



CASTILLO DE SAN MARCOS AR: SPATIAL AUGMENTED REALITY INTERACTIVE LEARNING SYSTEM FOR CULTURAL HERITAGE EDUCATION

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INTRODUCTION

- Cultural heritage sites provide opportunities for experiential and contextual learning.
- Traditional interpretation methods often rely on static signage and narration, which may limit user engagement and spatial understanding.
- Augmented Reality has emerged as an effective medium for cultural heritage education by enabling immersive and situated learning experiences
- AR enhances conceptual comprehension, supports experiential learning, and increases motivation by transforming passive observation into interactive exploration

- applying an AR to a masonry fort environment (Castillo de San Marcos) with spatially contextualized interaction



SYSTEM DESIGN & IMPLEMENTATION

- The 3D reconstruction of Castillo de San Marcos



SYSTEM DESIGN & IMPLEMENTATION

- Interactive Markerless Spatial AR
 - does not rely on predefined image targets or fiducial markers to align virtual content with the real environment
 - Reconstructed 3D architectural elements are overlaid onto the physical site to support spatial visualization and contextual learning.
 - Contextual hotspots provide access to historical narratives, reconstructed visualizations, and explanatory content.



CONCLUSION

- Spatial AR enhances spatial comprehension and engagement in outdoor heritage environments, although challenges remain in tracking stability, lighting variability, and reconstruction accuracy.
- Optimization for mobile performance is essential to ensure a consistent user experience. Augmented Reality also offers clear pedagogical benefits for cultural heritage education by embedding contextual information directly within the physical environment, thereby supporting situated learning and improving spatial cognition.
- Interactive visualization and user-driven exploration promote deeper understanding and engagement compared to traditional static interpretation methods.
- This paper presented a Spatial AR system for cultural heritage education at Castillo de San Marcos



THANK YOU