges and limitations in the design process for Augmented Reality?

3.1 Case Studies

Two German cities (Olpe and Siegen) were involved in our project and provided real problem scenarios, which we describe as design case studies. Hence, we work practice-oriented and conduct in-depth field studies in real-world settings [105]. With this approach, we gain detailed knowledge about citizen participation processes, practices and values [11], which we also analyzed through existing documentation covering past participation events. Our use cases came from citizens' meetings, city walks, working groups, and a website for ideas collection.

3.1.1 Use Case 1: Co-Determination on the Building of a New City Town Hall. The existing city town hall is to be demolished and redesigned. An architectural competition aims to produce several potential designs, and citizens will participate in the final decision. In order to visualize these designs as comprehensibly as possible, augmented reality is an option. In this way, the citizens can imagine what a possible new building might look like in the real environment.

3.1.2 Use Case 2: Redesign of a Lakeshore Area. Another plan arises from the current environment of a lakeshore, which will be redesigned. Ideas from citizens are required. A co-design of the lakeshore is to be made possible through augmented reality, in which digital objects are placed in the real environment of the lakeshore.

4 EMPIRICAL STUDIES

We then conducted empirical studies using participatory design methods [67]. As part of human-centered design, users were involved at an early stage to identify user needs [79]. After a stakeholder analysis, we focused on the immediate users, which are affected stakeholders (private citizens) and decision-makers (politicians/government administration). In a pre-study consisting of interviews and surveys, we identified current experiences and practices in citizen participation. This also led to the identification of

requirements for a possible tool. We then conducted focus groups and several participatory design workshops to focus on augmented reality and develop design solutions based on the requirements.

4.1 Interviews and Survey

4.1.1 Use of Social Media. Our survey confirmed that social networks play a significant role: 50.60% of citizens inform themselves about participation options through social media (e.g., Facebook). Articles and information on the Internet and the city's website are preferred even more frequently (63.86% in each case). For 46.99%, it is *extremely important* (highest rating) to obtain information on projects (e.g., participation opportunities). Regarding smartphone literacy, 28.92% rated their knowledge level as "extremely good" and 37.35% as "very good," which also explains the preference for access on a mobile device when participating, which was rated as *extremely important* by 36.14%. Nevertheless, 37.35% consider it as *very important* to be able to access it in an Internet browser as well (e.g., on a computer). Asking for individual user needs, 36.14% of participants said it is *very important* for them to share their opinions online and participate (for 31.33% it is *extremely important*). Similarly, 39.76% of participants thought it is *very important* to share ideas or make suggestions online, with 32.53% considering this *extremely important*. For more than half of the participants it is *very important* to read the contributions of others online (51.81%), rate them, and comment on them.

4.1.2 Enhancing New Participation Formats Based on Online Potentials. We recognized that previous citizen participation formats were not sufficient to address a broad range of the population and motivate them to participate. One problem is, e.g., time and location dependency. The interviewees agreed on the importance of involving citizens to consider different perspectives, but also stressed the need to use different competencies (from the community).

"I think [...] that urban planners and architects have one view of the city, but all other users may have a different one. You have to talk about how people want to use a city and how citizens want to use a city. That's why I think it's so important for citizens to participate because they use the city." (G03)

More innovative participation formats mean involving citizens in various ways at different stages. In the ideation phase, citizens may create their ideas quite freely, and provide opportunities to consider alternatives. In a second step, urban planning options and legislation has to be considered,

"because with citizens one can't always assume [...] that they have also considered the complexity accordingly [...] when it comes to more complex decisions, it is reasonable that one leaves that to politics ... Afterwards, you can pick out individual projects again and say, dear citizens, we have three or four similar alternatives. Which do you prefer? [...] Also the issue with the town hall. If you have several alternatives, they are all within a scope that you expect, e.g., in terms of costs. Then it's just a matter of making a decision [...] there are three alternatives under

certain conditions. Why not let the citizens decide?" (P06)

That option also meets the wishes of citizens, who "very much want to be involved in the decision-making process" (C01). Traditional participation formats, we should stress, are not to be replaced but supplemented by new formats. That could motivate more citizens, because "people are curious, want to have new formats and be involved" (G02). The participants responded positively about using new technologies. C06 stated that young people are keen to use new technologies, and sometimes elders could learn from their children. A digital online tool fosters a group dynamic that also has potential for new ideas because "the group is always smarter than the smartest person in the group alone" (P02). By having a wide range, ideas emerge that "you would never have thought of on your own. [...] you get suggestions" (P01). Also, it achieves independence of time and place as discussed by C06 & C09. People can't always participate in the meetings due to time constraints. Spontaneity can thus be encouraged more. "If someone is sitting on the bus, on the train or somewhere else, then she/he should also be able to participate [...], with an app, I can access it right now" (P08). It is possible to address many people with an online tool; the hope is "that perhaps those who represent the masses will express themselves. [...] that not only the usual ones will participate. That, a broad cross-section of the population is reached. [...] perhaps they will also see that it is worthwhile to get involved" (P01).

