

CitizenVision: A Mobile App to Promote Citizen Engagement with Generative AI

Yasmin Esmeralda Lützelshwab
University of St. Gallen
St. Gallen, Switzerland
yasminesmeralda.luetzelshwab@student.unisg.ch

Stefan Meier
University of St. Gallen
St. Gallen, Switzerland
stefan.meier@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

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

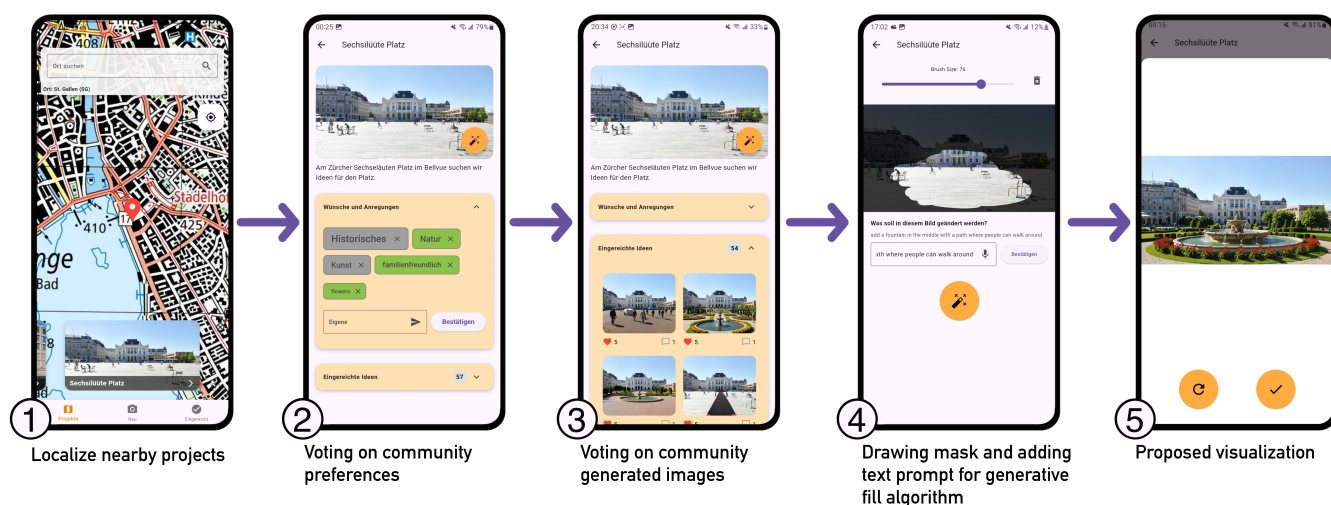


Figure 1: We research how generative AI can support citizens when contributing to local area projects. A citizen can select nearby projects (1), vote on community preferences (2), vote on other citizen-generated images for a specific urban development project (3), edit the current location image by drawing a mask and add a text prompt for the generative fill algorithm (4), and decide whether to accept the proposed visualization or re-generate (5). The generated visualization will then be shared again in the community space (3).

Abstract

Traditional methods for citizen participation in urban planning rely on written forms or hand-drawn sketches, which can be inaccessible to those without drawing or design skills. This limits the ability of citizens to communicate their visions effectively, leading to missed opportunities for community-driven improvements. We developed *CitizenVision*, a generative AI-powered app that enables citizens to visualize their ideas for public spaces by marking areas

in photos and textual prompts. *CitizenVision* incorporates features such as map-based project discovery, keyword-based voting, and community idea browsing. A user study with N=19 participants comparing *CitizenVision* with a traditional paper-based method showed that *CitizenVision* significantly improves user experience and engagement. We demonstrate how generative AI can be effectively used in participatory urban planning, allowing citizens to express ideas creatively and interact with those of others. Our findings highlight potential and driving factors for developing similar tools and using them effectively for participatory urban design processes.

