Street Alability

Report

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Abbreviations

AI Artificial Intelligence

HM Hochschule München University of Applied Sciences

MVP Minimum Viable Product

TUM Technical University of Munich

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1 Introduction

The transition to sustainable urban mobility is one of the most pressing challenges for cities in the 21st century. While political and scientific consensus on the urgency of ecological transformation has grown, public support remains ambivalent, especially when local interventions like traffic-calming measures meet everyday habits and emotional attachments to urban spaces. Despite broad agreement with sustainability goals, citizen participation in urban mobility planning often remains limited, abstract, or confrontational. The project *StreetAIability* was developed in response to this contradiction. It emerged from the interdisciplinary lecture series "sustAInability" at the Technical University of Munich (TUM) and Hochschule München University of Applied Sciences (HM). Within the framework of the MCube challenge "My Street of Tomorrow", the tool aims to explore how Artificial Intelligence (AI) can support citizens in visualizing and co-creating more sustainable urban mobility transitions in their own neighborhoods.

Specifically, *StreetAIability* offers an interactive and gamified web application that allows users to redesign real-world streets using elements such as trees, bike lanes, and seating areas. The transformations created are linked to real-time feedback in the form of simplified environmental and social impact scores and visualized through AI-generated imagery. The tool aims to make sustainable urban design tangible, relatable, and participatory to citizens. This report presents the development process and the conceptual foundation of *StreetAIability*, situates the project within current debates on digital citizen participation, and reflects critically on its potential and limitations.

Jacqueline Walk

2 Problem Analysis

Although a broad societal consensus exists in support of sustainable urban mobility, actual citizen participation in planning processes remains disproportionately low. Survey data show that over 70% of citizens in Germany express support for sustainability and climate-related goals (European Court of Auditors, 2020), yet only around 30% engage with participatory opportunities when they arise (Walk, 2025). In some cases, local interventions such as traffic-calming or reduced parking have triggered emotional resistance, even leading to organized opposition and social division. This was also the case for a street transformation project at Kolumbusstraße, where around 15% of the residents actively took action against the project (Stäbler, 2023). The transformation at Kolumbusstraße received significant media coverage, with headlines such as "Befürworter und Gegner brüllen sich nur noch an" (Stäbler, 2023) and "Ein Modellprojekt spaltet die Anwohner" (Stadler, 2023) dominating public discourse. These examples highlight the need for more effective participation processes to avoid similar scenarios. To address this issue, it is essential to understand the underlying causes. During the development of this project, a deeper exploration of the problem space revealed multiple structural barriers.

One key barrier lies in the nature of current participation formats. Traditional methods such as public meetings, consultation procedures, and written feedback tend to attract only a narrow segment of the population, typically well-organized interest groups or individuals with the time and expertise to engage (Bertelsmann Stiftung, 2017). These formats are often perceived as overly abstract, time-consuming, or inaccessible, particularly by younger and digitally-oriented citizens (Ssentongo, 2023, p.3). At the same time, the increased use of digital technologies has fueled public expectations for more direct and meaningful involvement, especially in early and strategic stages of planning. This shift places new demands on both alternative and traditional forms of participatory urban development (Hochmuth U., Mangold M., n.d.). Another barrier is the lack of visual and tangible representations of potential change. Citizens often struggle to imagine what planned interventions might look like in their own streets and how these changes would affect their daily lives. This absence of localized, personalized visualization reduces both emotional connection and perceived relevance. As a result, even well-intentioned sustainability efforts risk being perceived as top-down or technocratic, fueling skepticism, apathy or opposition (Ssentongo, 2023, p.3). Addressing this challenge requires rethinking not only what participation means, but also how it is facilitated. There is a need for tools that translate abstract planning goals into concrete, relatable experiences; that enable playful exploration and co-creation; and that are accessible to non-expert users.

Laila Yassin

3 Existing Approaches and the Role of AI in Urban Design

Josefine Jacobs

4 Results

For our group, beyond the completion of an Minimum Viable Product (MVP), our primary goal was to establish a clear and compelling storyline based on the problem statement we had identified. We aimed to create a product that effectively visualizes urban mobility transformations in a personalized, intuitive, and engaging way to maximize citizen participation. Additionally, we agreed that, if feasible, we wanted to deliver a functioning MVP, even if that meant reducing the number of features. To achieve this, we divided the group into two teams: one focused on the technical development of a working MVP, while the other concentrated on refining the concept and preparing the presentation. This ensured that we would still have a well-thought-out and presentable prototype, even if unforeseen technical issues arose.