4.1.3 Motivational Factors for Young Citizens under 30. Too few young citizens are currently involved in participation processes. It is desirable to involve more of them because they are significantly affected by the consequences of today's decisions as "the city is built for them" (G03). When asking the interviewees which age group should be involved in urban planning, most of them (with different ages from young to old) stated, e.g., "people who are younger than 35". The government also stresses the current absence of young citizens: "I totally miss young people. There were a few at the kick-off event, which was good. At the planning workshop, there were almost none at all [...]. Traditionally, only the older people who have the time participate come to the events [...] but the broad masses, the young people and young adults, I miss them because we build the city for them." (G03). G01 agrees: "The younger ones are very poorly represented. Under 30-year-olds were under 10% there [at the events]. That's a problem."

4.1.4 Visualizations as Essential User Needs Leads to Augmented Reality. Previous participation events show that citizens have some ideas for the redesign of their city. They do not always express them well due to a lack of tools, but their ideas could be made comprehensible through visualizations. Some of the participants (C06–C09), for example, wish to have more possibilities to sit near the water (case study 2) to stimulate ideas. Drawing options or providing digital objects could be beneficial (and were already provided in past events with printed city maps). C01 states, "I think it's good, if I could use provided tools [for visualizations]". A high level of usability is desirable because citizens have so far tended to have little intrinsic motivation to participate. A requirement is "to make the thresholds as low as possible and to create an incentive for people who might not bother to engage with it and want to get

involved" (P06). P07 stated, that a tool needs to be "visual, intuitive and moderated [...] the whole system also runs on smartphones and tablets". Visual tools are usable in urban planning because "when it's about buildings or infrastructure, a visualization is desirable. Sure, you can present any plans to someone. But not everyone can handle plans the way someone like me, who is technically skilled in reading plans, can. A 3D visualization e.g., is great" (P06). The participants mention the potential of augmented reality "to perhaps already look at things that one finds interesting or where I also get information presented, e.g., of buildings" (P05). AR seems to be very interesting for participants but they lack familiarity with it. They expressed surprise when seeing other AR applications. C09 mentions that she is interested in using new technologies, but needs to know the technology's instructions or tutorials. Gamification approaches have also positive acceptance. In contrast to traditional political strategies, such approaches could motivate young people to get involved because "you can probably only get them [young citizens] online. If you do get them online, I would say that creativity is needed. How can you motivate people? Maybe it's an online game" (G02). "Politics should then also be a bit playful. That's why an app like that fits quite well with such a younger world" (P08). The participants also mentioned social media integrations. Facebook is currently seen as an essential platform, as it has reached many people. C06 mentioned Facebook groups for discussing ideas and thoughts. The mayor also agrees: "The Facebook page that we use is an important platform. Because it allows us to achieve a fairly high level of dissemination" (P01). Among young citizens, on the other hand, Instagram is used instead of Facebook.

4.2 Participatory Design Workshop – Focus on Spatial Interactions

Our initial Participatory Design (PD) workshop with five citizens took place on-site in a park. The aim was to identify spatial interactions in the real environment by redesigning a specific area. We intended to address the particular challenges of designing for AR and identify possible prototyping methods for systems with spatial references. The workshop had three main activities, which contained the Design Sprint phases. For *Empathize* and *Define*, we used Walking interviews as an area exploration, with *Ideation* and *Prototyping*, the conception phase (individual and collaborative) started, and for *Testing*, we did reflective interviews with a brainstorming session at the end. As a case study for the workshop, we chose a fictional redesign of a park in the city center. The workshop started with walking interviews, enabling participants to move through and familiarize themselves with the actual park location. Participants explored the environment and gathered early ideas for redesign. Using materials (such as a clipboard, paper, and a printed map) that we provided, they explored the environment, took pictures, and wrote down and sketched their thoughts. In the conception phase the participants used different materials and utensils (e.g., Whiteboard, Cardboard and paper, Glue, Printout of elements, Play Dough, Toothpicks, Figures: Plastic models, Clipboards, Plastic foils, Gravel) for their concepts. A Blueprint / Map of the area (DIN A1 and A3) served as a basis. The first step was to individually develop ideas for the redesign of the park, which was then further developed collaboratively in the team. For the shared concept, the

Figure 1: Low-Fidelity Spatial Prototype for AR

team evaluated favorite features of the individual concepts with dot voting. These features were further considered.