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CCS Concepts

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

Keywords

urban planning, citizen participation, generative AI

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1 Introduction & Background

Co-creation in urban planning processes is acknowledged as an approach to promote inclusive urban planning and to achieve sustainable outcomes [12]. However, the mechanisms available for public participation often fail to enable meaningful contributions from diverse populations. Although the portfolio of tools and channels in urban e-planning is extensive, many are underutilized and limited to communication rather than active input into redesign processes [14, 19, 22, 25, 27]. Furthermore, although tools that leverage photos, videos, and social networks have become increasingly common, their application predominantly supports one-way communication rather than participatory urban redesign [18, 29]. Despite the growing acknowledgement of the importance of participatory urban planning, several barriers remain. Traditional methods often rely on textual forms or hand-drawn sketches, which are inaccessible to individuals lacking drawing or technical skills. This prevents meaningful engagement and reduces community involvement in decision-making. In addition, certain groups, such as young people, are often underrepresented in planning processes, despite their strong affinity for visual media technologies and the potential of visualizations to transform urban planning [10, 11, 17]. Engagement in urban planning is important for developing spaces that reflect diverse perspectives and community needs. Collaborative approaches that integrate local knowledge, research evidence, and professional expertise have enhanced outcomes and led to more vibrant, usable spaces [8, 14]. However, participatory processes remain complex, as they require reconciling diverse perspectives, languages, geographically specific, and conceptualizations of space.

Over the past decade, Human-Computer Interaction (HCI) research has explored a wide range of artefacts and methodological approaches to enhance citizen participation in urban planning. These approaches span from speculative design [4] and photovoice probes [16] to more technologically driven interventions such as augmented and virtual reality [6, 24]. More recently, advancements in generative AI image processing (GenAI) have opened new possibilities for enabling citizens to visually articulate their ideas [20, 21]. Recent work demonstrated how GenAI can be embedded into structured participation processes, for example through the design of speculative, even if not technically realized, mobile applications for civic engagement [20]. While these studies highlight the potential of GenAI for participatory urban planning, they remain conceptual and stop short of providing functional systems that can be evaluated in practice.

To address these gaps, this work contributes the design and evaluation of *CitizenVision*, a functional mobile app that leverages GenAI to aid in visualizing and sharing ideas for urban space redesign. The app enables users to generate realistic visualizations of

their ideas by marking areas in photographs and providing textual descriptions. Key features include a map-based interface for discovering ongoing projects (Figure 1 Step 1), a keyword-based voting mechanism to highlight community priorities (Figure 1 Step 2), and tools for exploring and interacting with community-submitted ideas (Figure 1 Step 3). Lastly, *CitizenVision* integrates GenAI to alter pictures taken in real-world scenes based on user input (Figure 1 Step 4 and 5). Through a user study involving 19 participants, the *CitizenVision* was compared to traditional paper-based methods of urban planning participation. The results indicated that *CitizenVision* significantly enhances user experience and engagement. For instance, participants highlighted that while describing and sketching their vision on paper, they struggled to convey their ideas clearly, so others would understand them. Even straightforward demands, such as a green tree area or a fountain, triggered frustration among the participants. In contrast, *CitizenVision* facilitated creative expression, assisted by GenAI and the inspiration provided by the work of others. The results suggest that *CitizenVision* could enhance participation in urban planning and engage typically disengaged populations, as several participants noted they usually do not participate but would be motivated to do so with such an app. By addressing barriers to communication and visualization, this technology can improve the quality and diversity of urban spaces and aid communities and decision-makers involved in the process.

2 Concept and Design of CitizenVision

We developed *CitizenVision* (Figure 1) as a comprehensive mobile app for participation and co-creation in urban design and planning. The concept and design of *CitizenVision* were inspired and further iteratively developed based on previous work [20], which explored the feasibility of GenAI in citizen participation processes and resulted in a speculative mobile participation app. In contrast to this prior work [20], *CitizenVision* presents a technically implemented mobile prototype with further features as described below.

CitizenVision enables users to 1) discover local participation projects and 2) contribute their ideas to these projects. Users can explore projects in nearby areas via an interactive map interface that can be centered around the current geolocation of the device (Figure 1 Step 1). Each project includes an "as-is" photograph of the location, a textual description of project goals, a keyword-based mechanism to vote on priorities (Figure 1 Step 2), and an overview of submitted community ideas (Figure 1 Step 3). Further, citizens can engage directly by using the provided location photograph as a basis for inpainting (Figure 1 Step 4).

