

UrbAI: Exploring the Possibilities of Generative AI Image Processing to Promote Citizen Participation

Adrian Preussner
University of St. Gallen
St. Gallen, Switzerland
adrian.preussner@unisg.ch

Johannes Schöning
University of St. Gallen
St. Gallen, Switzerland
johannes.schoening@unisg.ch

Anna Crescenza
University of St. Gallen
St. Gallen, Switzerland
annapalmira.crescenza@student.unisg.ch

Florian Mathis
University of St. Gallen
St. Gallen, Switzerland
University of Applied Sciences of the Grisons
Chur, Switzerland
florian.mathis@unisg.ch



Figure 1: We explore how generative AI can enhance citizens participation in urban development by enabling a more interactive and accessible process. Citizens can (1) capture an image of the current urban landscape, (2) highlight areas within the image where they want to propose enhancements, and (3) provide descriptions of their suggestions. Based on these inputs, the AI then (4) generates a visualisation reflecting the proposed enhancements, which can be shared with local government authorities for further discussion.

Abstract

Giving citizens a voice in urban development processes is crucial for enabling socially sustainable cities and communities. However, citizens' opportunities to express ideas are often limited to communication channels that offer poor incentives for participation. In this paper, we conducted an in-the-wild technology probe study (N=16) using a generative AI (GenAI) tool to allow citizens to visualise and submit urban development ideas by taking pictures and manipulating them with GenAI. The results highlight the potential of GenAI to empower, engage, and inspire citizens' creativity.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

CHI '25, Yokohama, Japan

© 2025 Copyright held by the owner/author(s).

ACM ISBN 979-8-4007-1394-1/25/04

<https://doi.org/10.1145/3706598.3713803>

We then conducted additional expert interviews (N=6) with city representatives and community associates. They voiced GenAI's value in early-stage citizen participation but raised concerns about excluding senior citizens. Building on these insights, we present the design and evaluation (N=10) of UrbAI, a co-creative system tailored to urban development participation and conclude with lessons learned to inform how GenAI could be embedded in future citizen participation processes.

CCS Concepts

• **Human-centered computing** → **Empirical studies in interaction design.**

Keywords

urban planning, citizen participation, civic engagement

ACM Reference Format:

Adrian Preussner, Anna Crescenza, Johannes Schöning, and Florian Mathis. 2025. UrbAI: Exploring the Possibilities of Generative AI Image Processing to Promote Citizen Participation. In *CHI Conference on Human Factors in Computing Systems (CHI '25)*, April 26–May 01, 2025, Yokohama, Japan. ACM, New York, NY, USA, 21 pages. <https://doi.org/10.1145/3706598.3713803>

1 Introduction

Participatory approaches, in which citizens contribute with their perspectives, needs, and ideas towards urban development projects, are well-established formats to ensure transparency and equity [7, 24, 43]. Many different methods allow public participation in the urban development processes of cities and communities. These methods range from collecting supporters for a city development project through signatures to participating in in-person workshops [7, 24, 32] and public gatherings at which new ideas are discussed or developed [40], or sharing citizen-generated data [41]. Additionally, there are digital methods, where citizens and community members connect online to elaborate on ideas [17] and submit them online to their local municipality [25, 52, 60], or use augmented and virtual reality (AR/VR) in participation processes [53]. However, the fidelity of the ideas often remains low, or participants depend on facilitators and mediators to implement citizens ideas [9, 11, 13, 53, 71]. For example, while architects, urban planners, and designers can use computer-aided design (CAD) tools or AR/VR to present their visions and ideas for a construction project with photorealistic 3D objects [61], these methods are often not accessible to the broader public due to the lack of expertise and the additional high costs. However, the integration of the broader public is particularly promising when contributing towards urban development as existing works have provided evidence of positive, sustainable outcomes [7, 24, 43].

To further advance the field of participatory approaches for urban development, this paper explores the use of generative artificial intelligence (GenAI) to offer citizen-driven initiatives the potential to overcome existing barriers and create visual representations of their visions with little to no effort. Taking Figure 1 as an example, a citizen may take an image using their phone and then enter their ideas for enhancements before receiving a photo-realistic image with their vision. Inspired by this example, the following research questions (RQs) guide our work:

RQ1: To what extent can GenAI support citizens to express their urban development ideas visually?

RQ2: How can GenAI be embedded in current participation processes?

To answer these RQs we underwent three research phases. First, we conducted a technology probe study (N=16) by comparing a generative fill system with current communication forms for citizens ideas in two urban development scenarios, including enhancing an existing public park and redesigning the function of a parking lot in a public space. We found that the usage of GenAI not only offers the possibility to visually translate citizens' ideas into meaningful images, but also encourages them to reflect on and refine their generated images. However, we also observed challenges, primarily concerning articulating suitable prompts to create their expected outcome.

Second, we conducted six expert interviews with representatives of municipalities and neighbourhood associations to contribute insights into the usage of GenAI on an organisational level, ensuring a holistic understanding. The experts acknowledged the opportunities of GenAI usage, especially in attracting citizens in early stages of participation processes, enabling them to express their needs and ideas, and allowing others to reflect on them more effectively than in written or spoken form. However, our experts also raised concerns in excluding digital novices like senior citizens, or higher frustrations, when generated ideas, which are not in the public interest, get rejected.

Third, we translated the insights from the technology probe study and the expert interviews into *UrbAI*, a co-creative system embedded into a citizen participation process. The design and evaluation (N=10) of UrbAI, our third study revealed that participants valued the integration GenAI in a guided process, translating citizens needs into ideas, while also highlighting its potential for providing feedback to iteratively refine ideas and support the collaboration with other citizens. By sharing our process and results of three research phases, we conclude by presenting five lessons learned in which GenAI can be embedded in existing participation processes, what challenges and limitations are, and how we propose future research direction in this field.

Contribution: Our paper contributes both artefacts and empirical contributions [67]:

- **Technology Probe:** We contribute empirical insights from a technology probe study with citizens (N=16) by comparing a GenAI tool with current communication forms in two urban development scenarios.
- **Expert Interviews:** We contribute empirical insights from expert interviews (N=6) with representatives of municipalities and neighbourhood associates about their perceptions and opinions on the usage of GenAI in participation processes.
- **Prototype Design and Evaluation:** We contribute artefact and empirical insights about the design and evaluation (N=10) of UrbAI, a prototype of a co-creative system embedded in the context of urban participation processes.

2 Related Work

We review the role of visualisations in urban participation processes in combination with the use of photographs, AI, AR and VR.

2.1 Photographs in Urban Participation Processes

Schoffelen et al. [54] reflected on the importance of visualisation in participatory processes to understand complex issues and foster reflection and sense-making. Thereby photovoice is a common methodology to make use of visualisations, especially to document challenges and needs in public spaces [27, 36, 64]. Wass and Safari [65] used this method to emphasise the needs of people with intellectual disabilities and empower them to participate in innovation processes. Maas et al. [39] handed disposable cameras to their participants to gather insights into which contexts they would like to have changes in their neighbourhood. Díez et al. [15] used photovoice with residents of a low-income area, where they reflected on their local food environment, resulting in community-driven interventions. O’Leary et al. [45] investigated, with the help of photovoice, the role and design of technology in the intersection of religion, race and community. PhotoMap [55] is a system that utilizes spontaneously captured images of public maps for pedestrian navigation tasks on mobile devices. In their work, Foster et al. [21] display the potential of smartphones and social media to increase the awareness and connection of community members within their neighbourhood. As shown by Wouters et al. [68] and Kjær Søgaard et al. [33], visualisations displayed on public display can foster interaction and communication within neighbourhoods. Using speculative design approaches, participants in Chopra et al. [10]’s study created drawings, written cards and crafts to represent their needs and ideas. As we learned, visualisation in citizen-driven idea development is crucial, especially in reflecting on challenges and needs and promoting discussions. However, the fidelity of the visualisations remains mostly low, which raises the question of how citizens can access modalities to display their perspectives in higher fidelity.

2.2 Visualisations with AR and VR in Urban Participation Processes

The use of VR and AR for sustainability-related topics has developed steadily in recent years [12]. Thereby research also investigated the opportunity for citizens to increase the fidelity of visualising their ideas. Saßmannshausen et al. [53] showcased how AR can motivate young citizens to participate in urban planning. Ehab and Heath [16] compared human interactions in the real and virtual co-design processes of urban planning, highlighting the possibility of reflecting on design alternatives in the VR setting. However, Luo et al. [38] demonstrated that in participatory approaches, the usage of a physical replica is easier, especially for older participants, compared to a digital twin in the urban park development, while the interactivity and high fidelity of the digital twin was more attractive for younger and educated participants. Similar to Thiel et al. [59, 60], Kavouras et al. [31] showed a framework for 3D simulation games to foster participation in co-creation processes in urban planning. Silva et al. [57] investigated the use of AR in public spaces for citizens activism towards social change. Others,

such as Hunter et al. [28], highlighted the potential of AR to enhance citizens’ sense of control and agency in the digitalisation of public services. Overall, research shows interest in enabling higher visual fidelity in participatory frameworks in citizen participation processes, motivating expanding this spectrum of methods.

2.3 Generative AI in Urban Participation Processes

Research on the use of GenAI in urban design has increased in recent years in the domains of architects and city planners [30]. For instance, Zhang et al. [70] investigate how architects could enhance their sketches to 3D designs using GenAI. However, despite the use of GenAI by architects and city planners, the wave of using GenAI in participatory approaches with citizens is, at this point, just slowly starting to build. Hohendanner et al. [26] investigated the use of GenAI for the speculative design of narratives, however, with young design professionals as study participants. Noyman and Larson [44] developed a platform where streetscape visualisations are generated based on the physical urban model on a tangible user interface, highlighting the potential that multiple participants can interact with the system and get real-time feedback. Others like LC and Tang [35], Blythe [6], and Rafner et al. [47] used GenAI in design fiction and speculative design frameworks to generate images for utopian and dystopian futures. In their work, Rafner et al. [48] investigated how GenAI aids citizens to create images to describe issues and provide solution construction, however acknowledging the limitation that citizens were constrained on given source images by the researchers.

3 Study 1: Technology Probe

To contribute towards RQ1, we conducted a technology probe study of a general-purpose GenAI tool, to explore to what extent citizens can express their urban development ideas in a visual way.

3.1 Study Probes & Scenarios

To learn more about the benefits and challenges of a GenAI tool in citizen processes, we compared the idea of using GenAI with an online form, which represents current practices in e-participation, where ideas are submitted mostly in written form [52].