4.2.1 Results. We observed which materials and strategies the participants used. The insights gathered helped generate possible suggestions for new design/prototyping opportunities. We regarded collaboration as an important focus for us since because most AR systems are used individually and not for collaborative work. In the context of urban planning, where different people can contribute new, creative ideas, a collaborative use of an augmented reality system is arguably advantageous. Observing movements in real, physical environments gave us insight into translation into digital interactions where appropriate. We interviewed the participants, first individually, then collectively, to ask them about their approach to the design process. It included their use of materials, explaining their ideas, and the pros and cons of collaboration. To express an idea, some participants used color coding; other participants preferred to explain ideas verbally to make them understandable. It was noticeable that hand gestures are often used, which might need to be taken into consideration. Three participants preferred physical modeling, which reinforced the feeling of working with others. When using flat sketches, one participant described it was easier to sketch in 2D, but it was difficult to explain. Therefore, a 3D view might be more comprehensible and easier to explain. Figure 1 shows the final design. The concept shows the redesign of a park with different areas. These subdivisions refer to the support of different activities and users. Also, in a digital design of a park, such categorizations need to be considered. One participant described the idea of building a park in an AR environment, where multiple users can see the same view.

5 PARTICIPATORY DESIGN WITH THE FOCUS ON YOUNG CITIZENS

After the above work, we focused specifically on young people (under 30), as they are significantly underrepresented in civic participation processes. We conducted further empirical studies with that group.

5.1 Focus Groups

5.1.1 Contextual Inquiry of the Event "Draw Your Own City". Drawing on Contextual Inquiry according to Holtzblatt & Beyer [41],

we participated in a citizens' event "*draw your own city*". In our partner city, the Caritas organized together with the youth center an event to bring young people and seniors together. The goal was to create ideas for the city's redesign through painting. About eight seniors and ten young people participated. We observed the interaction of the participants. In ad hoc interviews, we asked for their actions, ideas and motivations. We quickly got the impression that the cooperation between young people and seniors promoted creativity. It turns out that young people in particular have many wishes for a redesign, but they think that they are not heard. However, they would like to participate and change something. So far, they have barely heard of any citizen participation event. When asked, they confirm that an app would go well as a participation platform. They also prefer visualizations and would comment on other ideas, inspired by Instagram - the social media platform they use most. Regarding to experiences with augmented reality, they confirm that they are familiar with the AR game *PokemonGo*.

5.1.2 Group Discussion with the Youth Parliament. We conducted a group discussion with young people as a focus group. Participants were seven young people between the ages of 15 and 19 who are part of the youth parliament. We discussed topics like behavior during leisure time, relation to the city, engagement and experiences in participation processes, their use of (social) digital and analog media, known and preferred app features as well as ideas for a new participation app. It became clear that young people do not feel they are taken seriously and are not very involved, although they would like to participate more because they "also want to have a voice somehow." All participants agreed on social media as the best way to address young people. As a specific social media platform, "Instagram is the best at the moment." A reason typically expressed is the use of visualizations. It is a platform "where you can visualize more things, and that is then also easier to understand for most people. Then it is also easier to imagine something about it." Therefore, most participants expressed a positive attitude towards augmented reality because they think "it's actually great. Because then you can already see directly what it will look like [...] it's also very illustrative. You can say: I now imagine that the green corner is right there. Then you put a green corner there and say: It doesn't quite fit. Then you can also say: No, the green corner is removed. That would actually be a very good idea. And maybe you could also rate other people's ideas accordingly." The participants emphasized that such functions could increase participation, especially among young people, and are well accepted. Nevertheless, young citizens also value personal exchange. It is likely they would want to use a digital tool in combination with a personal exchange, possibly also collaboratively.

5.2 Participatory Design Workshops

We conducted three more Participatory Design Workshops with young citizens. In sum, 15 participants (three members of the youth parliament and 12 students) participated and designed AR prototypes with several materials like Lego or clay. Due to the corona situation, one session took place virtually.