The inpainting process starts with the provided photograph being overlaid with a semi-transparent, grey-toned widget of matching pixel size. By sliding the finger over this scratcher widget, the selected area of the widget turns fully transparent, revealing that part of the image without an overlay. In the background, the scratcher widget is transformed into a black and white PNG file where white pixels are those marked by the user and represent the area where inpainting is applied. Black pixels remain unaffected by the inpainting. A textual description of the envisioned change, together with the original photograph and the binary mask, are submitted to the inpainting API from Stability.ai [26], which returns the enhanced

image that can be accepted or refined (Figure 1 Step 5). The front-end is developed using Flutter [9] for cross-platform compatibility. All user interactions and API-calls are handled client-side within the Flutter app. Projects and submissions are stored Firestore Database [7], with associated images saved in Firebase Storage. Upon accepting a generated image as new submission to a project, it is also stored in the database and links to the project.

With *CitizenVision*, we demonstrate how GenAI can enhance citizen participation through a mobile app that serves as a shared platform for diverse stakeholders, including citizens, neighborhood associations, municipal governments, and non-profit organizations, to foster engagement, transparency, and dialogue in urban planning projects.

3 Study

To evaluate *CitizenVision*, we conducted a user study comparing *CitizenVision* with a traditional paper-based method, representing a state-of-the-art baseline, where citizens articulated ideas through written language and hand-drawn details. Both conditions focused on the same scenario, in which the local government initiated a project and asked for ideas to repurpose or redesign a large, well-known city square.

3.1 Participants

We recruited 19 participants (6 women and 13 men), with an average age of 37.79 years (SD = 17.76 years, min = 22 years, max = 82 years). Two participants reported to have taken part in a public urban planning project, whereby one did it by email and the other in person. For those not participating, twelve have reported missing information as the reason, two never had such a project in their area, two were not interested in them and one said it required too much effort. Each participant was given signed informed consent for study participation.

3.2 Tasks & Procedure

After assessing participants' general information, demographics and their experience with citizen participation, we presented an introductory video of *CitizenVision* that explained its features and navigation. Participants were encouraged to ask questions, ensuring they comprehended the fundamental features and felt confident to proceed with the user study. We then introduced the participants to their task, asking them to articulate their ideas for the redesign of a public space using both the *CitizenVision* app and a traditional paper-based method. As the study took place in a controlled environment on the university campus, separate from the actual site of the redesign scenario, we provided supplementary images of the public space, similar as shown in Figure 1 Step 2. All participants were already familiar with the location referenced in the task. The participants followed a within-subject design approach with a counterbalanced order of the conditions. After finishing the task with the first condition, the participant were asked to complete the System Usability Scale (SUS) questionnaire [2], and the short version of the User Experience Questionnaire (UEQ-S) [13, 28]. After completing both conditions, a semi-structured interview was conducted to gather qualitative insights focusing on ease of use, creativity, and satisfaction with their experience. Participants were

asked to compare the traditional paper-based method to *CitizenVision*, highlighting strengths, weaknesses, and preferences. Specific attention was given to understanding how the tools influenced their ability to express and visualize ideas. Suggestions for improving the mobile app and general feedback on GenAI in urban participation were also collected.

3.3 Data Collection & Analysis

During the user study, we asked the participants to think aloud [15]. The study session was audio-recorded, while we additionally screen-recorded the usage of *CitizenVision*. The text and drawings on the paper form, the prompts used for image generation and the resulting images were collected as well. The audio recordings of the thinking-aloud, the interview and the prompts were literally transcribed. The interview and think-aloud data were initially examined by one researcher through open coding, followed by an inductive grouping of the codes by two researchers using a reflexive thematic analysis approach [3]. The prompts were analyzed based on the approach taken to describe the vision, as well as in terms of the level of detail. Results from the SUS and UEQ-S were tested for significant differences using the Wilcoxon-Signed-Rank Test [23].