- **Probe 1 - Adobe Firefly with Generative Fill:** Compared to approaches that generate images purely based on text-based prompts, we focus on an approach where text-based prompts are applied to a self-selected area of a taken picture, also known as *generative fill* [2], demonstrated in Figure 1. We use the web version of Adobe Firefly (*Firefly*) [1] as probe (see Figure 2) to offer three key advantages in the context of visualising urban development ideas. First, to make use of generative fill, citizens can take a picture of the location by themselves, encouraging them to explore and experience the site. Second, by editing only specific areas of the self-taken images, citizens can see their ideas integrated into the current state, allowing them to reflect and refine their ideas. Third, by visualising their idea in situ, a third person can compare the consequences of the idea with the current state.
- **Probe 2 - Online Form (baseline):** To compare *Firefly* with a common digital approach [52] in participation processes,

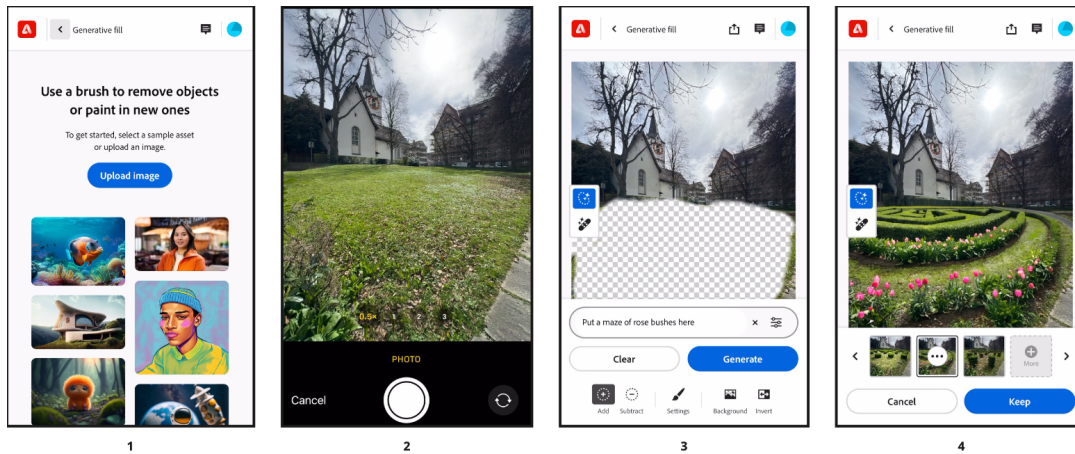


Figure 2: An overview of *Firefly* [1], including 1) uploading or 2) taking an image, 3) masking the areas for improvement and adding a prompt, and finally 4) getting three suggestions, where participants could choose from or ask for further suggestion.



Figure 3: Overview of the (a) parking space, which will be redesigned into a public space, and (b) public park, which seeks enhancement.

we used an online form as baseline (i.e., Microsoft Forms [42]). Participants could describe their vision in text form and optionally upload self-taken images.

To perform both study probes, participants received as apparatus an iPhone 15 Pro [5]. Both study probes were investigated in two urban development scenarios, which represent urban developments where citizens are asked to participate in revitalising a public space [23]. While the first scenario represents the redesign of urban space by radically changing its functionality [51], the second scenario represents an existing public space that strives for enhancements [46]. In summary, we introduced the participants to the following two scenarios with the order of the probes counter-balanced:

- **Scenario 1 - Redesign of a Parking Space into a Public Space in the City:** In this scenario, the local government wants to remodel a parking space into a public space within the city. The government is asking citizens to participate with their ideas in this redesign (Figure 3a).

- **Scenario 2 - Enhancing an existing Public Space in the City:** In this scenario, a public park has become outdated and is therefore not used by the citizens. The local government wants to revitalise this space without losing its function as a public park and asks citizens to contribute their ideas for enhancement (Figure 3b).

3.2 Participants & Ethics

We recruited 16 participants (9 women and 7 men) with an average age of 28.8 years ($SD = 8.02$ years, $min = 24$ years, $max = 58$ years). Asking how often participants used GenAI, four used it daily, three several times a week and nine on occasion, mainly for brainstorming, paraphrasing, rewriting content, and generating pictures. More specifically, 14 participants used GenAI tools for image creation and five for manipulating and editing images, while two used them neither for image creation nor for manipulation. Three participants stated they have started or been involved in participatory approaches in the development of their city or local

community, however never made use of GenAI in their contexts. The study underwent a university ethics review and was exempted from the committee's additional full ethical review. Each participant was given signed informed consent for study participation.

3.3 Tasks & Procedure

After assessing participants general information and demographics, as well as their experience with citizen participation and the use of GenAI, they went through the following study procedure:

- **Phase 0 - Briefing & Training:** We briefed the participants about the aim of our study and sensitised them to communicate their thoughts at any moment with us. We then familiarised them with the concept of generative fill by displaying a screen recording with the basic functionality of *Firefly*. The participants then went through a training session, where they were asked to visualise a living room with the *Firefly* within the lab and use the thinking aloud [37] technique. Here we encouraged the participant to ask questions when things were unclear. This ensured that by completing Phase 0 every participant understood the basic functionality and felt confident to continue with Phase 1.
- **Phase 1 - Probes:** The participants were then introduced to their task and the scenarios, as outlined in section 3.1. We then walked with each participant to the corresponding location in the wild. In each scenario, we ask them to explore the place first and briefly describe their general idea for this context. The participants then received the mobile phone to either fill in the online form or use *Firefly* to visualise their ideas. During the tasks, the participants were asked to think out loud. After that, the participants were asked to communicate their ideas again with the second probe. After completing both probes in one scenario, a short interview was conducted to reflect on comparing the probes. We then walked together with the participant to the second scenario, following the same approach.
- **Phase 2 - Reflection:** After completing both probes in both scenarios, we walked with the participants back to the laboratory, where we concluded the session with a semi-structured interview to gather insights into their overall experience and their reflections for future work.

3.4 Data Collection & Analysis

We screen- and audio-recorded participants' interactions when using the GenAI tool and the online form. Further, we collected the self taken images in both conditions as well as the images enhanced with the generative fill. The reflections as well as the final interview were also audio recorded. The audio recordings of the interviews and from the thinking aloud were literally transcribed and translated if necessary. The data from the interviews and the thinking aloud were analysed by a first round of open coding by one researcher. After that, three researchers discussed and inductively clustered the codes using a reflexive thematic analysis approach [8]. Based on the screen recording, the written prompts were literally transcribed and translated if necessary. Furthermore, the prompts were analysed qualitatively, meaning what and how a vision was prompted.

4 Results Study 1

In the following, we present qualitative empirical insights from the probes and the interviews. Figure 4 provides an overview of selected before and after images created by the participants, while in Appendix A all results are displayed.

4.1 Results Phase 1: Probes

We observed four main patterns, including 1) the communication of needs and idea representation, 2) prompting patterns, 3) observed challenges and workarounds, and 4) stimuli for inspiration and engagement.

4.1.1 Text Description for Needs and Prompts for Idea Representation. Our results show that the participants focused on the outcome and solution using the GenAI tool, while when using text only, i.e., the online form, they focused on the problems and needs in the given context. For example, in the remodelling of the parking space, P3 described in the forms *"On the left side of the first photo I would plant a few green hedges as a barrier to the main street to block out noise and pollution"* (P3). However, when using the GenAI tool, they marked in the picture the area and simply prompted *"green high hedges"* (P3). These behavioural differences when having access to the GenAI tool compared to the online form were observed across the majority of our participants. In some cases, participants added more contextual information about the problem and a direction for the solution: *"Put up a soundproof green wall to keep the noise from the road away. Trees and/or shrubs can be a means"*. Others did not describe the problem in the prompt, instead, they tailored their prompt to specific features of their solution: *"a dense soundproof hedge"* (P8).

4.1.2 Prompting Patterns. When visualising a remodelled urban environment using GenAI, we observed that the participants followed an incremental, step-by-step approach, generating one enhancement at a time (Figure 5). This helped the participants to have a better influence on how things are manipulated by GenAI. In case a specific enhancement could not be generated as expected, the participants made minor adjustments within each steps, including asking for more suggestions, reformulating the prompt or adjusting the selection. Here, the needed number of steps and minor adjustments are in redesign of the parking space (Steps: Mean = 4.38, Median = 4.0, Min = 2.0, Max = 8.0, SD = 1.78; Minor Adjustments: Mean = 2.47, Median = 2.0, Min = 1.0, Max = 11.0; SD = 1.94) and enhancement of the public park (Steps: Mean = 4.25, Median = 4.0, Min = 3.0, Max = 6.0, SD = 1.13; Minor Adjustments: Mean = 2.6, Median = 2.0, Min = 1.0, Max = 9.0, SD = 2.0) almost equally. By the end of the study, each participant contributed one AI-enhanced image in each Scenario (see Appendix A).

Furthermore, we observed different approaches when it comes to the selection of enhancement. While some marked an abstract outline of the planned tree, others indicated the position and number of trees. Most, however, generously marked the area for planned change. For example, in Figure 6 the participant's aim was to add a tree in their image. In the park scenario, P16 voiced: *"What's new about this system is that I can now place something better or simply in the place I imagined. I imagined the playground here and can now draw it here. This is easier than with forms"* (P16).

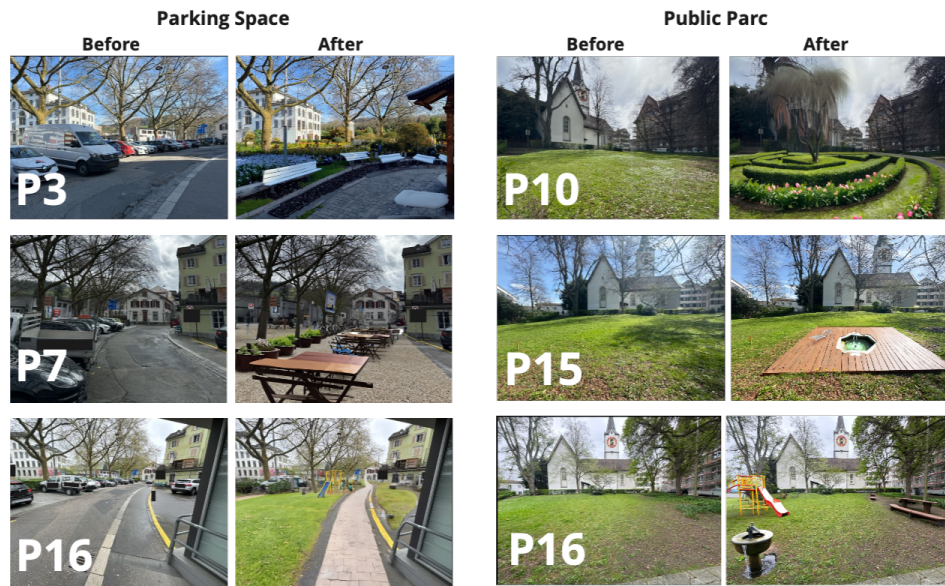


Figure 4: Extract from the results of the technology probe. The *before* images are self-taken by the participants and further edited by them using *Firefly*, resulting in the *after* images. In Appendix A an overview of all results is displayed.

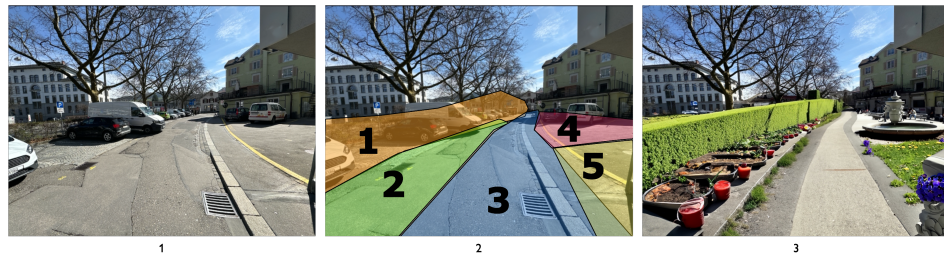


Figure 5: By remodelling the parking space, the participants followed a step-by-step approach, as can be seen by the process of P2. 1) The photograph they took. 2) The process of the marked areas in order to prompt the final results. The first prompt was "Green tall hedges", followed by the second "Public vegetable garden with various types", the third "Playful gravel path", fourth "Decorative fountain with splashing water" and "Park benches with people on them" and lastly "Lawn with wildflowers". 3) The result using *Firefly*.

