Leveraging Augmented Reality to Preserve Community History

Joyce Gill[1,2], Lisa Maria DiSalvo Garcia[2], Brian A. Smith[2]

Grinnell College[1], Columbia University Department of Computer Science[2]

Abstract:

As gentrification continues to rapidly transform many communities, the intangible heritage of a community's memories and lived experiences are at risk of being lost, leading to the gradual erosion of a community's history and cultural heritage. In this context, Augmented Reality (AR) has emerged as a powerful medium for integrating physical and digital realms, offering novel possibilities for preserving community history (Boboc et al., 2022). By overlaying historical content onto physical spaces, AR helps bridge the gap between the past and the current lived experience (Ramtohul & Khedo, 2024).

This paper explores the following questions:

1. How can AR be effectively utilized to preserve community history?
2. What are the key UI/UX design considerations for developing a community-centered AR application?

This research details a case study focused on Harlem, New York, where we employed a user-centric design approach to prototype Community AR, an interactive AR platform designed to preserve a building's story. We concluded by conducting a pilot study and usability testing with members of the Harlem community, through which we gained key insight into AR's potential to mitigate the loss of history in the face of urbanization.

Methods:

We decided to focus our research in Harlem, New York to leverage our team's existing relationship with the NSF Center for Smart Streetscapes (CS3) and the 125 St Business Improvement District. Our research methodology comprised several phases: first, we conducted comprehensive field studies, archival research, focus groups, literature review, and diary studies to understand Harlem's historical context and current challenges. We then engaged with Harlem residents through CS3 to ensure that our study aligned with community needs and preserved the authentic voices of the Harlem community. Based on community input, we designed wireframes on Adobe Illustrator, Balsamiq, and Figma; created 3D models of historic buildings using Blender; and developed prototypes of AR features in Unity. This process culminated in a beta mobile application, with which we conducted a pilot study with 15 people to gather preliminary feedback and inform future iterations.

System:

Community AR leverages several interactive features to help users explore the historical transformation of buildings. When users point their phone camera at a building, the application prompts an AR feature that displays the building's historical narrative.
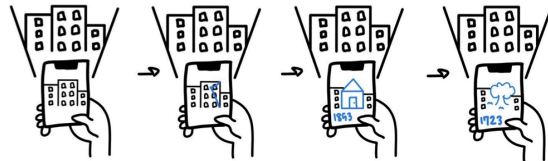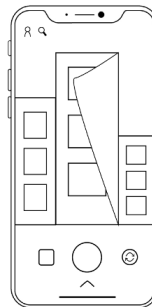
Figure 1.1

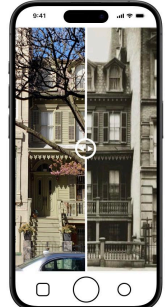**Figure 1.2** **Figure 1.3** **Figure 1.4**

Figure 1 details both low-fidelity and high-fidelity wireframes of the three AR features we implemented. **Figure 1.1** are drawings illustrating the human-computer interaction with the application. **Figure 1.2** is a feature that allows users to see what a building looks like in a specific time frame. **Figure 1.3** is a page-flip effect that allows users to visually compare how buildings have changed over time. **Figure 1.4** is a slider feature that enables users to see the before-and-after transformation of a building.

Results:

Our formative studies revealed a deep appreciation and desire among Harlem residents to preserve their history through AR. Participants shared that many buildings held deeply personal and collective meanings, and they expressed enthusiasm for AR's potential to make these histories more visible and accessible.

In our pilot deployment of the Community AR prototype, participants reported positive experiences across key usability and satisfaction metrics as well. On a 10-point Likert scale, users indicated that they were likely to continue using the app ($\overline{X} = 8.80$, s = 1.08), would recommend it to others ($\overline{X} = 8.27$, s = 1.10), and felt highly satisfied ($\overline{X} = 8.87$, s = 0.83).
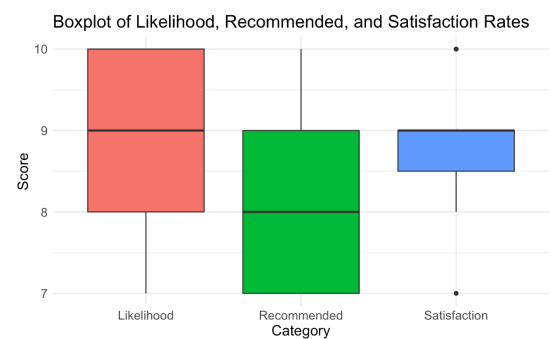

Figure 2. Quantitative results of the pilot study.

To further understand user experiences, we conducted a thematic analysis of open-ended responses gathered from post-interaction interviews, focus groups, and think-aloud sessions. Using natural language processing techniques and qualitative coding, we clustered participant feedback into recurring themes that point to both the strengths and limitations of our system.
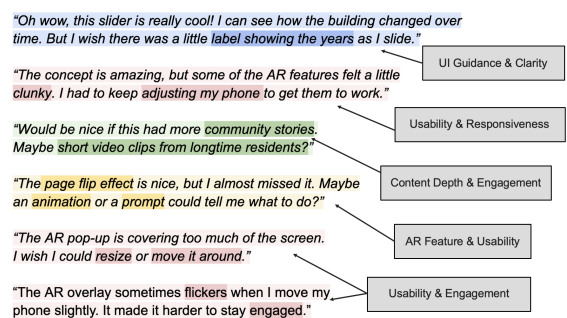

Figure 3. Qualitative results of the pilot study.

Collectively, the responses revealed that while the app's concept resonated strongly with users and successfully engaged them with Harlem's built history, there remain clear areas for improvement, particularly around interaction design, feature affordance, and accessibility.

Conclusion:
Together, these results provide a holistic picture of how users engaged with the app. Our findings suggest that AR can be effectively utilized to preserve community history, as participants generally expressed strong enthusiasm about AR's potential to provide more intuitive access to their community's

historical narratives. However, users also stressed the need for refinements in UI/UX design to ensure the application is user-friendly, particularly around usability. These observations were anticipated, given that the pilot study was conducted with a rudimentary, beta prototype of Community AR.

Future Work:
Moving forward, we plan to refine our AR features by optimizing existing functionalities to enhance the user experience, addressing any technical challenges encountered during the pilot study, and developing new AR features that align with the evolving needs and preferences of our users. With these improvements, we plan to conduct formal user studies with Harlem residents and seek active feedback to ensure their opinions are fully incorporated. These efforts will allow us to draw more definitive conclusions about AR's potential to preserve community history.

References:
Boboc, R.G. *et al.* (2022). Augmented reality in cultural heritage: An overview of the last decade of applications. *Applied Sciences*, 12(19), p. 9859. https://doi.org/10.3390/app12199859

Ramtohul, A. and Khedo, K.K. (2024). Augmented reality systems in the Cultural Heritage Domains: A systematic review. *Digital Applications in Archaeology and Cultural Heritage*, 32. https://doi.org/10.1016/j.daach.2024.e00317