4 Results

In this section, we present the findings of our study, categorized into the following main themes: 1) strengths and weaknesses of both methods, 2) comparison of iterative capabilities and 3) the role of GenAI in supporting citizen participation.

4.1 Strengths and Weaknesses of Both Methods

Participants expressed familiarity with paper-based forms, which did not *"require any [prior] technical knowledge"* (P16). Further, participants felt in control of their submission, since they *"just write what [they] have in [their] head on the paper"* (P11). However, sketching and drawing were found to be challenging, as concerns about the quality and understandability of the work were raised: *"I can't draw very specific, I don't have any precision when I'm sketching it"* (P1). Several participants had difficulties with the perspective from which the sketch should be drawn: *"It is difficult to draw the perspective. But I'll just draw the windows here. Just to illustrate that it should be a multi-story building"* (P9). During the study, we observed that several participants had labelled important areas in their sketch, such as prominent buildings for better orientation and the elements of their idea so that others could understand it (Figure 2). When using *CitizenVision*, participants perceived that their workload was lower compared to the paper form.

"The app did everything for me. So, I just have to select the area and then type in an idea. Maybe I didn't have a specific idea before. I just know I want to have some beach volleyball fields. And it shows me pretty well afterwards how it could look like." P14

Furthermore, viewing images generated by others provided inspiration to come up with an idea, while it also improved judgment about a participant's own idea: *"[Viewing others submissions] shows which ones are feasible and alike"* (P16). *"It gives you other ideas which were not in my initial intention and it helps to judge if I like it or not"* (P2). The map screen allowed the discovery of other projects

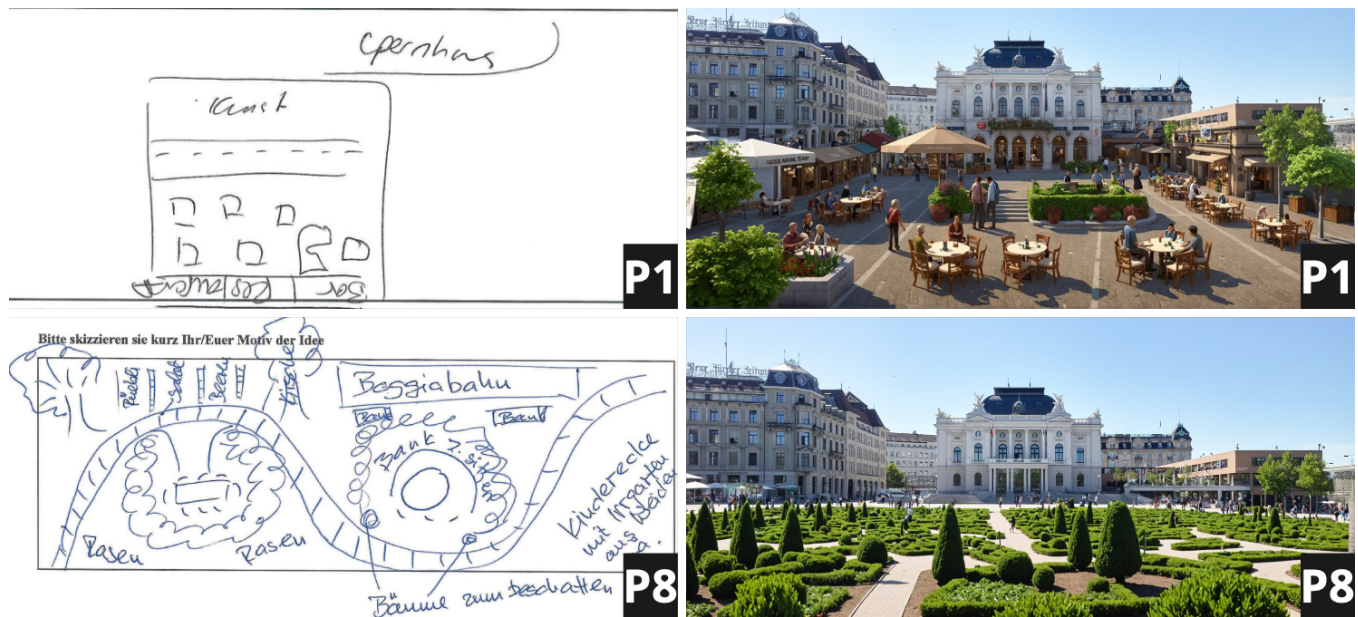


Figure 2: Visualisation made by P1 and P8. On the left, the hand-drawn sketches are displayed, while on the right their generated images are shown.