5.2.1 Session 1. Here, we pursued work with the youth parliament by conducting a workshop based on the findings of the group discussion. As a Design Sprint [55] we included the phases *Understand, Ideation and Prototype*. The problem scenario presented was the use case relating to the redesign of the lakeshore. To create a real atmosphere (since the workshop could not be done in daylight), posters of the lakeshore were hung up so that participants met in front of it and interacted with each other. We observed how the participants exchanged and interacted with each other and with the real environment when creating new ideas. Based on this, they developed design ideas for an AR system, which supported their interaction. For the transformation into design solutions, the participants started to sketch mockups and storyboards, for which they used different materials like white and transparent whiteboard foils. It was apparent that visualizations played a significant role. Their mockups had approaches for visualizations or scanning/photographing the real environment and commenting on these photos, redesigns, and drawings. The participants also integrated social media, such that the visualized ideas could be shared with other citizens. Suggestions were also made to use QR codes that can be scanned in the real environment to provide more information digitally. As part of the visualization capabilities, transparent sheets were used to overlay the lakeshore poster to sketch mockups specifically for augmented reality user interfaces. It showed, we argue, the importance of the real environment in the design process. Subsequently, 3D prototypes were created. Materials such as Lego, Playdoh, and other craft materials were provided. Lego as a prototyping method was preferred because it supports some degree of tangibility or spatial reference. It became clear that citizens like to communicate, collaborate and to work together on possible ideas for improvement. Interaction support, then, was seen as a key element of AR system. Figure 2 shows the final prototype for a possible AR system, where both the real environment, digital objects and the AR device itself are included. It also allows for the (collaborative) placement of objects in the real environment. Also essential are requirements such as voting, discussions, comments. Nevertheless, it was often noted that personal "face-to-face" exchange was also essential and should not be disregarded.

5.2.2 Session 2. The next workshop was with six citizens, who discussed the user needs identified in the interviews. Using a camera, we recorded the workshop, and we took notes about the participants' feedback for the analysis. The participants structured the interview data using the Affinity Diagram. With methods like Dot Voting and Method 101, they came up with some design ideas related to urban planning. Hence, they suggested designing a system that could collect data from all affected people and then create a collective decision by majority opinion. Citizens would be included in the decision process by using, e.g., a voting system, which gives the citizens the chance to express their opinions about some decisions or problems. Also, a gamification approach was felt to encourage instant interaction, facilitate happiness, and lead to simple decisions or actions. In this regard, the participants suggested using AR in urban planning in a way that helps the decision-makers. Figure 3 shows some workshop results, e.g., citizens can place 3D objects

Figure 2: Low-Fidelity Lego-Prototype

Figure 3: Left: Low-Fi Prototype for Object Placement and Social Media Sharing. Right: AR Table with 3D Objects

in the city using an AR app and share it via social media. The picture of the redesigned area can get likes or comments. For more collaboration, the participants suggested the use of a 3D AR table, which should act as a map. On that table, the citizens can place new objects and move them to show and discuss with others. It can be placed in several places within the city.

5.2.3 Session 3: Online Participatory Design Workshop due to the COVID-19 Situation. Because Covid-19 intervened, we used Stormboard¹ and Zoom² as tools for a collaboration board and for an online meeting. With Zoom, we recorded all the activities automatically. The workshop was based on the interview data gathered, which were structured by the participants using the affinity diagram method to define the current problem situation. For the ideation phase, methods like N.U.F. (new, useful, feasible) and 6-3-5 Techniques were used to create ideas for a possible solution. In the prototyping phase, the participants were free to draw, use clay, Lego, or whatever materials they had. Afterwards, they posted their prototype as a picture on the Stormboard. The participants used mostly sketches to show their solutions. In the online version of the PD workshop, it was hard to track all activities and to deduce how the participants felt about the discussion. It was easier to record the workshop using a camera for a later analysis in the physical workshop. We took some notes about the participants' feedback, but when online, some participants chose to disable their

cameras, which made it hard for us to see their facial expressions and emotions.

6 CONCEPTION AND FUNCTIONALITIES

Through the insights gained, we defined requirements for our participation tool. Due to the time and place dependency as well as the need for device familiarity, we chose a mobile smartphone application. Users can participate and obtain information while on the go without investing enormous effort. Based on the two use cases, we address two types of citizen participation: firstly, informing citizens with options for co-determination on planned projects and secondly, gathering input and ideas with co-design opportunities from citizens. Visualizations play a significant role in ensuring comprehensibility in communication - be it to inform the citizens appropriately or to be able to communicate their opinions and ideas. In that context, augmented reality technology was identified as a useful visualization option, as this functionality includes the real environment and enriches it with digital objects. That innovative approach, we argue, could increase participation and especially motivate citizens, such as young citizens, to get more involved. Since Augmented Reality is not yet widespread in everyday life, the users need to be supported in learning how to use it. Therefore, when the app first launches, a tutorial mode appears, which guides the user through possible interactions with the app. Also, the need for voting and commenting functions was mentioned to stimulate an exchange and gather opinions on specific decisions.