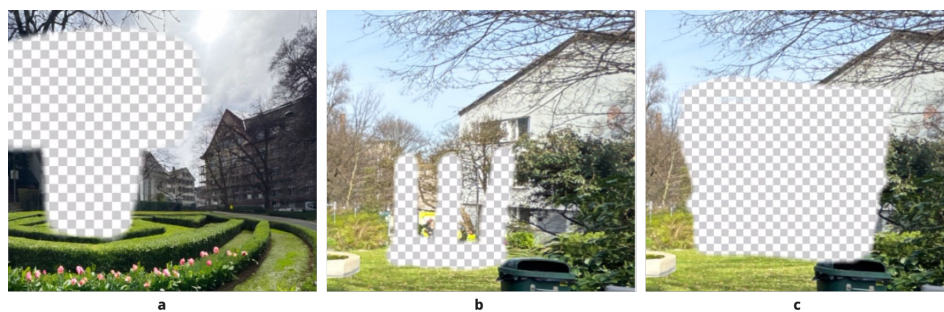


Figure 6: In these examples participants aimed to add trees in the images. We observed three approaches when participants selected the area to edit the image: a) *outlining the shape*, b) *indicating position and amount*, and c) *generous selection*.



Figure 7: In some cases, the AI tool did not generate the results as the participants intended it. However, the participants were still satisfied with the result, as it shows a metaphor for their idea. a) P1 wanted "a bar for drinks" which resulted in over-dimensional cocktail drinks. b) P5 wanted to have an "outdoor chess field", which resulted in chess pieces without the actual field. Both stated that they still believe that third person would still understand the intention of the metaphors.

4.1.3 Observed Challenges and Workarounds. By using *Firefly* as well as the online form, participants faced challenges in expressing their idea. While participants stated to communicate their needs with the forms easier, they had challenges when expressing their actual ideas, as demonstrated by P7's comment:

"So with the forms, the main challenge for me was the wording. How can I actually formulate what I want to represent in a way that another person can understand? That's exactly what I found relatively difficult, especially if you don't want to type a whole novel. So how can you formulate this as compactly as possible but still understandably?" P7

Some participants made use of the option to upload an additional picture to cross-reference their text description. For example, P3 noted: "In front of the café (see picture), I would build a winter garden or pavilion" (P3). After describing their needs and ideas, P1 even recorded a video in both scenarios to highlight identified issues and their ideas for improvement. When taking a closer look at participants' challenges when using *Firefly*, we observed two themes.

First, participants who had a concrete and highly detailed vision in mind got "stuck [because they] didn't know how to get the right prompting in order to get the right image" (P14). Some participants explained that they "had no guidance in finding a solution how to prompt differently, [they] tried different ways to do it and nothing worked, [resulting that they] felt a little bit helpless" (P14). When results of the prompting did not align with the participants' expectations, they often could not understand "what's the problem now? Is the section [they] chose again the problem? Or the prompt? Or the wording? Or is it too specific? Is it not specific enough?" (P7).

Second, we observed that participants got stuck in a prompting loop, where with each trial, the results did not get better or even worse, resulting that "especially at the beginning, you get in a little hyped and then the frustration might get later higher" (P5). However, we noticed scenarios where the results did not align with what they

envisioned, but "it did give an alternative that's pleasing. So [...] if it's pleasing enough, you'll settle for it" (P4). In cases like those shown in Figure 7, the prompting results were pleasing enough to work as a metaphor for their idea, believing that a third person would understand their intention. In this context, P1 argues that others will understand that with oversized cocktails (Figure 7) they "know that you should be able to drink there, you can relax there and you can buy something there and there is local recreation there" (P1).

4.1.4 Feeling Empowered While Getting Inspired and Engaged. P2 stated that GenAI is a convenient method "to create a concept, as architects do when they create a design. I think it's really cool for that because you can also do it as a layman" (P2). Several participants, such as P10, argued that the generated image "gets a point across. You know what I'm trying to say. It doesn't have to be like picture perfect" (P10). Furthermore, several participants stated that a broader audience can be reached by GenAI tools, as P9 believed that:

"You can do it at any time as it suits you. It doesn't take very long. You don't have to listen to a hour of speeches from mayors or cantonal speakers. [...] You can simply put your ideas on [...] digital paper because it's also a very simple way to reach a very broad audience" (P9). P9 further explained that "it tends to be the case that if you involve people in the process earlier and give them greater opportunities to help shape it, it is then also more accepted. And that there is a greater sense of ownership." P9

Participants stated that "contrary [to the forms, *Firefly*] is very creative and it expands your horizon of thought" (P11), particularly when remodelling more complex scenarios:

"It helped me more because it's also more difficult to imagine how it could look different when the change is just so big. It's somehow easier to imagine on a green field, there could be a bush than to somehow imagine a fountain and a vegetable garden in a car park." P2

More specifically in the parking space, finding an idea "was very *ad hoc* [...]. Accordingly, it also helped [them] to find [their] vision first, because the fact that [they] prompted things inspired [them] again, ah hey, you could do this and this" (P2). Others stated that they had a generous idea but nothing visually in mind. For example, P12 brought up that they "did not really have clear expectations of how these flowers could look like. So looking at different image options helped [them to] pick the one [they] liked the most, which [they] think is helpful" (P12). Additionally, participants stated that their initial idea got advanced in the process using *Firefly*.

"I have a first draft or a first idea and I discuss it with a friend. Then it goes back and forth [...] So with the generative fill, there were also things that I hadn't even thought about, and that didn't come from me, but something from the AI tool also flowed into it." P12

Concluding on that, participants stated that contrary to what they had initially in mind the output was also "cool or even cooler than what [they] actually had in [their] head. And that's actually what [they] think is the best thing about the tool. [...] The inspiration you can draw from it" (P2). Contrary to P2's statement, P11 appreciated the outcome that "was very different to what [they] expected. [They] actually didn't like the proposal of the AI, but [they] found it interesting to see how it could also look like" (P11). Others also stated that *Firefly* gave them "a stimulus to reconsider the idea" (P16). Seeing the result of their idea visually, participants reflected on the feasibility in actual implementation, like P10 where "the fountain just seemed out of place, and you saw that it's not much room for that. [...] It gave me some adversarial perspective, [that I then] thought maybe a willow tree would be nicer" (P10).

In summary, the participant stated that *Firefly* is "definitely more engaging than just writing" (P4). In comparison, the forms "didn't really bring any added value" (P2), because with the "Forms I would have just checked it off, okay, that bothers me, I would solve it that way" (P7). More specifically:

"with GenAI, it's more like, [...] maybe I get another idea because I see, ah okay, now it looks like this, I could change that or something, so it stimulates creativity, I would say. I thought that was cool. It was more about creating added value and not just solving the problem." P7

Key Takeaways from Phase 1 - Probes

Participants were highly engaged when visualising their ideas using *Firefly*. We observed that the communication was adapted depending on which tool participants were using. With the forms, participants were more focused on the problem description, while the prompting with *Firefly* was more solution-oriented. Allowing to have better control of the outcomes, participants approached the prompting incrementally (Figure 5). In some cases, challenges arose in getting the prompts right to articulate their ideas, leading to frustration. However, by being engaged and inspired in creativity, the *Firefly* helped participants to rethink and refine their ideas, which was not observed when they used the forms.

4.2 Results Phase 2: Reflection on Future Co-Creative Systems

We asked participants to reflect on, and propose, potential advancements and additional features for utilising systems like *Firefly* as co-creative systems in urban participation processes.

4.2.1 Reflection on Citizen-AI Collaboration. The interaction with GenAI in the probe was on a unidirectional conversational level, meaning that the participants received the results of their prompt directly in the image without any further descriptions or follow-up questions. Several participants stated they would prefer to receive and provide feedback for various reasons.

First, some participants stated that they felt "that perhaps the problem and the initial condition are not described so clearly" (P5), resulting that they would like to upload an image and to have first "another short conversation [to make sure] okay, what's in the picture actually? Where is a road, for example? So the system realises what is where, so that you are talking about the same initial condition" (P5).

Second, participants stated that they would acknowledge having built up on the generated image instead of rephrasing the whole prompt as P7 illustrates: "That I could have simply said [...] I don't want the small flower pots, I want them bigger. Because that way I had to go back and think, okay, how can I reformulate it now? And if you could give direct feedback, I feel I would have got what I wanted relatively quickly" (P7).

When it comes to collaborating with a co-creative system, the participants reflected on whether and how a system could provide feedback on citizens-generated ideas. One aspect mentioned was regulations and laws in urban development, whereby, for example, P12 stated: "Well, I'm sure there are also legal restrictions. The tool could also give me feedback on this if it were a major contravention" (P12). Besides feasibility and legal restriction, feedback could also concern requirements in terms of adapting the city to global challenges, as pointed out by P2 points out:

"Because it's also about making spaces not only more aesthetic, but also somehow adapting them to our global challenges. If you're not an expert in the field, it's probably difficult to think about that often. [...] Then perhaps suggestions for improvement could come from AI: Hey, if you plant this and that here, it's great for biodiversity [...] Make sure you can do something to provide shade or offer a watering place." P2

While some participants reported to appreciate feedback from an AI tool, others raised some concerns when citizens' ideas are automatically evaluated. In this regard, some participants stated, similar to P7, that their "contribution as a citizen is actually to give the idea and [that they] don't know the regulations, so [they] don't think it's [their] job to bring the idea together with the regulations, but simply to give an impetus" (P7). In a related context, P8 stated:

"I have the feeling that sometimes unrealistic or big ideas can make a big difference. And even if you only ever think about incremental steps, you might lose out on bigger perspectives. Then the AI might say to me, yes, let's put in fewer car parks instead of no car parks at all" P8.

When participants reflected on a citizen-AI collaboration in citizen engagement, the awareness of the challenges and needs for the public space was perceived as crucial. For example, several participants stated that a future system should guide them through a design process rather than visualising the initial idea directly. P5 explained this using an example of the noise pollution in a park and that we "need a noise protection installation, whether it is a wall or a bush, is a different question. First, the problem should be addressed, and we then try to figure out a solution together" (P5). P1 contributes a similar thought where instead of telling the AI "I want a playground with a slide, rather say the place should be family-friendly" (P1), or P4 is seeking the co-creative system on "how could this place be more accessible for children?" (P4).

In summary, participants see GenAI as having the potential to act as a social co-creator. For example, P9 related their interaction with *Firefly* to a discussion with another person:

"Well, I mean, you often notice in discussions with other people that you simply come up with a much cooler, more sophisticated overall solution than if you think about it alone. If AI is smart enough to do that, then I can imagine that things will get better. [...] Accordingly, I could also imagine that AI would provide me with prompts to give me new ideas." P9

Key Takeaways on Reflection of Citizen-AI Collaboration

Participants valued in *Firefly* a brainstorming partner to visualise, reflect and refine their urban development ideas. They highlighted the need of future co-creative systems being able to understand the initial condition and context of place. Further, participants discussed the opportunities to get feedback and recommendations based on feasibility, regulations, needs and concepts. However, they also voiced that restrictive guidance could limit their creativity.

4.2.2 Reflection on GenAI Supported Collaboration in Communities. Participants argued that a co-creative system could be used to bridge the needs and ideas of different citizens. For example, they stated that using it could also attract younger citizens as "younger people, in particular, don't find gatherings where you can raise a hand to share an idea, that attractive. But if you have the opportunity to really represent something visually, you can attract more people and could inspire people to get involved" (P9).

Additionally, participants see the potential to connect citizens so that "you get co-created with people you don't know. [...] An online version can help to build bridges between people who don't know each other" (P14). Furthermore, participants, like P16, see with the use of generated images also the opportunity to understand the needs of other community members, making it "also valuable for the discourse because you can perhaps put yourself in the other person's shoes more easily" (P16).

