

Proposal for an Area of Unique Distinction

Cover Page

Title:

Envisioning Urban Futures through Extended Reality (XR)

This proposal seeks recognition for the collaborative research described below as an Area of Unique Distinction based on PI's and co-PIs' recent successes in securing sponsorship with regional- and national-level research grants.

Participating Academic Units:

Architecture

Computing and Informatics

Urban Institute

Collaborating Leaders:

PI: Dr. Ming-Chun Lee (School of Architecture)

Co-PI: Dr. Aidong Lu (College of Computing and Informatics)

Co-PI: Jeff Michael, J.D. (UNC Charlotte Urban Institute)

Key Collaborator:

Dr. Lori Thomas (Urban Institute, School of Social Work)

Keywords:

Extended Reality, Immersive Technologies, Civic Engagement, Data Visualization, 3D Modeling

Executive Summary

This collaborative research initiative aims to enhance the current practice of public participation in urban planning and community design by using extended reality (XR) to create an immersive, intuitive, and interactive digital user interface for accessing socio-economic data and 3D visualizations of future urban forms needed to promote informed public engagement and better decision-making. This type of community-based practice has its root in participatory design, which is a response to the demand to have voices heard and ideas taken from those who are involved in the design process. It sees community members as citizen designers who play an active role in shaping the formulation of both the design process and its results.

XR is an umbrella term encompassing augmented (AR), virtual (VR), and mixed reality (MX) technologies. AR is a technology that combines real (physical) and virtual (digital) environments through an interactive and real-time 3D experience. VR is an experience that immerses users in synthetic and digital environments. MR is an overlay of synthetic content that is anchored to and interacts with objects in the real world in real-time. These technologies are adaptive and cross-platform and can be implemented on personal computers, handheld devices, smartphones, and display screens. As immersive visualization technologies capable of providing comprehensible information in an intuitive and interactive way, XR are powerful tools that can be utilized to facilitate public participation in urban planning and community design and to empower citizens in the process of changing their environment.

The primary goal of this collaborative research initiative is to develop a mobile XR platform that utilizes these immersive technologies to assist in two critical activities necessary for a successful urban planning and community design project: (a) using 3D visual data to reveal and communicate planning intentions and development goals, (b) engaging stakeholders and community members in meaningful decision-making roles.

This XR platform, which can be used in smartphones, tablets, head-mounted displays, and desktop computers, leverages not only cutting-edge immersive technologies but also geospatial data analytics and visualization techniques. This novel method creates a user interface that can support the two above-mentioned critical planning/design and community outreach activities for growth planning processes in metropolitan areas across the country. In particular, it is currently being applied to the Charlotte Future 2040 Comprehensive Plan as a pilot study. It is expected to be used in other projects including work to support transit oriented development and economic development projects in the City of Charlotte and beyond.

Other key objectives of this research initiative include: (1) creating a research platform to further strengthen UNC Charlotte's research capacity in immersive technologies and their applications in the context of community and regional planning by combining existing research expertise and capabilities across three units: Architecture (3D geospatial mapping and modeling), Computer Science (data visualization and visual analytics), Urban Institute (metropolitan studies and data analytics); (2) establishing partnerships with local communities interested in leveraging digital tools to promote inclusive and informed decision-making.

Evidence of Strength and Excellence

Since 2018, the PI of this research initiative, Dr. Ming-Chun Lee, has received research grants with a total of \$336,980 to support 6 different projects incorporating immersive technologies in the context of data visualizations for urban planning, community development, and neighborhood history story-telling.

In March 2018, Dr. Lee curated an AR exhibit titled “Mapping (In)Equality” at UNC Charlotte Center City Building. This event was aimed to explore the new junction between the conventional mapping methods and new emerging digital techniques for data processing and visualizations, including 3D GIS, AR, and integration with remote sensing imagery.

Dr. Lee was named one of the five Knight Foundation-Niantic AR Fellows and collaborated with local community organizations to use Niantic’s AR platform and the AR apps developed by Dr. Lee’s AR Team at UNC Charlotte to conduct a series of community events in Charlotte. This AR Fellowship is a part of broader efforts by Knight Foundation to explore new ways of fostering community engagement with modern technologies. Dr. Lee’s AR projects have been covered by local media outlets as well as “Inside UNC Charlotte.” These projects, supported by the Fellowship, were presented at GASS Conference in 2018 and ISOCARP World Planning Congress in 2019.

Dr. Lee developed another prototype mobile AR app in collaboration with the Levine Museum of the New South in 2019. This collaborative project demonstrates a new way to combine data visualizations, AR, and story-telling to engage community members in an effort to revisit the history of their neighborhoods and in turn to re-create a common ground for mutual understanding and consensus-building necessary for meaningful community engagement.

In 2020, Dr. Lee received two grants from Knight Foundation to support his continuing effort on exploring the potential of XR in urban planning/design and story-telling. He was named one of seven recipients of \$1 million in funding from Knight Foundation to foster civic engagement through access to public data. Funded as part of Knight Foundation’s Smart Cities initiative, Dr. Lee’s project, “Transforming City of Charlotte with Immersive Visual Data,” will develop an immersive platform that provides 3D visualizations of future developments in Charlotte neighborhoods and community data to engage community members in the creation of the City of Charlotte’s comprehensive plan. Another Knight Foundation grant continues to support Dr. Lee’s collaborative project with the Levine Museum of the New South to develop a web-XR platform for an on-going exhibit focused on story-telling of Charlotte’s history.