¹www.stormboard.com

²www.zoom.us

These requirements also support the need for social media integration. The stakeholders also agreed that the digital tool should be embedded in traditional participation processes, thus combining "offline" participation events with "online" tools.

In sum, we integrated the following requirements in our prototype:

- Possibility of mobile participation
- Appropriate information about planned building projects
- Participation / co-determination in the planning of public buildings
- Contribution of own ideas and co-design possibilities
- Contribution of personal opinions regarding planned building projects
- Use of visualization functions, especially the use of augmented reality
- Integration of Social Media
- Support of information exchange

7 PROTOTYPING AN AUGMENTED REALITY-APP FOR CITIZEN PARTICIPATION

Design Thinking is known to be an efficient way to prototype as early as possible and then iterate through multiple cycles of customization. For traditional 2D-screen-based products, this approach is easy to implement. Sketched paper prototypes and click dummies are a cost-effective way to gain valuable insights into basic product features early in the development process. For AR, the situation is more difficult due to the spatial dimension. The lack of efficient, low-fidelity methods is a very limiting challenge in prototyping AR applications and limits the scope for human-centered approaches. Thus, we explored possible approaches for low-fidelity prototyping that consider the AR context. We developed different prototypes throughout our process - from low-fidelity to high-fidelity prototypes - in an iterative process designed to increase functionality. Finally, we implemented an augmented reality app as a solution for the aforementioned use cases in urban planning by using tools like Adobe Aero, Adobe Experience Design, and Unity3D.

7.1 Lego Prototyping

Our Participatory Design Workshops showed that haptic 3D tools play an important role when assessing the significance of the real environment and the spatial third dimension. Lego prototyping and the use of haptic materials like clay (e.g., PlayDoh) are proposed as a promising tool for AR development, because it provides spatial awareness, flexibility, and a familiar common basis. Figure 4 shows a result of Lego prototyping from one of our workshops as a new type of AR design method. It enables collaboration in interdisciplinary teams and provides an option for user engagement. The nature of the Lego pieces creates a more realistic scale relative to other objects and represents important spatial information in a way that traditional 2D prototyping methods cannot. Similar use cases using Lego prototyping for modeling purposes can be found in the participatory design literature [92]. Combined with the "Wizard of Oz" method, Lego prototyping allows the researcher to take on the "systems" role to control and manipulate the tool and respond accordingly to the user's action. In general, such methods seem to

Figure 4: Lego Prototyping for Designing AR Systems

stimulate user imagination, collaboration and creative processes, because they enhance the ability to envision a more accurate final design. Even if the process does not contribute to real-world results, the user's behavior, reactions, and comments can impact the functionality of the tool. Finally, the Lego prototyping method provides useful and interactive features and significantly reduces development costs.

7.2 Technical Approach

The augmented reality app was developed in *Unity3D* by using different frameworks. We developed the prototype for Android devices. For the development in *Unity*, it was also necessary to use an AR-SDK so that several components, such as the rendering unit and the tracking system, were integrated [4]. There is a distinction between two tracking methods: The geo-localized technique and the marker-based technique [40]. Markers are used when areas with fixed buildings or infrastructure will be redesigned. However, in the case of free spaces without an infrastructure, the geo-localized technique is, we think, the better one. Both tracking methods will be used with different frameworks. For the solution of both use cases, we combined two different AR-SDKs by using separate scenes in one AR-Engine. We used the *ARFoundation* SDK to place objects and the *Vuforia* SDK for the building overlay. *Vuforia* enables the recognition and tracking of previously defined markers through a camera in real-time [61]. The SDK has one of the fastest tracking algorithms for marker-based AR applications [19]. That increases the fidelity of the virtual experience, as virtual objects can be displayed quickly and well, even when moving with the smartphone. It is very suitable for overlaying the building with alternative designs. We used *Natural feature tracking* here, in that objects from the real world form markers [101].

7.3 Use Case 1: Redesign of the City Town Hall with Different Visualizations

To show citizens possible new buildings for the city town hall, two alternative 3D-building designs were created. Every design can be overlayed as a digital object over the existing building in the real environment. The view can be used vertically or horizontally. It

Figure 5: Augmented Visualization of a New Building Design

is possible to add comments at any point on the digital object as shown in Figure 5, which is visible for others and marked as a red dot. Different users can comment on the designs, so an exchange and collaboration between users is supported. Even when the user moves the smartphone, the proportions and position of the digital building remain consistent.