Our approach led to the development of streetAIability, a website that allows users to redesign their own street according to their personal preferences. The website uses a Google Maps API interface, enabling users to search for any street they wish to transform. Once a street is selected, the map becomes fixed, and users can begin dragging and dropping various elements associated with urban mobility transitions, such as trees, raised flower beds, social spaces, and bike lanes, into the street layout. As users make changes, the website dynamically calculates and displays scores related to air pollution and estimated costs. Once the user finishes the drag-and-drop process, an image is generated using the Google Street View API in combination with OpenAI's DALL·E API, which visually integrates the selected elements into the real street view interface. The user can then create a title for their design and publish it in the community space, where others can view the street transformation. The community space serves as an interactive platform where users can like and share designs, as well as compare their scores with those of other users.

Additionally, if users want to support a particular street design, they are directly redirected to a petition website. Future features we aim to implement include an enhanced petition function and improved information delivery. When initiating a petition, the calculated scores will automatically be included in the petition sheet. If a petition for a specific street design already exists, users will be able to sign it directly using the login credentials they provided. To improve the flow of information, both the drag-and-drop icons and the score indicators will feature information screens, offering users immediate insights into the impact of each item and how it influences the various calculated scores.

Although our MVP addresses many of the key challenges identified, one critical question remains: How can we motivate citizens to actively use our tool, and what strategies can we implement to encourage engagement? To address this, we developed three complementary marketing strategies. The first and most intuitive strategy is the gamification of the MVP itself. Users receive immediate feedback on the designs they create, compete for the highest scores, and can share their creations with family and friends. In this way, our MVP fulfills key criteria for effective gamification, which is known to significantly increase user engagement.

A second strategy involves integrating our tool into city rallies by placing QR codes in popular public areas throughout Munich. Passersby who scan the code can immediately visualize how the street they are currently viewing could be transformed according to their own preferences. These city rallies can also be incorporated into school projects or other educational programs like summer schools, adding an informative dimension to the experience and promoting awareness around urban mobility transitions. In a later project phase, the most popular designs could be showcased in public exhibitions or museums. By collaborating with local institutions to provide tech support and access stations where the tool can be used on-site, we aim to make the product available to individuals without access to digital devices, thereby further increasing the engagement of citizens in urban transformation processes.

Looking beyond the current MVP, we have also conceptualized potential future developments. Since the MVP is already connected to the Google Street View API, we envision a mobile app extension that would allow users to transform approved public spaces directly through their smartphones. The app would use the device's camera to scan the surroundings and automatically highlight designated transformation zones, such as green strips or sidewalk edges. Users could then redesign these areas according to their preferences, promoting hands-on involvement in shaping their urban environment. This not only enhances user engagement, but also establishes the groundwork for long-term citizen involvement in sustainable urban planning processes.

Jacqueline Walk

5 Discussion

The results presented in this report demonstrate the potential of StreetAIability as a tool to foster more inclusive and emotionally engaging urban participation. By enabling users to redesign real-world streets with intuitive drag-and-drop elements, and visualizing the impact of their decisions through AI-generated images and live scoring, the prototype addresses many of the barriers identified in the problem and literature sections.

First, StreetAIability responds to the documented mismatch between citizens' willingness to support sustainable mobility and their limited participation in existing planning formats. Traditional participation tools often struggle to attract diverse demographic groups, particularly younger, digitally-oriented citizens (Ssentongo, 2023; Bertelsmann Stiftung, 2017). Our prototype addresses this gap through a gamified, visual, and personalized interface that lowers the barrier to entry and invites participation on the users' own terms. In doing so, it supports calls in the literature for more accessible, user-centered digital planning tools (Hochmuth & Mangold, 2021; Radtke & Saßmannshausen, 2020).

Second, the MVP directly tackles the issue of abstraction in traditional planning communication. As Ssentongo (2023) notes, citizens often lack tangible representations of future changes, which hinders emotional engagement and trust in the process. By visualizing design changes side-by-side with real street views, StreetAIability offers an immediate and context-specific representation of urban transformation. Visualizing changes on their own street may reduce the sense that sustainability projects are imposed from above, as shown by the resistance in the Kolumbusstraße case.

