# Collaborative Development of Augmented Reality Memoralization Applications

ANA MARÍA CÁRDENAS GASCA, University of California Santa Barbara
EMILIA YANG, University of Michigan
JENNIFER JACOBS, University of California Santa Barbara
KAI THALER, University of California Santa Barbara
TOBIAS HÖLLERER, University of California Santa Barbara

Our objective is to understand how to responsibly use Augmented Reality for human rights memorialization. We are partnering with human rights museums and artists to collaboratively develop interactive AR technologies that document human rights struggles, communicate stories of individuals who have suffered human rights abuses, and engage the public in dialog on human rights issues. In doing so, we seek to understand how collaborative technology design with artists and museum curators can help inform broader research frameworks for responsible technology use and ethical media representation of sensitive narratives.

**ACM Reference Format:**
Ana María Cárdenas Gasca, Emilia Yang, Jennifer Jacobs, Kai Thaler, and Tobias Höllerer. 2018. Collaborative Development of Augmented Reality Memoralization Applications. In . ACM, New York, NY, USA, 4 pages. https://doi.org/XXXXXXX.XXXXXXX

## 1 INTRODUCTION AND OBJECTIVE

Our objective is to create ethical research frameworks for immersive communication technologies by developing platforms for digitally communicating human experience in collaboration with communities who have been historically marginalized by society and technology. We will engage STEM graduate students at minority-serving institutions and museum practitioners in partnership to co-develop immersive interactive technologies that aid in 1) memorialization of communities impacted by past and present human rights challenges, and 2) public engagement and dialog on human rights. We will build on our expertise to focus human rights issues pertaining to or resulting in migration and displacement, and the development of augmented reality (AR) technologies for memorialization and education, while working to ensure that our findings are generalizable to other domains of human rights research and technology development.

AR technology offers the unique opportunity to blend aspects of the physical environment with virtual content [5].

The rapid growth of AR has corresponded with a growing concern about the potentially negative ethical, social, and political consequences of unchecked AR research and widespread deployment [4]. Industrial and academic engineering communities have a history of developing and deploying technological platforms without accounting for the risks such platforms pose for individual privacy and security, or harm to vulnerable communities [2].

The growth of AR, contrasted with the legacy of disenfranchisement created by technologies upon which AR seeks to build, has made it urgent to research methodologies for socially responsible AR development.


Manuscript submitted to ACM


Fig. 1. a) The AMA Constructing Memory Interactive Art Book. The book (a) contains stories of victims murdered by the Ortega-Murillo Nicaraguan regime, told through the voices of their families. It includes an AR component that (b-c, through the reading of QR codes on mobile devices, allows access to the testimonies of families on video, maps about the events and virtual altars (d) that hold memory objects of the victims in 3D. [7]

AR applied to *memorialization* provides a context to investigate the unique communicative and educational potential of AR platforms while confronting the risks and limits of AR for creating digital representations of human experiences. AR can offer unique opportunities for memorialization for human-rights. Museums are increasingly seeking to develop visitor engagement that enable sensorial interactions and personal connection [6]. Immersive and interactive exhibits can provide a pathway for for audiences to infer meaning and rationale in historical thoughts and actions in contexts they have no personal direct experience with [8]. Further technological techniques that are adjacent to, or encompassed by AR enable communicating information and content in distributed and remote forms, allowing institutions to engage a broader audience [3].

We will investigate the design and engineering of ethical advanced communication technologies through *collaborative development* (co-development) of AR applications with human rights experts. Our work will contribute innovative approaches for AR production while simultaneously creating new opportunities to engage STEM researchers in ethical technology production, and the broader public in human rights topics.

## 2 COLLABORATORS

**Ana María Cárdenas Gasca** Is a Ph.D student in Media Arts and Technology. She has conducted prior research co-designing and deploying human-rights AR applications in Colombia.

**Emilia Yang** is a scholar, artist, and community organizer with expertise the creation of transnational and speculative media and transformative justice projects. Her dissertation research explores participatory forms of mediation for remembering victims of state violence and examines the role of memory in the political imagination.

**Jennifer Jacobs** is Assistant Professor of Media Arts and Technology and affiliated faculty in Computer Science. Jacobs develops computational systems for art, design, manufacturing, and learning in partnership and collaboration with domain professionals.