Some participants stated that they would appreciate seeing "the images that others have generated and then editing them further like a copy that you continue to work on might bring in your own ideas" (P9). They saw an opportunity to have a collaboration with other citizens, allowing them to "share an idea and [when] it comes from another

person with a completely different background, maybe a different vision. And then you look, okay, what are the best elements of both ideas or how they can be combined to make it even better overall" (P12). To collaborate with others, several participants stated that GenAI should be embedded within a forum. The main motivation for that is that they:

"actually prefer to co-create these ideas because I would never feel let's say confident enough and also would not want to be confident enough to plan something completely on my own that should then be appreciated by the wider community just because I only have one opinion and people may have their different opinions so I think I would always use this tool to like to share an initial idea but then want to have feedback from the community on how it could be further evolved" P11.

Therefore several participants raised the need for kind of a voting system to "find an agreement on what is best for everyone. Maybe you can discuss there again what you find good and bad about different ideas" (P2).

Key Takeaways on Reflection about GenAI in Communities

Participants noted that the usage of a co-creative system could bridge diverse needs and ideas from citizens, especially by attracting younger citizens and those who are currently not motivated to take part in such processes. They highlighted the value of visual representation impacting the understanding of other perspectives. By creating a collaborative and creative space, the idea emerged that building on others' generated ideas can inspire new concepts and enhance co-creation. Thereby the participants suggested to embedding GenAI within a process that encompasses feedback mechanisms to allow citizens to identify common ground and refine their ideas.

Although the results of the technology probe study are promising, it remains unclear how tools like *Firefly* can be embedded in actual citizen participation processes. Therefore, we explore in additional interviews experts' perspectives and opinions on the usage of GenAI to enhance citizen participation processes for urban development.

5 Study 2: Expert Interviews with City- and Community Representatives

To ensure that GenAI is an effective measure in attracting citizens and supporting them in visualising their ideas, we also need to understand the organizational opportunities and challenges. Therefore, we conducted six expert interviews with representatives of municipalities and neighbourhood associations to understand how they perceive the usage of GenAI and how it could be embedded in their existing citizens' participation processes.

5.1 Participants & Ethics

We approached two stakeholder groups (N=6) who are significantly involved in citizens' participation processes and urban developments.

- **Representatives of a Municipality** (N=3; ID = M1; M2; M3), who hold a professional role in the context of urban development and citizen participation. M1 represents a city with a population of around 80.000 citizens, while M2 and M3 are representatives of a city with a population of around 15.000 citizens.
- **Representatives of a Neighborhood Association** (N=3; ID = NA1; NA2; NA3), who are actively involved in their local community to organise gatherings and events, but also to be an interface between their local municipalities and community needs. NA1, NA2 and NA3 hold each the role as president within their neighbourhood association and are located at the same municipality.

The study underwent a university ethics check and was exempted from an additional full ethical review by the committee. Signed informed consent for participation was obtained from each expert.

5.2 Procedure, Data Collection & Analysis

For the interviews, we followed a semi-structured interview with two main parts. First, the status quo about the current process, the main challenges and improvements, as well as the current usage of AI tools in urban participation processes were investigated. In the second part, the concept of generative fill (Figure 5) and the results of study 1 were presented to learn more about their thoughts and opinions when integrating GenAI tools into urban development processes. The interviews were conducted in person or remotely. The sessions were audio recorded and literally transcribed and translated. The interviews were open-coded by two researchers, followed by a thematic reflexive analysis by three researchers.

6 Results Study 2

The experts highlighted the importance of citizens engagement in urban development, as summarised by M1.

"We can't know everything about this area. We need to know what everyday knowledge is. How is the area used? What are the needs of the local area? What are the needs of the local population? We are dependent on this. We can't do everything from our desks" - M1

By presenting the results of study 1, we received positive expert feedback about the usage of GenAI for citizen participation as well as current challenges, which we will present in the following.

6.1 Current Challenges of Citizen Participation and the Role of Visualisations

During the expert interviews, three main challenges in citizen engagement emerged. First, the gap between public and individual interests. Although it is important to take the needs, concerns and ideas of citizens seriously, there are also cases in which it must be weighed up to what extent individual interests are compatible with public interests, such as laws, costs and regulations. For this reason, frameworks and requirements are also communicated in project processes in which citizens are involved. The challenge here is to balance *"the extent to which you want to lead this process and at what point you intervene too much in the creative process"* (NA2).

Second, one challenge voiced by the expert is when in urban projects citizens have to participate in rather abstract goals and complex strategies, instead of being able to contribute to a concrete construction project. This leads to the third challenge when outcomes of a participatory process are not considered, poor and not transparent communicated with the citizens, which results in distrust in future participation events. Especially when they have the feeling that:

"I contributed. Now they've said they'll listen to me or see what ideas I have. And now I don't know what's going to happen." M3

Besides current challenges, the experts also reported on the current role of images in participation processes. M1 highlighted a case *"of how an idea of the population can be reflected in the planning process"* (M1). In the past, a local blogger illustrated their idea in the development of rail station square in a photo-realistic way, which was published in a local newspaper and later considered in the development. While M1 reported that during a participation process they needed pictures to showcase the goal of the project, M1 added that the problem here is that they *"always have to search for it and something is not good in this picture. For example, if you point reference examples from another city"* (M1), the first reaction of citizens is always, that they are not this other city.

Key Takeaways on Challenges in Citizen Participation and the Role of Visualisations

The experts voiced that finding a balance between individual and public interests is challenging, especially when laws, costs, and regulations may create obstacles. Furthermore, discussions may get difficult when goals are rather abstract like a strategy. Furthermore, poor communication of participation process outcomes might lead to citizens' distrust. Further, the experts highlighted the role of visuals, where citizens ideas influenced the process, but external visual references create resistance if they are not locally connected.

6.2 Reflection about GenAI Usage in Citizen Engagement

When reflecting on the use of GenAI in citizen engagement, we observed three key themes on an organizational level. First, the representatives pointed out that they believe that:

"If you involve the people there in such a way that they can already generate images, it would make participation very attractive [due to] the fun factor. That there is a kind of increase in activity in order to participate. I don't have to be able to do so much, but I can work with a tool and contribute." M3

Second, the experts valued the usage of GenAI as the effective way for citizens to communicate their ideas so *"that its more tangible"* (NA2). Especially, since up to now *"if they come up with an idea for a location and cannot draw, they have to explain it verbally, and it may be misunderstood"* (M3). Giving citizens the GenAI tool might make them not dependent on *"professionals, who have their tools to express what they want"* (M1).

Third, the experts voiced that with GenAI the thought process can be initiated, especially in situation where stakeholders *"lack the idea and the imagination. GenAI would be one way of showing what it will look like (NA2)"*. While *"it enables others to present their ideas more clearly and quickly" (M1)*, they have *"the great opportunity that one can concretely deal and comment on the concepts (M1)"*.

However, the experts also raised some critical thoughts, mostly concerning excluding older and digital novice citizens. Therefore the *"access to this tool needs to be thought through as well. When thinking about using it on a smartphone, it always depends on the target group. If you're targeting older individuals, there are hurdles once again" (NA3)*. M1 pointed out that *"there are individuals who like to participate in events by simply listening and then discussing with others" (M1)*. There were also concerns regarding the actual implementation, as NA2 remembers that they tried to launch a neighbourhood community app, which was poorly designed and *"completely failed, since the hurdles were too big" (NA2)*. Further, NA3 questions if the participation processes will with the aid of GenAI *"whether will get easier or if the flood of information will become even greater" (NA3)*.

Key Takeaways on Experts Reflection About the Usage of GenAI

The experts voiced that using GenAI to create visuals could make citizen participation more attractive and accessible. They argued that by overcoming the limitations of verbal descriptions, citizens could communicate their ideas more effectively. Additionally, there were comments on how GenAI might allow others to understand concepts quicker, which makes discussions more concrete. However, the experts also voiced concerns about excluding digital novices and older citizens in the process, and criticised potential information overloads.

6.3 Positioning and Requirements for Sustainable Usage of GenAI in Citizen Engagement

The results of the interviews indicate that the usage of GenAI might be best positioned rather at the beginning of participation processes. Here the tool can be helpful to *"first listen to the needs, [especially] in the early phase, when people want to express their views" (M1)*. However, similar as mentioned before the usage of GenAI might target mostly digitally experienced citizens, whereby novices would be overlooked, which needs to be considered as *"technology should only be a means to change and not the goal" (M2)*. Thereby the experts indicate two directions on how they could imagine to embed GenAI in participation processes.

First, during an event with pop-up stands with *"power users who could guide others" (NA2)* in the image generation process, which could be a suitable option for digital novice citizens.

The second option might be to give citizens direct access to a GenAI embedded in a platform, e.g. in the form of a mobile application, where they can share their images in a community space. Regarding a mobile application, the experts stated some further features, which might be essential to implement. For example, as

shown in section 6.1, participation processes require balancing public and personal interests. To ensure, that submitted ideas are not getting *"too fast too unrealistic" (M1)*, the experts believe that a GenAI should provide *"certain key parameters [e.g. laws and regulations]" (M1)* which provides feedback to the citizens. That they get *"first draft and then start refining" (M1)* their ideas. However, this rises the questions, *"how much one wants to guide and when you are intervening too much in the creative process" (NA2)*. To keep track of diverse idea submissions, they also believe that a GenAI could support from an organisational perspective to cluster certain needs in *"theme groups (NA3)"*. Displaying the transparency of *"the entire process from A to Z documented and making it accessible" (M3)* is vital, especially when several *"options are on the table, then you have to make sure to find a compromise somewhere. [...] Most of the time it's a compromise. You need to demonstrate that it the different interests was reviewed (M1)"*.

Key Takeaways on Positioning and Requirements for Sustainable Usage of GenAI

The experts believe that GenAI is most effectively positioned in the early stages of participation processes, supporting citizens to express their needs. However, *technology should be a means, not the goal*, which proposed two possible implementations of GenAI: First, pop-up events where powers guide digital novices in generating images. Second, a mobile platform, where citizens use it on their own. Thereby they speculate about parameters ensuring ideas remain realistic, and organisational tools, where submissions can be clustered by themes, ensuring transparent decision-making.

7 Study 3: Prototype Design & Evaluation

Based on the key takeaways from study 1 (section 4.2.1 and 4.2.2) and study 2 (section 6.1, 6.2 and 6.3), we developed a prototype to investigate how GenAI can be embedded as co-creation system in mobile participation processes. In the following, we present the design of the interactive prototype UrbAI, aligned with the previous results. Further, we describe the evaluation of UrbAI.

7.1 UrbAI: Prototype Overview

The focus of our prototype development was on how to embed GenAI in a citizen participation process. Therefore, we developed an interactive prototype, using Figma [20], which depicts an exemplary citizen participation process that encompasses the two core elements of 1) submitting a city development idea (7.1.1) and 2) a community space to share and discuss ideas (7.1.2), both enhanced with speculative AI features (Table 1).