In addition, the community features of the platform that include publishing, liking, and petitioning transform participation into a collaborative and ongoing process. This design moves beyond one-time consultation and aligns with more recent participatory ideals, which emphasize iteration, transparency, and shared authorship. As seen in projects like Urban Up or meinBerlin, sustained engagement is more likely when citizens feel that their input leads to visible, collective outcomes. That said, the MVP also has current limitations. While the visual and gamified elements appear promising, it remains unclear whether these features are sufficient to generate sustained engagement or influence actual planning decisions. Further empirical testing would be required to evaluate user retention and effectiveness in real-world planning contexts. Furthermore, the tool currently lacks direct feedback loops with municipal actors or official planning frameworks, a gap that limits its potential impact on policy and decision making.

Finally, it is important to recognize that tools like StreetAIability can only complement, not replace, existing democratic processes. They are most powerful when embedded within broader participation strategies that combine digital outreach with in-person dialogue, institutional responsiveness, and clear follow-up mechanisms. Future development could explore partnerships with city administrations, schools, or NGOs to ensure that the tool not only visualizes possibilities but also facilitates real influence.

6 Methodology

To implement the *StreetAIability* concept, we followed a user-centered, iterative design approach focused on translating our core idea, a tool for interactive street redesign, into a functional and engaging web-based prototype.

6.1 Fundamentals of the technical Solution

To realize this vision, we required a platform that offered comprehensive control over design and interactivity, robust API integration, and scalability across web and mobile platforms. Flutter met all these requirements, making it our framework of choice. Flutter afforded us the creative flexibility to implement a highly interactive interface without compromise. Key technical demands included a responsive, drag-and-drop interface adaptable to both desktop and mobile screens, seamless integration with Google Maps, and connections to various APIs, including OpenAI's DALL·E and Google's Air Quality Index API. Flutter's rendering engine, widget architecture, and asynchronous programming model enabled us to deliver these features efficiently within a unified codebase, while maintaining both performance and an intuitive user experience. We integrated Google Maps using the "google_maps_flutter" package, allowing users to embed and interact with a dynamic map. Through the Geocoding API, users can locate and lock a specific street view, at which point the map becomes non-interactive and a central design zone is defined. This restriction ensures that user-placed elements, such as trees and bike lanes, remain contextually appropriate and confined to the street layout. To visually enhance user designs, we employed OpenAI's DALL·E API. Upon completion of a street design, the app captures a screenshot and generates a descriptive prompt based on the user-added elements, for example, "A street in Munich with trees, benches, and bike lanes." This prompt is sent to DALL·E, which returns a high-resolution image of the redesigned street. We juxtapose this image with a corresponding Google Street View to provide a compelling before and after comparison, enriching the design experience. Environmental feedback is provided via Google's Air Quality API, which supplies localized pollution data. Combined with our internal scoring algorithm, the app dynamically adjusts an air quality score based on the type and quantity of design elements for example, trees and bike lanes improve the score, while carbon-intensive elements decrease it. Additionally, a happiness index is calculated based on the inclusion of socially beneficial features such as benches or community BBQs, promoting a balanced approach to ecological and social urban planning. While Flutter supports multiple platforms, we initially focused on deploying a web version to expedite development, bypass app store limitations, and allow immediate user access. Flutter's web capabilities, paired with tools like hot reload and comprehensive developer tooling, enabled rapid iteration. Firebase Hosting was selected for deployment, offering secure HTTPS, efficient versioning, and swift distribution. We evaluated alternatives such as Microsoft PowerApps, which showed early promise for rapid prototyping. However, its limited layout control, constrained API support, and rigid UI customization made it unsuitable for the interactive, user-driven experience we envisioned. In contrast, Flutter provided the flexibility needed to build dynamic content, layer visual elements, invoke custom APIs, and support responsive layouts capabilities essential for a project of this complexity. As we continue expanding features, such as a Community Designs hub for naming, saving, and ranking user creations, Flutter remains our development foundation. It empowers us to fuse technical sophistication with creative vision, bringing the ethos of participatory urban design to digital life.