**Kai Thaler** is Assistant Professor of Global Studies and affiliated faculty in Political Science. He researches human rights violations and international and civil conflict, across the United States, Africa, Latin America, and Southeast Asia. He also researches and develops graduate training for ethically and rigorously conducting research with conflict-affected communities.

**Tobias Höllerer** is Professor of Computer Science and affiliated faculty in Media Arts and Technology. He directs the Four Eyes Laboratory, conducting research in the four I's of Imaging, Interaction, and Innovative Interfaces. His NSF CAREER award on "Anywhere Augmentation" helped augmented reality technologies on the path to adoption, enabling mobile computer users to place annotations in 3D space wherever they go.

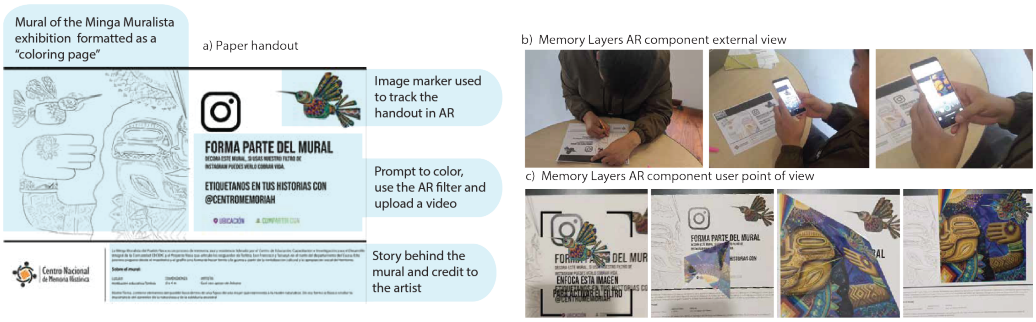


Fig. 2. The Memory layers exhibition included a paper handout a) with a black and white version of a Nasa memorialization mural and information about the Nasa people's story. B) and c), show the experience of the AR app. Users trigger an animation of an unfolding origami bird by pointing their phone cameras at an image marker. The bird unfolds into the missing half of the mural showing the original mural. Images from [1].

## 3 INITIAL WORK

Our future research builds on prior collaborative memorialization efforts by members of our team. Yang, a native of Nicaragua, worked with the Museum of Memory against Impunity in Nicaragua to create an interactive memorial book documenting the stories of victims killed by government repression in 2018 (figure: 1). The book includes an AR component that allows readers to access video recordings of the testimonies of families, digital maps about the events, and 3D virtual altars, created through photogrammetry, that document possessions of the victims retained by their families in their memory [7].

Cárdenas Gasca, a native of Colombia, worked with the Colombian Museum of Memory, we developed an AR application that digitally augmented a commemorative mural (figure: 2), enabling viewers to access digital media accounts of individuals memorialized by the mural. The system also enabled audience members to leave digital reflections [1].

These examples demonstrate the potential of AR to support new forms of memorialization and dialog on human rights issues through viewer immersion and direct audience participation. Further, they show how AR's ability to disrupt physical spaces with digital content can provide opportunities for institutional critique and redress for marginalized groups or individuals. Through our proposed research, we seek to further explore the opportunities offered by user engagement enhanced through immersion, interactivity, and spatial and temporal flexibility that are possible through AR. Additionally, we aim to provide insight into the trade-offs that these interactions can introduce when working with sensitive narratives.

## 4 DIAGRAM

Our research involves collaboration with many different stakeholders. Among our team, we have practitioners from computer science and engineering, social science, design, and fine art. Our collaborations thus far have also included work with museum curators and staff, victims, and human rights researchers. We have produced exhibitions that have been open to the general public, and we have been directly impacted by state and political actors who have alternatively supported or restricted the efforts of the institutions we have collaborated with. Figure 3 represents an initial attempt at communicating the potential benefits of our work across different actors, as well as the roles these groups may take.