7.1.1 Submitting City Development Ideas. In study 1 citizens valued the ability to visualise their ideas with the aid of GenAI (4.2.1), however expressed a preference for engaging with such a system through a more structured process, where they could receive constructive feedback to spark their creativity (4.2.2). This aligns with the findings in study 2, where experts mentioned that highlighting certain requirements in urban participation processes is common practice (6.3). With the design of UrbAI, citizens are guided through a structured participation process, enhanced with speculative AI

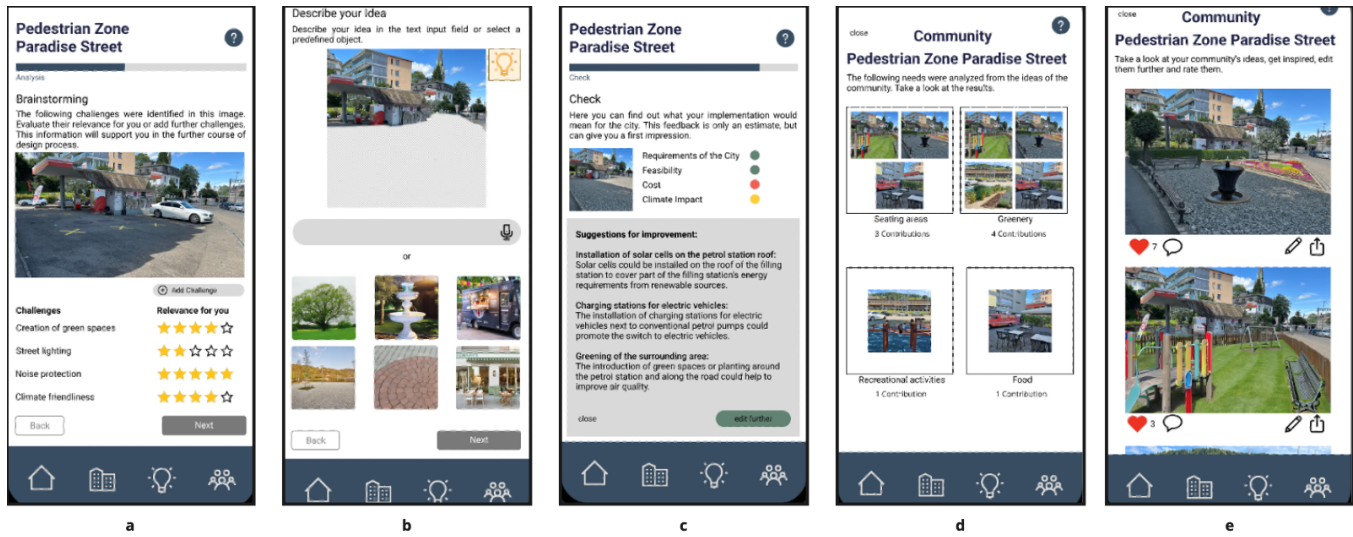


Figure 8: An overview of UrbAI, including a) urban challenges detected in the uploaded image, where citizens can rate the relevance, b) the prompting interface based on text, voice and image input, c) feedback indicators rating citizens ideas and providing suggestions for improvement, d) an overview of submitted ideas themed based on common needs and e) a community space where citizens can rate, comment or further edit others' ideas. Note: The screens shown here are translated versions. The original versions, used in the user study, can be found in Appendix A.

features. In the following, we present the structured process, while Table 1 provides an overview of the description and rationale of each *speculative AI feature*. The participation process begins by presenting the current situation and outlining necessary requirements. Potential challenges within the place of change are then identified to provide a better understanding of the issues in the place (Figure 8a and Table 1; *Screening Challenges*). Citizens can then rate the relevance of the identified challenges for their ideation process (Figure 8a and Table 1; *Rating of Challenges*). In the next stage, citizens can edit the image to visualise their idea, following the concept of generative fill (Figure 8b). Before completing their submission, UrbAI provides feedback based on a set of indicators, as well as suggestions for improvement (Figure 8c and Table 1; *Feedback Indicators & Suggestions for Improvement*).

7.1.2 Community. In study 1 (4.2.2) and study 2 (6.2), both citizens and experts voiced that participation is not only about visualising one's ideas, but also about sharing them and getting engaged in discourse from different perspectives. Therefore, a forum with voting and comment function (Figure 8e) was requested, as well as the option to cluster the submitted ideas into common themes (Figure 8d and Table 1; *Clustering of Needs*), thereby allowing greater transparency in the process.

7.2 Evaluation

In the following, we will describe the evaluation of UrbAI, including the recruited participants and their task, as well as the data collection and analysis procedure.

7.2.1 Participants. We recruited 10 participants (4 women and 6 men) with an average of 41 years (SD = 17.9 years, min = 18

years, max = 60 years). Eight participants stated that they had some experience with GenAI, mostly with ChatGPT (N=8) and image generation (N=2), while two had no prior experience. Asking about prior experiences in urban participation processes only one participant responded. The study underwent a university ethics check and was exempted from an additional full ethical review by the committee. Signed informed consent for participation was obtained from each participant.

7.2.2 Task & Procedure. After assessing the participants' demographics and their experience in citizen participation and GenAI, we briefed the participants about the objective of our study. We then asked them to submit an urban development idea using UrbAI, as well as evaluating the community space. After completing the tasks a semi-structured interview was conducted.

7.2.3 Data Collection & Analysis. The interaction with the prototype, the thinking aloud and the semi-structured interview were screen- and audio-recorded. The recordings were literally transcribed and translated if necessary. The data from the interviews were analysed by a first round of open coding by one researcher, followed by a discussion and inductively clustering with three researchers using a reflexive thematic analysis [8].

Table 1: Speculative AI-based features in mobile participation processes.

Feature	Description	Rationale
<i>Screening Challenges</i>	By uploading the taken image, this AI-feature screens potential challenges, summarizing them into categories such as safety, inclusion, noise pollution, aesthetics, environmental friendliness. The objective is to increase citizens' awareness of issues they may have not considered during their creative process (Figure 8a).	As described in section 4.2.1, citizens prefer to have a shared understanding with a co-creative system about current challenges of a certain place, before developing new ideas.
<i>Rating of Challenges</i>	By displaying the identified challenges, citizens can rate their perceived relevance and add additional challenges, not detected by the AI (Figure 8a). Based on these ratings, the GenAI will support the citizens in their creative process, by providing feedback and suggestions for improvement aligned with their preferences (e.g. safety, environmental friendliness, etc.).	Section 4.2.1 and 6.3 emphasise the importance of balancing guidance and intervention in a creative process with certain requirements. To maintain an open and constructive ideation process, citizens can retain control by evaluating the relevance of the identified challenges.
<i>Feedback Indicators</i>	After completing a draft of their visualised idea, citizens can receive feedback from an organizational perspective (Figure 8c). Indicators such as "city requirements," "feasibility," "costs," and "climate impact" are assessed using a traffic light system: green indicates "fulfilled/ very good/ low cost," orange signifies "partially fulfilled/ good/ medium cost," and red signifies "not fulfilled/ poor/ high cost".	To ensure transparency in urban participation processes it is a common approach to communicate certain requirements. Sections 4.2.1, 6.1 and 6.3 highlight, that a co-creative system should enhance interactivity and transparency by providing citizens with feedback on their ideas.
<i>Suggestions for Improvement</i>	Based on their perceived relevance of challenges and the results of the feedback indicators, the AI provides qualitative suggestions for improvement (Figure 8c). This aims to support citizens to refine their concepts by fostering their creativity.	As described in section 4.2.1, besides providing feedback about the feasibility of an idea, citizens value to get concrete suggestions to improve their ideas.
<i>Clustering of Needs</i>	Once a contribution is submitted, an AI-based clustering process automatically groups images based on the communicated needs. For instance, contributions featuring seating are clustered together in a group (Figure 8d). This provides users a clear overview of the community's expressed needs, facilitating the city to make informed decisions about the project. Additionally, this feature optimises resource use, contributing the efficiency of capturing and analyzing needs.	Urban participatory processes bring different citizens with diverse ideas, interests and needs together. Section 4.2.2 highlights that citizens value understanding others' needs and ideas, sparking further inspiration. Additionally, section 6.3 underscores the importance of communicating the decision-making process transparently with the population.

8 Results Study 3

The following presents the key results of UrbAI's evaluation.

8.1 Enhancing Public Engagement in Urban Development: Participant Perceptions of App-Based Involvement and Visualisation Tools

Participants see UrbAI as a convenient method to participate in urban development processes. One participant, P11, stated that "with an app like this, I think it would certainly be a way [to get involved], as I could do it from the comfort of my sofa and would not

have to go anywhere in the city to share my idea" (P11). Additionally, P7 posited that an app could make the process faster and more efficient, particularly for the emerging generation of mobile-phone-literate individuals. However, the results also indicate a preference for viewing images in larger sizes (P9, P10, P12). Communicating a need was evaluated as straightforward and logically structured (P6). For P10 and P14, the step-by-step guidance provided throughout the process proved beneficial, enabling the participants to develop their ideas in a structured manner. P7 highlighted, "You quickly come up with a new image that helps you put your ideas on paper" (P7). P7 and P8 noted that this enables everyone to visualise images, eliminating the need for complex sketches to illustrate an idea. Additionally,

the results indicate that to visualise the idea, it is helpful to provide reasons to garner support and understanding for the project (P3 and P10).

8.2 Perceptions of UrbAI in Idea Generation and Feedback

P13 commented on GenAI for idea generation: *“If you are perhaps not that creative and do not have many ideas yourself, AI can still make a few suggestions. For someone who is perhaps very innovative and has many ideas, I do not know (P13)”*. P3 and P11 think that the idea arises naturally, as humans encounter problems in everyday life and know the challenges best. A different opinion is expressed by P9, who wants AI to work out the problem as independently as possible: *“In a case like this, I expect the AI to analyze the picture and point out the challenges and directly present possible solutions A, B, and C. I would then be able to choose which one. I would then be able to choose which one I like best (P9)”*.

The use of GenAI for feedback was perceived as beneficial by the participants, as it provided new ideas, experience, and another perspective (P6, P7, P10). One participant commented, *“It is good that suggestions for improvement come automatically. Then there are certainly some experiences that could be included (P11)”*. P3 has expressed concerns regarding the reliability of the assessment results generated by the AI. *“I do not think GPT models can do that reliably. I do not trust them in this regard. [...] The question is whether it is correct or not. If it is unintuitive, then an explanation would be helpful (P3)”*.

The AI-based clustering of needs provides a good overview of the various needs that have been identified, as this allows, for example, P12 *“to see where it could go and what will finally be developed. Because it is often the case that you have an idea or ideas during the participation process, and in the end something completely different comes out and your idea is not included (P7)”*. The *“main goal which is to be able to respond to the needs (P12)”* is achieved through AI-based clustering. Participant P6 takes a similar view, because otherwise *“the city is probably planning without taking the majority of the population into account [if the stated needs are not taken into account] (P6)”*.

8.3 Community Features in Mobile Public Participation: Enhancing Idea Exchanges and Citizens' Engagement

The results show that the inclusion of community functions was perceived as inspiring as it allows citizens to use the ideas of others to develop their own ideas or optimise existing ones. P13 mentioned that *“there may be other ideas, and maybe I can develop another new idea and build on it (P13)”*. P10 stated: *“I can also give or get tips from others in this community. I can also give my opinion or see what others think (P10)”*. The added value for the city administration, which initiated the participation, was also recognised. P8 and P14 believe that the city can use the comments and likes to gain more precise insight into the population's opinion on individual ideas and incorporate this into further development. The results indicate that the community should facilitate additional opportunities for discussion (P9) and that each neighbourhood should have a community-based platform where citizens can share and discuss

their ideas independently of a project (P14). Furthermore, P11 believes that a community can enhance the well-being and sense of solidarity among its residents while simultaneously optimizing the allocation of financial resources in a more targeted and efficient manner, ensuring that the citizens' actual needs are met (P11).

Key Takeaways from the Evaluation of UrbAI

Participants perceived UrbAI as a convenient and efficient tool to engage citizens in urban development, particularly valuing step-by-step guidance and receiving feedback on generated images. Community features, such as viewing others' ideas and clustering needs, were seen as promising for fostering idea exchange and providing transparency in city administration processes. However, concerns were raised in the reliability of AI-generated feedback.