6.2 Problems regarding the implementation

Building *StreetAIability* was an exciting and ambitious undertaking, but not without its challenges. Establishing the application architecture in Flutter demanded considerable time and effort, particularly as we worked to integrate several external services, including Google Maps, OpenAI's DALL·E, and the Google Air Quality API.

Early in development, we encountered deployment delays due to GitHub rejecting commits that accidentally included exposed API keys a valuable security safeguard that nonetheless prompted us to redesign our approach to managing environment variables.

A particularly persistent challenge involved rendering the Google Maps API correctly. For a period, the map failed to load consistently, significantly hindering our ability to test location-based functionality. Implementing the drag-and-drop icon system allowing users to place trees, bike lanes, and other street-level features proved more complex than anticipated. Ensuring the icons functioned seamlessly across devices, and were confined to the defined "street" area, required a complex layout logic and iterative testing.

While Firebase Hosting provided a reliable platform for deploying the web app, integration issues with both the Google Air Quality API and DALL·E image generation API presented further obstacles. These difficulties have temporarily limited the implementation of the environmental scoring system and the visual transformation features. Consequently, although the StreetAIability website is live, several core functionalities are not yet fully operational. We continue to actively address these issues, aiming to deliver the complete user experience envisioned from the outset.

6.3 Features of the final prototype

The final prototype of StreetAIability integrates all essential features to enable users to explore and redesign real-world streets in an intuitive and engaging manner. The experience begins with a street search via the integrated Google Maps API. Once an address is confirmed, the corresponding street is locked in a vertically aligned, design-optimized view to ensure consistency throughout the customization process. Users can then drag and drop a range of street elements categorized as Green, Mobility, or Social, such as trees, bike lanes, benches, and other enhancements. As elements are added, real-time calculations dynamically update the design's air quality score, the happiness index and the cost impact, offering immediate feedback on the ecological and social impact of the layout.

When users are satisfied with their design, they can publish it. A custom image is generated using OpenAI's DALL·E API, visually rendering their additions. Each published design is saved with a unique title and creator credit, then displayed in the Community Designs section. This shared space allows users to browse alternative visions, distribute likes, and gain inspiration from others' work. Collectively, these features create a comprehensive, interactive platform that merges real-world data, visual expression, and participatory urban design.

6.4 Unimplemented features and necessary improvements

Although *StreetAIability* already includes most core functions, several key features and necessary improvements remain under development. Most notably, the precise placement of items in the generated image is not accurate enough and will be subject of future development. Although DALL·E typically recognizes the selected elements and arranges them in roughly the correct order, it does not reflect their exact positions on the map or number. This limitation results from the black-box nature of AI-generated images, which can only be improved through prompt refinement. An additional challenge is that the visual output varies in style. Some images appear unrealistic, black-and-white, or cartoon-like, especially when many items are added. This can make the street difficult to recognize. Another missing feature is a user account system. Without it, liking and voting designs cannot be reliably tracked or linked to individual users, making it impossible to transfer likes into official petitions. These missing elements are critical for achieving realistic visualizations and meaningful participation of citizens, and they are prioritized for future development.

7 Conclusion and Lookout

The development of *StreetAIability* reflects our group's ambition to move beyond a functioning MVP toward creating a meaningful tool for citizen-centered urban transformation. By combining intuitive design, real-world data integration, and AI-driven visualizations, the project successfully translates abstract sustainability goals into tangible, personalized experiences. Our approach, balancing concept development with technical execution, allowed us to deliver a prototype that is not only functional but resonates with users through its visual, interactive, and gamified features.

The results demonstrate that *StreetAIability* has the potential to address several key barriers in current participatory planning practices, including accessibility, emotional engagement, and relevance to everyday life. Through the website, users are empowered to envision change in their own environment, fostering a sense of ownership and agency that traditional tools often fail to deliver. The inclusion of a community platform and the possibility to support and petition for specific designs further positions the tool as a bridge between urban transformation and citizen engagement.

At the same time, the project highlighted important limitations. Sustained user engagement and policy integration remain challenges that require further development, testing, and collaboration with MCube. However, these challenges also present opportunities. With additional features, strategic partnerships, and real-world piloting, *StreetAIability* could become a scalable platform for participatory urban design, helping cities not only to plan for the future, but to do so with their citizens, not just for them.

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