and also provided geographical information to the participants: “I could see directly on the map where the projects are. So if I didn’t know where the location is, I wouldn’t know how it looks. And it would be difficult for me to envision what changes I would like to make” (P5). *CitizenVision* required an initial learning curve, but 13 of the participants stated that using the app was the overall more natural experience for them. Six participants found the paper form more natural to use.

Several areas for improvement were suggested that addressed the shortcomings of the app. However, they were considered as weaknesses of the prototype rather than the process that involves such a tool. For example, a multilingual interface (P6, P16), adjustable text input space (P5, P18), and better visualization options (e.g., zoom and landscape mode) (P19) were proposed.

The average SUS score for *CitizenVision* was 80.13 (SD = 16.64). According to Bangor et al. [1] this score is classified as “Good” (ranging from 71.4 to 85.4) which is between “OK” and “Excellent”. The average SUS score for the paper form was 70.53 (SD = 17.10). This is classified as “OK” (ranging from 50.9 to 71.3) which is between “Poor” and “Good”. A Wilcoxon-Signed-Rank Test resulted in no significant difference in the comparison ($p = 0.112$) [23]. Resulting from the UEQ-S the overall value for *CitizenVision* is 1.93 (SD = 0.91). This compares as “Excellent” to the benchmark and can be interpreted such that it is in the range of the 10% best results [28]. The pragmatic quality of *CitizenVision* is 1.74 (SD = 1.09). This compares as “Good” to the benchmark and can be interpreted such that 10% of results are better and 75% are worse. The hedonic quality of the *CitizenVision* is 2.13 (SD = 0.89). This compares as “Excellent” to the benchmark. The paper form resulted in an overall UEQ-S value of -0.64 (SD = 1.19). This compares as “Bad” to the benchmark and can be interpreted such that it is in the range of the 25% worst

results. The pragmatic quality of the paper form is 0.40 (SD = 1.58). This compares as “Bad” to the benchmark. The hedonic quality of the paper form is -1.67 (SD = 1.10). This compares as “Bad” to the benchmark. Using the Cronbach Alpha coefficient [5], the internal consistency of all scales is sufficient i.e. > 0.7 [28] (App-pragmatic: 0.88, App-hedonic: 0.85, Paper-pragmatic: 0.87, Paper-hedonic: 0.82). A Wilcoxon-Signed-Rank Test resulted in a significant difference in the comparison of pragmatic qualities ($p = 0.012$) and hedonic qualities ($p = < 0.001$).

4.2 Comparison of Iterative Capabilities

The paper form restricted iterative enhancements or pivots unless a new form was used. Thus, no participant changed what was already on paper. Using *CitizenVision* instead, some were observed to refine their ideas (P5, P8, P19). If the resulting image was not satisfactory, the participants adjusted their prompt and mask with the intention of improving the output (P3, P11, P12, P14, P18). This could also lead to dissatisfaction when “having several tries and iterations to get the result, which, for the initial idea, was not successful. However, that allowed [them] to pivot” (P5). Participants requested the ability to iteratively work on a generated image instead of starting from the initial picture every time (P1, P5, P19), by “building up bit by bit, rather than doing everything at once” (P18). Further, they expressed the idea of building on others generated images (P18).