9 Discussion

In this paper, we explored (1) the use of GenAI to support citizens in visualising and communicating their ideas in urban participation processes and (2) conducted expert interviews with city representatives and community associates to receive insights into real-life applications. Further, we translated the insights from the previous two phases into (3) an interactive prototype, showing how GenAI can be embedded urban participation processes. In the following, we provide answers to our research questions and conclude with critical considerations for using GenAI in participation processes.

9.1 RQ1: To What Extent Can GenAI Support Citizens to Express Their Urban Development Ideas Visually?

Participants of study 1 particularly valued the ability of GenAI to inspire and engage them in the ideation process. While participants described in the forms more the current challenges and needs for improvements of a place, the usage of the GenAI shifted the focus to finding opportunities and solutions. Getting their ideas displayed in a photo-realistic way served participant as a stimulus to reflect on the consequences and refine their ideas, resulting in higher engagement and creativity in the process. We further observed that some participants were not motivated by prompting a solution but rather by their needs (e.g. *“Nice hedge that prevents the view to the road” (P7)*), highlighting the desire in having a co-creator who can translate these needs into possible outcomes, which aligns with the literature, where GenAI tools are not only perceived as tools to complete tasks but also as co-creative systems, actively contributing to the creative process [19, 22, 29]. Further, our interviewed experts in study 2 highlighted the vital role of visualisations in current participation processes. However, they also voiced that - as of now - these are primarily utilised by municipalities and urban planners when sharing their ideas, with limited opportunities for citizens to do the same. This goes in line with existing research, where the visualisations by citizens are primarily used to raise awareness on challenges and needs in public spaces [30, 36, 63] instead of visualising a concrete idea. Experts identified the use of AI-manipulated images as a way to empower citizens, enabling them to present

their perspectives more clearly, while city representatives can more effectively address these needs and concepts.

However, some participants encountered challenges, primarily concerning finding appropriate prompts to visually generate their idea. This aligns with existing research by Zamfirescu-Pereira et al. [69], where non-expert users have difficulties in the right prompting, which requires the consideration of potential prompting difficulties when developing for lay users [63, 69]. During study 1, there were some cases where the GenAI tool failed to generate the outputs intended by the participants. For example, over-dimensional cocktail drinks instead of a bar (Figure 7). However, despite the inaccuracy of the GenAI tool, participants voiced to belief that a third person would still be able to understand the need or intention for this place as a metaphor. Aligned with existing research by Reed et al. [50], our results show that AI-manipulated images offer the potential to be an artefact for mutual understanding in a metaphorical communication. Compared to existing methods in participation processes, where metaphors are an essential part of articulating and discussing ideas, such as low fidelity prototyping with cardboards, Lego, and Play Dough [10, 14, 53], we believe that the usage of AI-manipulated images could be a complementary approach within this spectrum. For example, Rafner et al. [48] showed that generated images offer the opportunity to represent utopian and dystopian vision [47, 48] of individuals, serving as conversation starter to identify common ground in collaborative and participatory settings. Compared to Rafner et al. [48], our approach, wherein citizens capture images themselves to visualise their visions using GenAI, enhances their understanding and relationship with the proposed changes [34, 58].

In summary, the results indicate that the added value of using GenAI compared to traditional methods lies in its role as a co-creative system that facilitates improved context understanding and idea refinement. Having images as an outcome of this co-creative process fosters dialogue and supports to identify a common ground. Furthermore, the democratization of creative tools to citizens may enhance engagement and creativity in the participation process. However, potential trade-offs need to be acknowledged, particularly when citizens provide incorrect prompts, leading the GenAI tool to generate outputs that do not align with their intended outcomes. Citizens need then to assess whether a flawed outcome might still hold potential as a metaphorical representation of their ideas and needs. At the same time, it is the task of technologists to adapt and train the GenAI tools to the prompting behaviour of citizens, rather than expecting citizens to adapt to the tools.

9.2 RQ2: How Can GenAI Be Embedded in Current Participation Processes?

Our results indicate that GenAI is best positioned in the early stages of the participation process, allowing stakeholders to get a holistic perspective on current needs and ideas. Informed by the results of study 1 and study 2, we identified the added value in using GenAI in citizen participation in its role of a co-creative system [62], resulting in the design of *UrbAI*. Aligned with the human-AI interaction design guidelines of Amershi et al. [4], the design and evaluation of *UrbAI* demonstrate the importance of features such as expectations setting (e.g. goal of participation project), grasping contextual

nuances (e.g. understanding of challenges and limitations within public spaces, to propose suggestions for improvement), and the facilitation of efficient correction (e.g. when citizens want to refine their prompted ideas).

Looking at the HCI literature, especially in participatory designs, it is common sense not to limit participants to any constraints in the ideation process, allowing them to grasp the whole design space. However, contrary to this freedom, our participants were positive about the idea of a co-creative system that evaluates their generated images in terms of regulations or feasibility to ensure realistic outcomes by both, citizens and experts (see 4.2.1 and 6.3). Striking the balance between broad and speculative ideas, while also guiding the process for feasible ideas, needs further investigation in the context of GenAI in urban participation processes [18]. Similar as outlined in the work of Saßmannshausen et al. [53], where they explored the usage of AR in citizen participation, our results indicate that the usage of GenAI holds promise in attracting especially younger citizens in these processes. However, the experts in our work highlight that older and digitally novice citizens might feel excluded when they are not considered.

Instead of thriving for a co-creative system that aims to attract *all citizens*, we encourage future research to explore the usage of GenAI in diverse settings, such as in-person workshops. Here power-users could guide digitally inexperienced citizens, as previous work has shown [3]. Further, integrating mixed-method approaches within such workshop formats might enhance the overall creativity, which we examine in 9.3 in more detail.

9.3 Critical Consideration & Limitations of GenAI in the Creative Process in Citizen Participation

While the results of our exploration about the usage of GenAI in urban participation processes hold promises to empower and attract citizens, some critical considerations must be acknowledged.

- (1) **Potential Pitfall of Bypassing the Contextual Understanding:** Having the possibility to generate high-fidelity outcomes with little effort might lead to bypassing the understanding of everyday practices and problems of an urban space. Traditional participation formats, like workshops, are usually structured in a way that citizen get engaged in sharing their practices and discussing problems and needs they wish to be considered when (re-)developing public places [10]. Therefore, before making use of GenAI in participation formats to visualise citizen ideas, it's crucial to ensure that these generated images are grounded in contextual understanding. In section 7.1.1, we demonstrated with *UrbAI* how the usage of GenAI is embedded in structured processes, supporting citizens in understanding the challenges of a place and refining ideas by providing feedback.
- (2) **Impact of High-Fidelity Outcomes on the Creativity and Expectations of Citizens:** On the one hand, the generated images are high-fidelity idea representations which might not align with the actual realities, potentially misleading citizens with expectations that are hard to realise by the stakeholders. It is important to emphasise that the generated images are not intended to be directly implemented in

the urban space or replace the expertise of professionals like architects and urban planners. Instead, GenAI should be positioned as a tool for collecting a broad range of ideas, with its outputs serving as conversation starters to facilitate dialogue, broaden perspectives, and foster mutual understanding [50] in the context of change. On the other hand, there is the risk that high-fidelity outcomes may constrain the imagination and further exploration, since citizens may be less likely to critique on visually complete appearing solutions. This aligns with design theory, where low-fidelity prototypes, e.g., with cardboards, Lego, and Play Dough [10, 14, 53], leave room for exploration and imagination, making them an effective and common approach in early ideation stages. Our presented approach with UrbAI, where the GenAI holds the role of a co-creative system, addresses further exploration by providing feedback on the generated outcome. Building on the work of Saßmannshausen et al. [53], another way to address these constraints is to adopt a mixed-method approach, starting with workshops using traditional low-fidelity approaches and progressively moving toward higher-fidelity outcomes with each iteration.

- (3) **Limitations of Generative Models Impacting the Range of Novel Solutions:** The nature of the generative models, which are constrained by the data they are trained with, may lead to limitations in the creative process, affecting the range of possible and novel outcomes. While this is primarily a theoretical limitation, future generative models used in citizen participation should be tailored to this context ensuring appropriate results. As we learned in section 4.1.1 and 4.2.1, citizens tend to request suggestions for a specific need instead of prompting direct solutions. Therefore, one potential approach to adapt these generative models is by aligning them with the way citizens provide input, emphasizing need-oriented prompting over solution-oriented prompting - for instance, requesting "*shaded areas*" instead of "*trees*". Another direction for future generative models is the incorporation of teachable AI systems [49, 66], allowing users to customise GenAI applications to their specific needs, as this has been proven in other domains such as for blind and low vision people [66]. However, our results highlight the importance of not overestimating the content novelty generated by such models. Instead, the primary value of the generated images lies in their capacity to facilitate diverse perspectives, fostering dialogue between citizens and experts. This exchange enhances understanding of daily practices and needs, contributing to the development of appropriate solutions.

In summary, the effective usage of GenAI in citizen participation requires a grounded contextual understanding. High-fidelity outcomes carry the risk of creating unrealistic expectations or limiting the creativity of citizens. These can be mitigated through a structured and moderated process and mixed-method approaches in diverse formats. Lastly, while the generative models are constrained by their training data, they should be tailored for citizen participation, for instance, by emphasizing need-oriented prompting or teachable AI system approaches.

10 Conclusion & Future Work

In this paper, we first conducted a technology probe study with a generic GenAI tool to explore its effectiveness in visualising citizens' ideas and to get citizens' speculative ideas for a tailored co-creative system. To gain a holistic perspective, we conducted additional expert interviews with representatives of municipalities and neighbourhood associations to learn more about their thoughts and opinions on the use of GenAI in citizen participation processes. Based on the key takeaways of the technology probe and the expert interviews, we designed and evaluated UrbAI, a prototype of a co-creation system that is tailored for citizens in urban participation processes.

Our research highlights five lessons for advancing GenAI tools in citizen participation processes. First, AI-manipulated images show great potential for translating citizens' ideas into visual representations, helping participants reflect on the impact of their proposals. These images, while not needing to be perfect, can metaphorically convey ideas and serve as discussion starters, fostering more transparent communication. Second, GenAI tools are most effective in the early stages of participation, where municipalities seek to understand local needs and challenges. They can enhance creativity and engagement as co-creators by providing feedback that is aligned with urban concepts and citizens' needs. These systems should consider contextual challenges and constraints to ensure realistic results. Third, transparency is essential at two levels: in the participation process to ensure open communication between stakeholders and in the AI's feedback so citizens understand its reasoning. Fourth, while GenAI can attract younger participants, care must be taken to avoid excluding older or less tech-savvy individuals. Future research should explore alternative formats, such as workshops, where digital novices can receive guidance. Finally, co-creation in urban development thrives on collaboration. Future work should investigate how to integrate individual ideas into shared urban visions by identifying common ground and encouraging collective design efforts.

Acknowledgments

This research was funded by the Swiss National Science Foundation (SNSF) grant number 200021_207430. We would like to thank all participants of the *CHITogether 2024* [56] at the University of St.Gallen for their support as well as all participants of our user studies for their valuable input.

In this paper, we used Overleaf's built-in spell checker, Grammarly, DeepL and the current version of ChatGPT (GPT-4o). These tools helped us fix spelling mistakes and get suggestions to improve the writing of the paper. If not noted otherwise in a specific section, these tools were not used in other forms.