7.4 Use Case 2: Create New Digital Objects into a Real Environment

In the second use case, it is possible to enrich the real environment with digital objects as visualizations of one's own ideas. A model that is as realistic and detailed as possible is essential for credibility [35]. Therefore, 3D objects are used, whose position belongs to a specific place by transmitting position coordinates. The objects are predefined. The user currently has a selection out of two benches, two trees, and two trash cans. Besides placing and deleting objects, the citizens can interact with the created objects using functions like scaling or rotating with the pinch-gesture. In this way, the environment can be designed flexibly to visualize different ideas clearly (see Figure 6). In addition to predefined objects, there is a drawing function using a pen with different colors to visualize ideas or mark specific areas.

7.5 Sharing Ideas in Social Media

Citizens already use social networks to exchange information about current events and planned projects in the city [76] and so we integrated social media into the AR participation app (see Figure 7). Among the younger population, Instagram is preferred, but cannot be technically integrated directly into the AR app. However, among the broad mass of citizens in our partner city, Facebook is also a frequently used social media channel, so that several Facebook groups already exist. *C03 states that Facebook is the platform for news.* P09 agrees: "Facebook is the better option to interact with big crowds [...] because Facebook is more about content, more about spreading news, content."

8 EVALUATION AND OUTLOOK FOR COLLABORATION AND APPROPRIATION

The prototypes were also evaluated in an iterative and ongoing process for testing individual functions. In total, 29 people participated

Figure 6: Placing New Objects at the Lake Shore

in evaluating both clickable, implemented prototypes at different stages for both use cases. We used the think-aloud method [99], in which the participants had to perform specific tasks and express their thoughts and impressions in a follow-up discussion. In general, the participants appreciated the AR technology as a good visualization option and as an innovative, interesting feature. As positive feedback, the application seems to be particularly practical, clear, creative, and innovative. Nevertheless, we encountered some minor usability flaws. There were problems with manipulation objects and surface scanning, people would like to see dislikes as well, and sometimes font size, icons (likes, views), or buttons are too small to manipulate. Users felt interested while playing around with objects using AR. After some initial confusion, people quickly learned. We solved the usability flaws in the next iteration. Nevertheless, a summative evaluation and study of appropriation processes is still needed, which will be conducted post-COVID-19.

In addition to that, we also plan to evaluate the collaborative use of augmented reality as it is mostly used individually. We created different concepts, which will be integrated into existing civic participation processes. Our empirical studies shows that traditional participation options should not be eliminated but rather enriched.

Figure 7: Sharing a New Idea in a Facebook Group

Therefore, we will integrate the tool into traditional formats such as citizens' meetings or walking tours through the city. For the use case of co-determination on new building projects, the idea is to use a table-top solution with AR in existing citizens' meetings so, different building designs could be visualized on a table with a shared view, as can be seen in Figure 8. Frameworks like WRLD [104] for the implementation of such table-top solutions with 3D maps already exist. In the use case of co-design, the AR tool can be used in and through walking tours in the city, where citizens design their ideas in situ. However, it is also intended to enable co-design in the sense of a shared view directly in the app. If a citizen has designed the environment from a certain point of view, it should be possible for someone else to take that perspective and, if necessary, modify the design further (see Figure 8). In terms of appropriation processes, we will observe and evaluate the social interactions and the collaborative interactions by using the tool.

9 DESIGN- AND TECHNICAL CHALLENGES AND LIMITATIONS

Design- and technical challenges and limitations need to be considered in future developments:

- *Missing Design Methods for AR:* We had difficulties in finding suitable design methods for AR. There is a lack of existing and standardized guidelines or methods that are specifically designed for AR and which consider the spatial context. Individual methods and tools, especially in the field of AR, still seem to dominate. Dünser et al. [23] point out that universal design principles are usually too generic and cannot be meaningfully mapped to AR systems. In contrast to the design of other (mobile) systems, the real environment and context is essential in AR. Tools like Lego or clay or transparent foils, which are attached to windows or pictures of environments, seemed to work well in the design of mockups and prototypes. Nebeling & Speicher [69] also identified technical and design challenges in developing AR applications which, again, stimulated the use of more haptic 3D tools for prototyping and simulating the real environment.
- *Adobe Aero limitations:* In the evaluation of click-dummies, we noticed that users were sometimes unable to follow the instructions and had multiple mis-clicks. Actions such as placing the assets led to confusion. The system message "Tap to place asset" looks like a button, and most participants tried clicking on it. Secondly, all 3D files in Adobe Aero must be prepared regarding the Adobe Aero guidelines. This restricted the uploading certain formats.
- *Environmental conditions:* Interaction with AR outdoors is a bit challenging due to unpredictable environmental conditions such as lighting, ambient noise, social and weather conditions, including wind, cold and rain. Our app is mainly used as an outdoor application. Therefore, these variations in conditions might influence the user experience.
- *Occlusion of objects* is a problem [40]. This refers to the problem that virtual objects cover real objects, although they should actually appear behind this object. Due to this problem, the reality of the experience is reduced. Virtual