4.3 Role of GenAI in Supporting Citizen Participation

According to the participants, using GenAI in an urban planning project would help them to “see the vision directly embedded on the picture” (P5). As a result, they “felt like [they] could convey [their]

idea much better so and it was more fun to do it as well" (P4). In addition, participants valued receiving an image based on their written suggestions, highlighting *CitizenVision* as *"very powerful because AI really turns [the idea] into a complete picture. [...] You've visualized it and it looks better than if you had to draw it yourself"* (P13). Participants indicated that utilizing GenAI for submissions resulted in greater clarity than their sketches, since *"it conveyed the message much clearer than [their] drawing"* (P16). In certain instances, participants typed only keywords in the text prompt such as *"Tower"* (P2) or *"Water Games"* (P15), while others included complete sentences: *"I would like this square to have a small beach volleyball court and 5-A-SIDE FOOTBALL both courts should be in the shade and there is a small bar cart and some spectators for the sports. It should be a flexible space please also add 5 a side football"* (P8).

5 Discussion

The study showed that the paper form provided a simple and familiar mechanism of participation, without technical knowledge or prior experience. However, this simplicity came at the cost of limited functionality. Participants frequently struggled to accurately visualize their ideas, particularly with perspectives and often had to label elements for clarity. This process required more effort, reducing confidence in articulating their idea clearly. Additionally, the inability to iterate or refine ideas constrained creativity, as participants were locked into a static submission.

CitizenVision addressed these shortcomings. By automating the visualization process, often working better with keywords rather than full descriptions, *CitizenVision* ensured consistent perspectives and enhanced clarity. This reduced the perceived cognitive burden of manual sketching. The AI's ability to generate visually appealing representations appeared to foster a sense of confidence among participants that their ideas would be understood by others. While the app introduced technical challenges, it drastically improved participants' attitudes toward urban development processes. The UEQ-S scores highlighted *CitizenVisions* superior pragmatic and hedonic qualities over the paper form. Though SUS scores showed no significant difference, the app was rated as *"Good"*. Findings suggest that while paper forms provide an accessible starting point, they often fail to support citizen idea communication and can even discourage participation. By offering a reference image as a starting point, the inpainting process in *CitizenVision* enabled participants to embed their ideas using keywords. This facilitated both comparison and inspiration by highlighting diverse ideas on the same visual starting point. This suggests that GenAI-enabled tools, such as inpainting, holds promise to improve citizen engagement in urban design processes. However, these tools must be embedded in comprehensive systems where GenAI and supporting features complement each other. As a result, much of the complexity in urban redesign participation can be abstracted away from citizens.

To leverage the potential of GenAI supported tools in participatory urban planning, we recommend for future work integrating them with complementary features that enhance their effectiveness. This includes annotating generated images to understand the reasoning behind ideas, while also enhancing iterative capabilities for refining ideas, for instance, by providing in-app support or templates to guide effective prompting, especially for digital novices.

It also involves facilitating project discovery and meaningful interaction, such as voting and commenting on suggestions. Beyond simple voting, users should also be enabled to select and build upon the visual contributions of others to collaboratively refine proposals [20].

While we compared *CitizenVision* with a paper-based approach, future work should explore the use of GenAI in comparison to other methods, including virtual and augmented reality [6, 24], but also alternative settings such as moderated speculative co-design workshops [4]. Lastly, future research should investigate how the application performs at a larger scale, for example in municipality-led pilots involving diverse populations and projects.

6 Conclusion

We have implemented and examined *CitizenVision*, a mobile app prototype using GenAI to support citizens in communicating their ideas visually in urban design projects. As part of the user study (N=19), we compared *CitizenVision* with a traditional paper form. The research indicated that the paper format is regarded as tedious and conventional, whereas hand drawing induces frustration. The participants showed considerable enthusiasm for the generated visuals when they utilized GenAI. Our findings show that GenAI tools, particularly when embedded in a comprehensive platform, hold promise for lowering barriers to participation and increasing citizens' confidence in articulating ideas by automating the visualization of their suggestions. In conclusion, this work should serve as a starting point for further research, such as comparing GenAI-supported approaches with other tools or exploring their use in different settings, populations, and projects, to better understand how GenAI can promote citizen participation in urban planning.

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In this paper, we applied Overleaf's integrated spell checker, Grammarly, DeepL, QuillBot, and ChatGPT (Version GPT-4o). These tools helped us fix spelling errors 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.

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