References

- [1] Adobe. 2024. *Adobe Firefly*. Retrieved April 08, 2024 from <https://www.adobe.com/products/firefly.html>
- [2] Adobe. 2024. *Generative Fill*. Retrieved April 08, 2024 from <https://www.adobe.com/products/photoshop/generative-fill.html>
- [3] Aloha Hufana Ambe, Margot Brereton, Alessandro Soro, Laurie Buys, and Paul Roe. 2019. The Adventures of Older Authors: Exploring Futures through Co-Design Fictions. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*. ACM. <https://doi.org/10.1145/3290605.3300588>
- [4] Saleema Amershi, Dan Weld, Mihaela Vorvoreanu, Adam Fournay, Besmira Nushi, Penny Collisson, Jina Suh, Shamsi Iqbal, Paul N. Bennett, Kori Inkpen,

- Jaime Teevan, Ruth Kikin-Gil, and Eric Horvitz. 2019. Guidelines for Human-AI Interaction. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*. ACM. <https://doi.org/10.1145/3290605.3300233>
- [5] Apple. 2024. *iPhone 15 Pro*. Retrieved April 08, 2024 from <https://www.apple.com/chde/iphone-15-pro/>
- [6] Mark Blythe. 2023. Artificial Design Fiction: Using AI as a Material for Pastiche Scenarios. In *26th International Academic Mindtrek Conference (Mindtrek '23)*. ACM. <https://doi.org/10.1145/3616961.3616987>
- [7] Andrea Botero and Joanna Saad-Sulonen. 2008. Co-designing for new city-citizen interaction possibilities: weaving prototypes and interventions in the design and development of Urban Mediator (PDC '08). Indiana University, USA, 266–269.
- [8] David Byrne. 2021. A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Quality & Quantity* 56, 3 (June 2021), 1391–1412. <https://doi.org/10.1007/s11135-021-01182-y>
- [9] Alan Chamberlain, Andy Crabtree, and Mark Davies. 2013. Community engagement for research: contextual design in rural CSCW system development. In *Proceedings of the 6th International Conference on Communities and Technologies (C&T '13)*. ACM. <https://doi.org/10.1145/2482991.2483001>
- [10] Simran Chopra, Rachel E Clarke, Adrian K Clear, Sara Heitlinger, Ozge Dilaver, and Christina Vasiliou. 2022. Negotiating sustainable futures in communities through participatory speculative design and experiments in living. In *CHI Conference on Human Factors in Computing Systems (CHI '22)*. ACM. <https://doi.org/10.1145/3491102.3501929>
- [11] Roberto Cibin, Sarah Robinson, Maurizio Teli, Conor Linehan, Laura Maye, and Christopher Csikszentmihályi. 2020. Shaping Social Innovation in Local Communities: The Contribution of Intermediaries. In *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society (NordiCHI '20)*. ACM. <https://doi.org/10.1145/3419249.3420178>
- [12] Laura D Cosio, Oğuz "Oz" Buruk, Daniel Fernández Galeote, Isak De Villiers Bosman, and Juho Hamari. 2023. Virtual and Augmented Reality for Environmental Sustainability: A Systematic Review. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*. ACM. <https://doi.org/10.1145/3544548.3581147>
- [13] Peter Dalgaard, Jonas Frich, and Thomas Riisgaard. 2022. Four Challenges of Designing Digital Services to Support Participatory Design. In *Nordic Human-Computer Interaction Conference (NordiCHI '22)*. ACM. <https://doi.org/10.1145/3546155.3547273>
- [14] Stevienna de Saille, David Cameron, and Amanda Sharkey. 2022. LEGO® Serious Play® in HRI research: results of a pilot imagining robotic care. In *CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '22)*. ACM. <https://doi.org/10.1145/3491101.3519708>
- [15] Julia Díez, Paloma Conde, María Sandin, María Urtasun, Remedios López, José Luis Carrero, Joel Gittelsohn, and Manuel Franco. 2017. Understanding the local food environment: A participatory photovoice project in a low-income area in Madrid, Spain. *Health & Place* 43 (Jan. 2017), 95–103. <https://doi.org/10.1016/j.healthplace.2016.11.012>
- [16] Ahmed Ehab and Tim Heath. 2023. Exploring Immersive Co-Design: Comparing Human Interaction in Real and Virtual Elevated Urban Spaces in London. *Sustainability* 15, 12 (June 2023), 9184. <https://doi.org/10.3390/su15129184>
- [17] Philip Engelbutzeder, Katerina Cerna, Dave Randall, Dennis Lawo, Claudia Müller, Gunnar Stevens, and Volker Wulf. 2020. Investigating the use of digital artifacts in a community project of sustainable food practices: 'My chili blossoms'. In *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society (NordiCHI '20)*. ACM. <https://doi.org/10.1145/3419249.3420089>
- [18] Sheena Erete and Jennifer O. Burrell. 2017. Empowered Participation: How Citizens Use Technology in Local Governance. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM. <https://doi.org/10.1145/3025453.3025996>
- [19] Xianzhe Fan, Zihan Wu, Chun Yu, Fenggui Rao, Weinan Shi, and Teng Tu. 2024. ContextCam: Bridging Context Awareness with Creative Human-AI Image Co-Creation. In *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '24, Vol. 23)*. ACM, 1–17. <https://doi.org/10.1145/3613904.3642129>
- [20] Figma. 2024. *Figma Design*. Retrieved August 07, 2024 from <https://www.figma.com/design/>
- [21] Kirk A. Foster, Brittany Davis, and Andrew Foell. 2022. Innovations to Photovoice: Using Smartphones & Social Media. *Urban Affairs Review* 59, 5 (May 2022), 1728–1744. <https://doi.org/10.1177/10780874221100263>
- [22] Frederic Gmeiner, Jamie Lynn Conlin, Eric Handa Tang, Nikolas Martelaro, and Kenneth Holstein. 2024. An Evidence-based Workflow for Studying and Designing Learning Supports for Human-AI Co-creation. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI '24)*. ACM, 1–15. <https://doi.org/10.1145/3613905.3650763>
- [23] Carl Grodach and Renia Ehrenfeucht. 2015. *Urban Revitalization*. Routledge. <https://doi.org/10.4324/9781315850214>
- [24] Christina Harrington, Sheena Erete, and Anne Marie Piper. 2019. Deconstructing Community-Based Collaborative Design: Towards More Equitable Participatory Design Engagements. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (Nov. 2019), 1–25. <https://doi.org/10.1145/3359318>
- [25] Jan Hess, David Randall, Volkmar Pipek, and Volker Wulf. 2013. Involving users in the wild—Participatory product development in and with online communities. *International Journal of Human-Computer Studies* 71, 5 (May 2013), 570–589. <https://doi.org/10.1016/j.ijhcs.2013.01.003>
- [26] Michel Hohendanner, Chiara Ullstein, Yosuke Buchmeier, and Jens Grossklags. 2023. Exploring the Reflective Space of AI Narratives Through Speculative Design in Japan and Germany. In *Proceedings of the 2023 ACM Conference on Information Technology for Social Good (GoodIT '23)*. ACM. <https://doi.org/10.1145/3582515.3609554>
- [27] Sami Hulkko, Tuuli Mattelmäki, Katja Virtanen, and Turkka Keinonen. 2004. Mobile probes. In *Proceedings of the third Nordic conference on Human-computer interaction (NordiCHI04)*. ACM. <https://doi.org/10.1145/1028014.1028020>
- [28] Michael G. Hunter, Alessandro Soro, Ross A. Brown, Joel Harman, and Tan Yigitcanlar. 2022. Augmenting Community Engagement in City 4.0: Considerations for Digital Agency in Urban Public Space. *Sustainability* 14, 16 (Aug. 2022), 9803. <https://doi.org/10.3390/su14169803>
- [29] Angel Hsing-Chi Hwang. 2022. Too Late to be Creative? AI-Empowered Tools in Creative Processes. In *CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '22)*. ACM. <https://doi.org/10.1145/3491101.3503549>
- [30] Feifeng Jiang, Jun Ma, Christopher John Webster, Alain J.F. Chiaradia, Yulun Zhou, Zhan Zhao, and Xiaohu Zhang. 2024. Generative urban design: A systematic review on problem formulation, design generation, and decision-making. *Progress in Planning* 180 (Feb. 2024), 100795. <https://doi.org/10.1016/j.progress.2023.100795>
- [31] Ioannis Kavouras, Emmanuel Sardis, Eftychios Protopapadakis, Ioannis Rallis, Anastasios Doulamis, and Nikolaos Doulamis. 2023. A Low-Cost Gamified Urban Planning Methodology Enhanced with Co-Creation and Participatory Approaches. *Sustainability* 15, 3 (Jan. 2023), 2297. <https://doi.org/10.3390/su15032297>
- [32] Jini Kim, Chorong Kim, and Ki-Young Nam. 2022. ThinkWrite: Design Interventions for Empowering User Deliberation in Online Petition. In *CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '22, Vol. 18)*. ACM, 1–8. <https://doi.org/10.1145/3491101.3519644>
- [33] Adam Kjaer Søgaard, Bo Jacobsen, Michael Utne Kærholm Svendsen, Rune Lundegaard Uggerhøj, and Markus Löchtefeld. 2021. Evaluation Framework for Public Interactive Installations. In *Media Architecture Biennale 20 (MAB20)*. ACM. <https://doi.org/10.1145/3469410.3469418>
- [34] Gwen Klerks, Geertje Slingerland, Indre Kalinauskaitė, Nicolai Brodersen Hansen, and Ben Schouten. 2022. When Reality Kicks In: Exploring the Influence of Local Context on Community-Based Design. *Sustainability* 14, 7 (March 2022), 4107. <https://doi.org/10.3390/su14074107>
- [35] RAY LC and Yuying Tang. 2023. Speculative Design with Generative AI: Applying Stable Diffusion and ChatGPT to imagining climate change futures. In *Proceedings of the 11th International Conference on Digital and Interactive Arts (ARTECH 2023)*. ACM. <https://doi.org/10.1145/3632776.3632827>
- [36] Kirsti Lehtimäki and Taina Rajanti. 2008. Documenting the ordinary: mobile digital photography as an agent of change in people's practices concerning storing and sharing of photography. In *Proceedings of the 5th Nordic conference on Human-computer interaction: building bridges (NordiCHI08)*. ACM. <https://doi.org/10.1145/1463160.1463229>
- [37] Clayton Lewis. 1982. *Using the "thinking-aloud" method in cognitive interface design*. IBM TJ Watson Research Center Yorktown Heights, NY.
- [38] Junjie Luo, Pengyuan Liu, and Lei Cao. 2022. Coupling a Physical Replica with a Digital Twin: A Comparison of Participatory Decision-Making Methods in an Urban Park Environment. *ISPRS International Journal of Geo-Information* 11, 8 (Aug. 2022), 452. <https://doi.org/10.3390/ijgi11080452>
- [39] Franzisca Maas, Sara Wolf, Anna Hohm, and Jörn Hurtienne. 2021. Citizen Needs – To Be Considered: Requirements for Local Civic Participation Tools. *i-com* 20, 2 (Aug. 2021), 141–159. <https://doi.org/10.1515/icom-2021-0013>
- [40] Sanna Marttila, Andrea Botero, and Joanna Saad-Sulonen. 2014. Towards commons design in participatory design. In *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium papers, and Keynote abstracts - Volume 2 (PDC '14)*. ACM. <https://doi.org/10.1145/2662155.2662187>
- [41] Thomas Maskell, Clara Crivellaro, Robert Anderson, Tom Nappey, Vera Araújo-Soares, and Kyle Montague. 2018. Spokespeople: Exploring Routes to Action through Citizen-Generated Data. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM. <https://doi.org/10.1145/3173574.3173979>
- [42] Microsoft. 2024. *Microsoft Forms*. Retrieved April 08, 2024 from <https://www.microsoft.com/en-us/microsoft-365/online-surveys-polls-quizzes>
- [43] Michael J. Muller. 2002. *Participatory design: the third space in HCI*. L. Erlbaum Associates Inc., USA, 1051–1068.
- [44] Ariel Noyma and Kent Larson. 2020. DeepScope: HCI Platform for Generative Cityscape Visualization. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. ACM. <https://doi.org/10.1145/3334480.3382809>