Dr. Lee, with extended experience in research on data visualizations and public participation, also received funding from UNC Charlotte Urban Institute and School of Architecture in 2020 to develop a mobile AR application as a part of Urban Institute’s Data Walks project. This on-going project and its associated community outreach efforts are expected to be essential to the success of other related research efforts aimed at increasing Charlotte’s economic upward mobility in that they help Charlotte’s communities build their collective capacity with a better understanding of pressing issues through the lens of data visualizations.

Dr. Lee has presented his XR research work on several other conferences, including MLA Conference (2019), NCLGBA Conference (2019), and was invited as a speaker at Knight Smart Cities Lab (2019), Technology for Good Summit (2019), and Knight Public Spaces Forum (2020).

Co-PI Dr. Aidong Lu's research on immersive analytics is at the frontier where visualization meets mixed reality. She studies how virtual reality and augmented reality can be used for people to perform various data-centric tasks. Since VR/AR devices became commercially available in 2016, her research group has published several work on immersive analytics, including 4 top tier IEEE/ACM conference papers (IEEE Virtual Reality, IEEE ISMAR, ACM IUI) and journal articles (IEEE Transactions on Visualization and Computer Graphics).

Dr. Lu's research has received 3 NSF grants on this topic over the past five years: (1) NSF Convergence Accelerator Phase I (RAISE): Smart Platform of Personalized Learning, Assessment and Prediction for Future Career Training of Skilled Workers, \$999,938.00, Sep 2019 - May 2020; (2) NSF FW-HTF: Future of Firefighting and Career Training - Advancing Cognitive, Communication, and Decision Making Capabilities of Firefighters, \$1,494,976, Oct 2018 - Sep 2022; (3) NSF CRI: A Mixed Reality Environment for Enabling Everywhere Data-Centric Work, \$749,983.00 (UNC Charlotte \$399,280.00), Oct 2016 - Sep 2019.

Co-PI Mr. Jeff Michael (J.D.) is Executive Director of the UNC Charlotte Urban Institute. A planner and attorney by training, his professional experience includes extensive work around land use, sustainable development and land conservation issues. Mr. Michael has been project lead and co-principal investigator for the Carolinas Urban-Rural Connection project, a two-year research and engagement initiative funded by The Duke Endowment, focusing on economic renewal in rural communities by strengthening their ties to nearby urban markets, and capitalizing on place-based economic strategies such as outdoor recreation, cultural & heritage tourism and local foods. Mr. Michael was named a William C. Friday Fellow in 1997 and an American Marshall Memorial Fellow in 2005 and has served on the boards of numerous statewide and regional organizations.

Key collaborator Dr. Lori Thomas is an Associate Professor of Social Work. She currently directs research at the UNC Charlotte Urban Institute where she also serves as the Executive Director of the Institute for Social Capital, an integrated community data system. Dr. Thomas' research examines programmatic and systemic responses to social issues, such as homelessness and housing instability. Her research is informed by over 15 years of practice experience in the field using data analytics as the key instrument. Dr. Thomas served as the Principal Investigator of the Housing First Charlotte-Mecklenburg Research & Evaluation Project and the Charlotte-Mecklenburg Coordinated Entry Evaluation.

Alignment with Regional and National Priorities

National Priorities

This proposal aligns with National Science Foundation's 10 Big Ideas, in particular, *Idea 1: Future of Work at the Human-Technology Frontier*: understanding how constantly evolving technologies are actively shaping the lives of workers and how people in turn can shape those technologies, especially in the world of work. *Idea 2: Growing Convergence Research*: merging ideas, approaches, tools, and technologies from widely diverse fields of science and engineering to stimulate discovery and innovation. *Idea 3: Harnessing the Data Revolution*: engaging research community in the pursuit of fundamental research in data science and engineering, the development of a cohesive, federated, national-scale approach to research data infrastructure, and the development of a 21st-century data-capable workforce.

Regional Priorities

This proposal addresses three of the five key focus areas from the Charlotte-Mecklenburg Opportunity Task Force Report examining the issues of deficient economic mobility for underserved communities in the Charlotte region: (1) *Social Capital and Capacity-Building*: technologies, such as data visualization and XR, help translate raw data into visual information that is useful and meaningful to community members and in turn help initiate constructive dialogues among members, policy makers and other stakeholders involved in community development; (2) *Education and Career Readiness*: this proposal offers community members an opportunity of learning about XR and gaining first-hand experience about its potential to promote civic engagement and public education; (3) *Segregation*: through data visualization and immersive technologies, the issues of racial segregation and their associated socio-economic inequalities can be clearly revealed to the general public. These digital tools further expose the correlations among these conditions in terms of overall inequalities in social and economic statuses across the Charlotte metropolitan area.

University Mission

This proposal addresses the University's mission by: leveraging our "location in the state's largest city to offer internationally competitive programs of research and creative activity" that reinforces our "commitment to addressing the cultural, economic, educational, environmental, health, and social needs of the greater Charlotte region" and beyond. This proposal addresses University values that foster "A robust intellectual environment that values social and cultural diversity, free expression, collegiality, integrity, and mutual respect."

Supporting Documents

Name	Title	Contribution/Expertise
Dr. Ming-Chun Lee	Associate Professor of Architecture	Geospatial analytics, urban design, urban planning, and community engagement expertise
Dr. Aidong Lu	Professor of Computer Science	Data visualization, mixed reality, intelligent systems, and applied machine learning expertise
Jeff Michael, J.D.	Executive Director of UNC Charlotte Urban Institute	Land use law, land conservation, regional planning, sustainable economic development, leadership development, diversity/multicultural training expertise
Dr. Lori Thomas (key collaborator)	Associate Professor of Social Work	Macro social work, community-engaged research, community development, administrative data and qualitative data expertise