Figure 8: Concepts for Collaboration with AR. Left: Sketched Mockups for Different User Perspectives. Right: AR Framework of WRLD with a Digital City Map on a Real Table (see [104])

objects should only be displayed when there are no physical objects between them and the camera.

- *Immersion:* The precise integration of virtual objects into the real environment is challenging [40]. Digital elements must be precisely coordinated with real objects. It was difficult to adjust the exact position in the AR environment based on images. As a result, the digital object, e.g., is partly in the front, partly higher than the object to be overlaid.
- *Personal information:* The awareness of and attitudes towards the provision of personal information is also an issue. Sometimes people are not willing to provide certain facts, such as name, location, or permission to access the camera. The General Data Protection Regulation (GDPR) needs to be considered, and the app needs to inform citizens about data usage.
- *Battery drain:* AR applications are expected to heavily drain the smartphone's battery. Google, in its guidelines, asks developers to ensure that the app minimizes battery drain, enabling users to use their device for other tasks throughout the day or engage longer with AR experience [33].

10 DISCUSSION AND CONCLUSION

In our paper, we have assessed the potential of Augmented Reality for citizen participation in urban planning. AR, we argue, can make a significant contribution to a new form of participation, which may particularly draw benefits from spatial and contextual cues and may motivate more citizens. We have developed an approach in which traditional participation options, mostly visited by the older population, are supported but also extended by AR options. In doing so, we address, in particular, the motives and interests of young citizens as they are most affected by the impact of urban planning. We developed a mobile AR-participation app and shared our experiences in the design process. In this way, we created new interaction concepts for different use cases in urban planning to increase participation through a higher degree of creativity and interactivity. The use cases include different levels of participation, such as informing citizens, co-determination, and co-design. Our empirical studies used a participatory design approach starting with interviews, surveys, focus groups, and observations, which helped us understand and consider the stakeholders' different needs regarding citizen participation. By conducting four participatory design workshops, users were highly involved during the design process, which allows them to create their design solutions. In terms of the design process, we encountered some challenges, as augmented reality is not yet fully established, and best practices in the choice of design and prototyping methods are lacking. Our approach shows that by using haptic 3D tools like Lego, clay (e.g., PlayDoh), other craft materials, or transparent foils, the real environment could nevertheless be simulated and included in the prototype of the AR system. The use of such materials is proposed as a promising tool for AR development because it supports some degree of tangibility or spatial reference. It also enables collaboration in interdisciplinary teams and provides an option for user engagement. That approach allowed even low-tech users like citizens to prototype and develop ideas for high-tech applications like an AR app.

Overall, we found that users responded positively to the use of AR for planning purposes and reacted positively to the participatory and co-design methods we adopted. This does not mean that we have solved all problems associated with either the use of technology for urban planning, or indeed AR. AR does not only carry promise, there are also downsides – in particular with participation alienation. AR is yet another technology to use in participation processes, and it is rather complicated to author if the resulting illustrations are required to look real. As a consequence, we were aiming to counter this complexity by aiming more at playfulness and ease of articulation, allowing quick, sketchy illustrations. We recognized social networks as 'everyday tools of self-organization', and aimed at allowing individuals to articulate there as well. We anticipate a use situation in which AR tools would not be used by everybody individually, but where delegation and group structures along social ties that participants already have (e.g. in the family) would lead to situation where participants enjoying the technology would help others in their social environment to express their opinions as well. Neither have we addressed wider issues to do with the value or otherwise of participation processes in urban planning, or indeed elsewhere (see for instance, [6, 13, 14, 52, 90]) or the wider issues, including the distribution of power, associated with the planning process. The digital citizen participation addressed in this paper refers to the "degrees of tokenism" according to Arnstein's Ladder of Citizen Participation [6]. Depending on the use cases, the design of this varies from immersive information about new planning projects to the opportunity for citizens to shape their own new ideas. However, these levels cannot ensure that citizens are allowed to make decisions, and that citizen input is actually considered or even implemented. The final decision on the actual realization of the ideas nevertheless remains with those responsible for the planning projects. We proposed a solution in which citizens are motivated to participate, but there are still issues regarding tokenism and co-optation [93]. Real-world outcomes mean, of course, that the entire participation and planning process must be taken into account. We as Designer and HCI researcher could recommend non-functional requirements and tools, which we identified through user research of pursuing for a better participation and to engage more people. But for genuine democracy, it is also up to the city administration to actually consider the ideas for the realization. The participatory approach discussed above could be extended to include consideration of the broader institutionalized process and, in the sense of institutionalizing [45] reflection on the dependencies on these institutional processes as well as participation itself. Long-term effects of participatory design for participation processes could be established [10]. Along with Kamols (op cit), we accept that institutional structures limit participation, largely as a function of limited knowledge and skill sharing outside of the institution. We did not, and do not, believe that technological innovation can, in itself, lead to more democratic forms.