- [45] Teresa K. O'Leary, Elizabeth Stowell, Jessica A. Hoffman, Michael Paasche-Orlow, Timothy Bickmore, and Andrea G. Parker. 2021. Examining the Intersections of Race, Religion & Community Technologies: A Photovoice Study. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)*. ACM. <https://doi.org/10.1145/3411764.3445418>
- [46] Megan M. Patton-López, Rocio Muñoz, Kristty Polanco, Brigetta Olson, George Brown, and Stephen DeGhetto. 2015. Redesigning a Neighborhood Park to Increase Physical Activity: A Community-Based Participatory Approach. *Journal of Public Health Management and Practice* 21, Supplement 3 (May 2015), S101–S105. <https://doi.org/10.1097/phh.0000000000000206>
- [47] Janet Rafner, Steven Langsford, Arthur Hjorth, Miroslav Gajdacz, Lotte Philipsen, Sebastian Risi, Joel Simon, and Jacob Sherson. 2021. Utopian or Dystopian?: using a ML-assisted image generation game to empower the general public to envision the future. In *Creativity and Cognition (C&C '21)*. ACM. <https://doi.org/10.1145/3450741.3466815>
- [48] Janet Rafner, Blanka Zana, Peter Dalsgaard, Michael Mose Biskjaer, and Jacob Sherson. 2023. Picture This: AI-Assisted Image Generation as a Resource for Problem Construction in Creative Problem-Solving. In *Creativity and Cognition (C&C '23)*. ACM. <https://doi.org/10.1145/3591196.3596823>
- [49] Gonzalo Ramos, Christopher Meek, Patrice Simard, Jina Suh, and Soroush Ghosh. 2020. Interactive machine teaching: a human-centered approach to building machine-learned models. *Human-Computer Interaction* 35, 5–6 (April 2020), 413–451. <https://doi.org/10.1080/07370024.2020.1734931>
- [50] Courtney N. Reed, Paul Strohmeier, and Andrew P. McPherson. 2023. Negotiating Experience and Communicating Information Through Abstract Metaphor. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23, Vol. 5)*. ACM, 1–16. <https://doi.org/10.1145/3544548.3580700>
- [51] Erin Robinson. 2019. Creating “People’s Park”: Toward a Redefinition of Urban Space. *Human Ecology Review* 25, 1 (Aug. 2019), 87–110. <https://doi.org/10.22459/her.25.01.2019.05>
- [52] Joanna Saad-Sulonen. 2012. The Role of the Creation and Sharing of Digital Media Content in Participatory E-Planning. *International Journal of E-Planning Research* 1, 2 (April 2012), 1–22. <https://doi.org/10.4018/ijep.2012040101>
- [53] 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)*. ACM. <https://doi.org/10.1145/3461778.3462130>
- [54] Jessica Schoffelen, Sandy Claes, Liesbeth Huybrechts, Sarah Martens, Alvin Chua, and Andrew Vande Moere. 2015. Visualising things. Perspectives on how to make things public through visualisation. *CoDesign* 11, 3–4 (Oct. 2015), 179–192. <https://doi.org/10.1080/15710882.2015.1081240>
- [55] Johannes Schöning, Antonio Krüger, Keith Cheverst, Michael Rohs, Markus Löchtfeld, and Faisal Taher. 2009. PhotoMap: using spontaneously taken images of public maps for pedestrian navigation tasks on mobile devices. In *Proceedings of the 11th international Conference on Human-Computer interaction with Mobile Devices and Services*. 1–10.
- [56] Ava Elizabeth Scott, Leon Reicherts, and Evropi Stefanidi. 2024. Doing CHI together: The benefits of a writing retreat for early-career HCI researchers. *Interactions* 31, 3 (2024), 8–9.
- [57] Rafael M. L. Silva, Erica Principe Cruz, Daniela K. Rosner, Dayton Kelly, Andrés Monroy-Hernández, and Fannie Liu. 2022. Understanding AR Activism: An Interview Study with Creators of Augmented Reality Experiences for Social Change. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (, New Orleans, LA, USA,) (CHI '22). Association for Computing Machinery, New York, NY, USA, Article 630, 15 pages. <https://doi.org/10.1145/3491102.3517605>
- [58] Shenando Stals, Michael Smyth, and Wijnand Ijsselstein. 2014. Walking & talking: probing the urban lived experience. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational (NordiCHI '14)*. ACM. <https://doi.org/10.1145/2639189.2641215>
- [59] Sarah-Kristin Thiel. 2016. Reward-based vs. social gamification: Exploring effectiveness of gamefulness in public participation. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction*. 1–6.
- [60] Sarah-Kristin Thiel, Michaela Reisinger, Kathrin Röderer, and Peter Fröhlich. 2016. Playing (with) democracy: A review of gamified participation approaches. *JeDEM-eJournal of eDemocracy and Open Government* 8, 3 (2016), 32–60.
- [61] John Underkoffler and Hiroshi Ishii. 1999. Urp: a luminous-tangible workbench for urban planning and design. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 386–393.
- [62] Simone van den Broek, Supraja Sankaran, Jan de Wit, and Alwin de Rooij. 2024. Exploring the Supportive Role of Artificial Intelligence in Participatory Design: A Systematic Review. In *Participatory Design Conference 2024 (PDC '24, Vol. 2)*. ACM, 37–44. <https://doi.org/10.1145/3661455.3669868>
- [63] Beatrice Vincenzi, Simone Stumpf, Alex S. Taylor, and Yuri Nakao. 2024. Lay User Involvement in Developing Human-Centric Responsible AI Systems: When and How? *ACM Journal on Responsible Computing* (March 2024). <https://doi.org/10.1145/3652592>
- [64] Caroline Wang and Mary Ann Burris. 1997. Photovoice: Concept, Methodology, and Use for Participatory Needs Assessment. *Health Education & Behavior* 24, 3 (June 1997), 369–387. <https://doi.org/10.1177/109019819702400309>
- [65] Sofie Wass and Mugula Chris Safari. 2020. Photovoice—Towards Engaging and Empowering People with Intellectual Disabilities in Innovation. *Life* 10, 11 (Nov. 2020), 272. <https://doi.org/10.3390/life10110272>
- [66] Linda Yilin Wen, Cecily Morrison, Martin Grayson, Rita Faia Marques, Daniela Massiceti, Camilla Longden, and Edward Cutrell. 2024. Find My Things: Personalized Accessibility through Teachable AI for People who are Blind or Low Vision. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI '24)*. ACM, 1–6. <https://doi.org/10.1145/3613905.3648641>
- [67] Jacob O. Wobbrock and Julie A. Kientz. 2016. Research contributions in human-computer interaction. *Interactions* 23, 3 (apr 2016), 38–44. <https://doi.org/10.1145/2907069>
- [68] Niels Wouters, Jonathan Huyghe, and Andrew Vande Moere. 2014. StreetTalk: participative design of situated public displays for urban neighborhood interaction. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational (NordiCHI '14)*. ACM. <https://doi.org/10.1145/2639189.2641211>
- [69] J.D. Zamfirescu-Pereira, Richmond Y. Wong, Bjoern Hartmann, and Qian Yang. 2023. Why Johnny Can’t Prompt: How Non-AI Experts Try (and Fail) to Design LLM Prompts. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*. ACM. <https://doi.org/10.1145/3544548.3581388>
- [70] Chengzhi Zhang, Weijie Wang, Paul Pangaro, Nikolas Martelaro, and Daragh Byrne. 2023. Generative Image AI Using Design Sketches as input: Opportunities and Challenges. In *Creativity and Cognition (C&C '23)*. ACM. <https://doi.org/10.1145/3591196.3596820>
- [71] Man Zhang, Jing Wang, and Danwen Ji. 2023. *Between Institutioning and Commoning: Grassroots Co-creation in Web3 Communities*. Springer Nature Switzerland, 317–329. https://doi.org/10.1007/978-3-031-35936-1_23

A Results Technology Probe and Original Version of UrbAI



Figure 9: Results of the technology probe study in the scenario 1 using *Firefly*. The *before* images are self taken by the participants and further edited by them using generative fill, resulting in the *after* images.



Figure 10: Results of the technology probe study in scenario 2 using *Firefly*. The *before* images are self taken by the participants and further edited by them using generative fill, resulting in the *after* images.

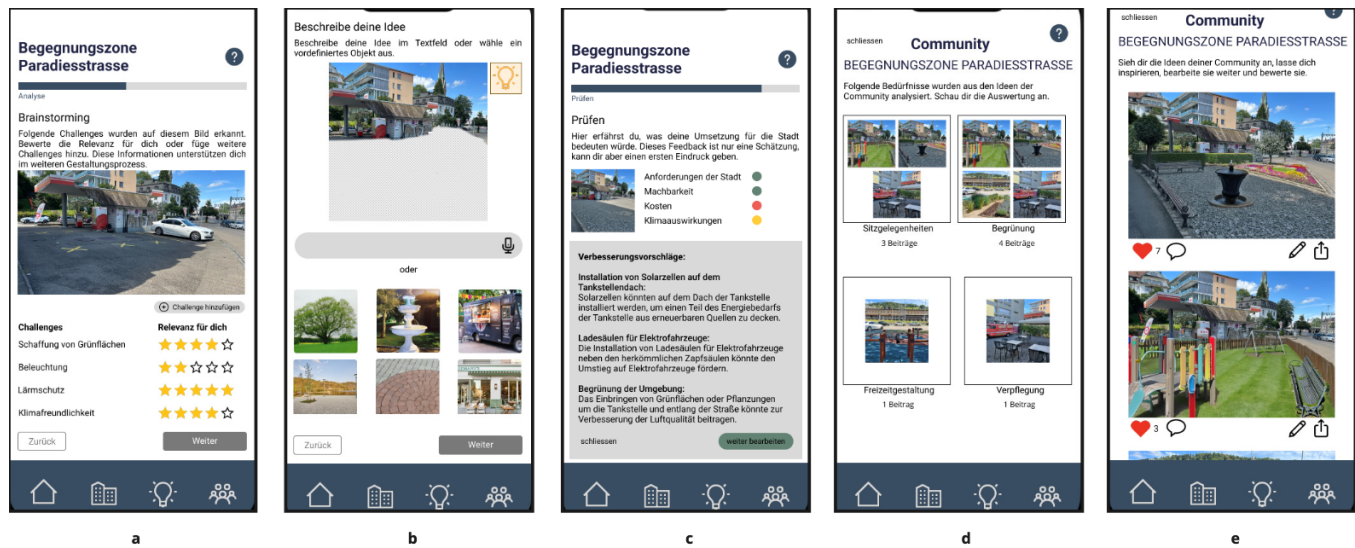


Figure 11: Original Version of UrbAI, including a) urban challenges detected in the uploaded image, where citizens can rate the relevance, b) the prompting interface based on text, voice and image input, c) feedback indicators rating the citizens ideas and providing suggestions for improvement, d) an overview of submitted ideas themed based on common needs and e) a community space where citizens can rate, comment or further edit others' ideas.