

A Fusion of XR Technology and Physical Objects to Increase Citizens Participation in Urban Planning

Sam Sabah ¹, Imran Hossain ², David Weiss ³ and Alexander Tillmann ⁴

Abstract: Extended Reality (XR), comprising Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) technologies have the potential to enhance urban planning with immersive and interactive experiences, but their learning cost hinders citizen participation. XR development requires technical knowledge, limiting individual engagement in urban planning. On the other hand, physical models offer tangible visualization for urban planning but lack features compared to software applications. Combining physical objects with XR technology poses challenges but holds the potential to promote citizen participation. This article introduces the concept of the city planner app, an application that integrates XR technology and physical objects in a mixed-reality setting. This app aims to leverage the strengths of both worlds and overcome their limitations to facilitate the involvement of citizens and students in urban planning.

Keywords: Social citizenship, Urban Planning, Citizens Participation, Extended Reality (XR), Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR)

1 Motivation and Background

Active participation of civil society in urban planning is challenging due to citizens' rational ignorance and the perceived costs outweighing the benefits of involvement [Kr05]. Extended Reality (XR), technologies, can revolutionize urban planning by visualizing the unseen. XR models enable flexible and functional representation of urban environments, aiding by visualization of the unseen furthermore, tangible interfaces can be more inviting and more conducive to collaborative interaction [THF06] but have size and scale limitations and may be seen as toys. They also lack features compared to software applications [Ma18]. Mixing the appeal of tangible with the benefits of XR technology has the potential to increase the active participation of citizens in urban planning.

¹ University of Frankfurt, studiumdigitale, Eschersheimer Landstr. 155-157, 60323 Frankfurt am Main, Germany, sabah@sd.uni-frankfurt.de, <https://orcid.org/0009-0009-5111-3068>

² University of Frankfurt, studiumdigitale, Eschersheimer Landstr. 155-157, 60323 Frankfurt am Main, Germany, hossain@sd.uni-frankfurt.de, <https://orcid.org/0009-0009-1272-2688>

³ University of Frankfurt, studiumdigitale, Eschersheimer Landstr. 155-157, 60323 Frankfurt am Main, Germany, weiss@sd.uni-frankfurt.de, <https://orcid.org/0000-0002-7689-7833>

⁴ University of Frankfurt, studiumdigitale, Eschersheimer Landstr. 155-157, 60323 Frankfurt am Main, Germany, tillmann@sd.uni-frankfurt.de, <https://orcid.org/0000-0001-7230-7042>

2 Implementation

The city planner app comprises six components: Gameboard: a portable surface for placing physical objects to create a virtual model of the city for planning. Physical objects: Elementary 3D objects representing real-world elements, to allow customization and experimentation in urban planning. Stakeholders: Inclusive involvement of diverse individuals and groups in urban planning. Monitoring system: Tracks and records user changes on the gameboard in real-time, providing information to the authoring component. Authoring component: Translates data from the monitoring system into immersive XR experiences (VR, MR, or AR) using UEmbed [HWV23] and Unreal Engine. Viewing Device: Users can immerse themselves in virtual city models using VR or overlay AR objects on real-world locations to explore planning scenarios and understand urban planning impacts. These components work together to simplify urban planning and enable users to explore different planning scenarios and understand the impacts of various strategies.

3 Conclusions and Future Work

Despite the potential benefits of Extended Reality (XR) technology, the road to develop such applications remains a challenge for many. The city planner app overcomes this hurdle by automating urban planning development process, utilizing tangible interfaces, object detection techniques and Augmented and Virtual Reality to create an immersive Mixed reality (MR) environment. Our approach aims to assess the effectiveness of citizen involvement in urban planning and further investigate the benefit of XR applications in urban planning, as well as help students develop spatial citizenship skills. Which in turn allows users to explore and make informed decisions about the future of their city.

Bibliography

- [HWV23] Hossain, I.; Weist, L.; Voß-Nakkour, S.: UEmbed: An Authoring Tool to Make Game Development Accessible for Users Without Knowledge of Coding, S. 31-36, 2023.
- [Kr05] Krek, A.: Rational ignorance of the citizens in public participatory planning. In: 10th symposium on Information-and communication technologies (ICT) in urban planning and spatial development and impacts of ICT on physical space, CORP. Jgg. 5, S. 420, 2005.
- [Ma18] Maquil, V.; Leopold, U.; De Sousa, Luís Moreira; Schwartz, Lou; Tobias, Eric: Towards a framework for geospatial tangible user interfaces in collaborative urban planning. *Journal of Geographical Systems*, 20:185–206, 2018.
- [THF06] Thompson, E. M.; Horne, M.; Fleming, D.: Virtual reality urban modelling an overview. 2006.