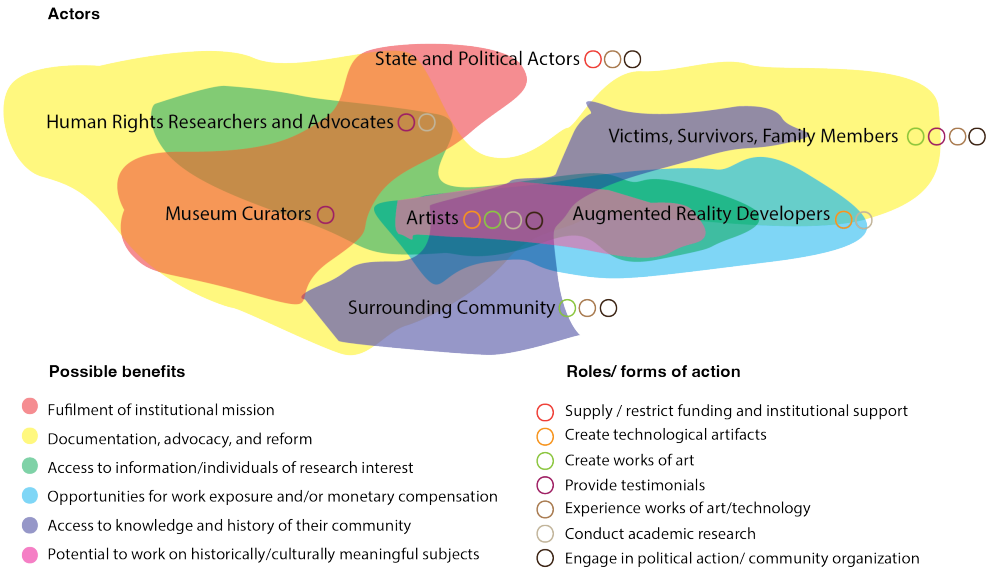


Fig. 3. A diagram of actors within our research.

## REFERENCES

[1] Ana María Cárdenas Gasca, Jennifer Mary Jacobs, Andrés Monroy-Hernández, and Michael Nebeling. 2022. AR Exhibitions for Sensitive Narratives: Designing an Immersive Exhibition for the Museum of Memory in Colombia. In *Designing Interactive Systems Conference* (Virtual Event, Australia) *(DIS '22)*. Association for Computing Machinery, New York, NY, USA, 1698–1714. https://doi.org/10.1145/3532106.3533549

[2] Sasha Costanza-Chock. 2020. *Design Justice: Community-Led Practices to Build the Worlds We Need.* MIT Press. Google-Books-ID: h4LPDwAAQBAJ.

[3] Abigail C. Durrant, David S. Kirk, and Stuart Reeves. 2014. Human Values in Curating a Human Rights Media Archive. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Toronto, Ontario, Canada) *(CHI '14)*. Association for Computing Machinery, New York, NY, USA, 2685–2694. https://doi.org/10.1145/2556288.2557196

[4] Jan Gugenheimer, Mark McGill, Samuel Huron, Christian Mai, Julie Williamson, and Michael Nebeling. 2020. Exploring Potentially Abusive Ethical, Social and Political Implications of Mixed Reality Research in HCI. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI EA '20)*. Association for Computing Machinery, New York, NY, USA, 1–8. https://doi.org/10.1145/3334480.3375180

[5] Wendy E. Mackay. 1998. Augmented reality: linking real and virtual worlds: a new paradigm for interacting with computers. In *Proceedings of the working conference on Advanced visual interfaces (AVI '98)*. Association for Computing Machinery, New York, NY, USA, 13–21. https://doi.org/10.1145/948496.948498

[6] Daniela Petrelli, Nick Dulake, Mark T. Marshall, Anna Pisetti, and Elena Not. 2016. Voices from the War: Design as a Means of Understanding the Experience of Visiting Heritage. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 1033–1044. https://doi.org/10.1145/2858036.2858287

[7] Emilia Yang Rappaccioli. 2022. AMA y No Olvida Collectivizing Memory Against Impunity: Transmedia Memory Practices, Modular Visibility, and Activist Participatory Design in Nicaragua. *International Journal of Communication* 16, 0 (2022). https://ijoc.org/index.php/ijoc/article/view/16382

[8] Sara K. Sweeney, Phyllis Newbill, Todd Ogle, and Krista Terry. 2018. Using Augmented Reality and Virtual Environments in Historic Places to Scaffold Historical Empathy. *TechTrends* 62, 1 (Jan 2018), 114–118. https://doi.org/10.1007/s11528-017-0234-9