Our work is intended to be an assessment of potential in relation to both motivating participation in the planning process and, potentially, making it easier and planning processes more comprehensible. As such it can be seen as consistent with Kamol et al's argument that skills and knowledges are important discriminators. Our work can be seen as an initial, and small, step towards reducing those inequalities by furnishing young people with some of the

skills they need to participate more fully. Due to the COVID-19 pandemic, we could not conduct the summative evaluation and thus cannot be confident that, in the long term, that citizen motivation will increase and led to higher levels of participation. Indeed, only changes in political will and the transformation of the local democratic process can do that. Technology is only ever an aid to that. We hope, however, that it will prove a useful one. To this end, we plan to use the app as part of walking tours of the city or citizen meetings to look at plans of a new building together or create new designs that the users can discuss in person with each other. We have also developed concepts for collaboratively use of the AR app. So, an AR tabletop variant should also be used in citizens' meetings. The collaboration will also be enabled through the app directly so that another user's perspective is taken, and based on that design, other ideas can be added. In this way, associative thinking can be promoted, and the different ideas can build on each other.

ACKNOWLEDGMENTS

This paper presents the results of the research project *Creactive Citizen*, which is funded by the European Regional Development Fund (Funding Code: EFRE-0801080). We would like to thank our partners GeoMobile GmbH and the city of Olpe as well as all participants from Olpe and Siegen. Also, we would like to thank in particular our students Yazan Aljaloudi, Marco Becker, Paula-Linda Bürschgens, Jana Butorac, Ernst Diener, Patrick Fallmann, Svetlana Fedorovich, María López Garro, Vanessa Hambürger, Eva Krapp, Chandana Makam, Maryam Mehreen, Akhil Nalliboina, Muhammed Asad Saleem, David Schlabach, Sebastian Schwarzloh, Timur Sereflioglu and Chris Vogt for their support in our research project. The paper is funded by the German Research Foundation (DFG) – Project number 262513311 – SFB 1187 Media of Cooperation.

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A APPENDICES

A.1 Interview Details

Table 1: Interview Participants

Participant ID	Gender	Age	Role
G01	Male	57	Government employee
G02	Male	51	Government employee
G03	Female	39	Government employee
G04	Male	30	Government employee
G05	Female	29	Government employee
P01	Male	49	Politician (Mayor)
P02	Male	67	Politician
P03	Male	60	Politician
P04	Male	65	Politician
P05	Male	73	Politician
P06	Male	48	Politician
P07	Male	56	Politician
P08	Male	48	Politician
P09	Male	28	Politician
C01	Male	66	Citizen
C02	Male	54	Citizen
C03	Female	21	Citizen
C04	Male	22	Citizen
C05	Male	34	Citizen
C06	Female	35	Citizen
C07	Male	30	Citizen
C08	Male	63	Citizen
C09	Female	31	Citizen
C10	Female	>25	Citizen
C11	Female	>20	Citizen
C12	Female	>35	Citizen
C13	Female	>35	Citizen
C14	Male	>25	Citizen
C15	Male	>25	Citizen
C16	Female	>25	Citizen
C17	Female	>30	Citizen
C18	Female	>28	Citizen
C19	Male	>20	Citizen
C20	Male	>65	Citizen
C21	Female	>20	Citizen
C22	Female	>20	Citizen
C23	Female	>30	Citizen
C24	Male	>30	Citizen
C25	Male	>20	Citizen
C26	Male	>20	Citizen