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Research Grant Proposal: 3D and Augmented Reality (AR) Learning Modules for Ancient Civilization Represented Visually in Rock-cut Buddhist Caves in Yungang, China

The Humanities Edge

Title: "3D and Augmented Reality (AR) Learning Modules for Ancient Civilization Represented Visually in Rock-cut Buddhist Caves in Yungang, China."

Importance to Humanity:

Buddhist rock-cut cave art and architecture were unique contributions by humankind in ancient times. Digital preservation efforts in the forms of 3D scanning and imaging have provided a unique opportunity to develop learning tools for scholars and students, as well as an interested lay audience. Faculty and students from FIU and Miami Dade College will join their efforts to develop a prototype of 3D and AR/VR visual learning and an educational platform for Yungang cave Buddhist art and architecture. They will collaborate with Yungang Research Academy in China, which has started digital preservation of some of the caves. We aim to enhance students' global learning about ancient civilizations and enrich their experiences using digital methods and humanities research.

Yungang, a fifth-century rock-cut cave-temple complex, a UNESCO World Heritage site, and one of the greatest Buddhist monuments of all time, is situated south of Mount Wuzhou and north of the Wuzhou River, and is 10 miles west of Datong City in Shanxi Province, in northern China. The complex consists of 45 major caves that contain more than 1,000 niches and 51,000 images. The caves were hewn from the mountain's cliff surface and stretch out from east to west for more than half a mile, with the purpose of carrying on the Buddha Dharma infinitely, and providing a blessing for the Northern Wei (386–534) imperial family, under whose patronage the excavations were initiated.

In 1902, Japanese architect Itō Chūta (1867–1954) "rediscovered" Yungang accidently, and published two articles thereafter, introducing Yungang to the world. In 1907, French sinologist Émmanuel-Édouard Chavannes (1865–1918) investigated Yungang and other caves, recording them with his lens. His *Mission archéologique dans la Chine septentrionale* (Archaeological Expeditions in Northern China, 1909–15, 13 vols.) contains 78 valuable photographs of Yungang. After this, the study of Yungang entered a new era, that of visual images. These early expeditions to China at the beginning of the 20th century opened a new chapter in the scholarship of Yungang.

Two scholars, Mizuno Seiichi (1905–71) and Nagahiro Toshio (1905–90), undertook painstaking investigations of Buddhist cave temples at Xiangtangshan (1937), Yungang (1938–45), and Longmen (1941). Their monumental *Yungang: The Buddhist Cave-Temples of the Fifth Century A.D. in North China* (16 volumes, 32 books) has been a valuable source for the study of Yungang.

These publications and records, combined with the 3D scans and imaging, could provide rich resources for the project team to develop 3D/Augmented Reality (AR) learning modules, used with mobile devices in combination with 2D or 3D replicas of the original cave art, enriching students' learning experience beyond traditional text books and websites.

(Figure 1: Rock-cut Buddhist Art in Yungang Cave, China, Source: Dr. Lidu Yi)

Principal Activities:

The project team, consisting of faculty and students from FIU and MDC, will create a prototype learning tool, using 3D models provided by Yungang Research Academy, and will develop AR components to enhance the exploration and learning of Buddhist history recorded in the Yungang Caves in Shanxi Province, China. The narratives in the 3D/AR learning prototype will be in Chinese and English language, and will includ: 1) relevant historical background relating to individual wall paintings and inscriptions; 2) a 3D scanning of the original paintings and inscriptions, which can be viewed life-size using 3D glasses in a Virtual Reality (VR) setting; 3) optional audio recordings of explanatory texts and music to facilitate the

learning. Furthermore, all digital materials, including digitized manuscripts and 3D objects, will go to FIU's dPanther digital library repository system, which is publicly available for all humanities scholars and students. We aim to seek future funding, to extend implementation of the process to all of the Yungang caves, by applying for the NEH's Digital Projects for the Public program award in the funding cycle of 2019-2020. The Mellon research grant will help us to build a project network, explore technical requirements needed for 3D imaging and AR tool creation, and develop a prototype for testing the outcomes of the technology-assisted learning tool. In future grants, we will extend our collaborative network to include local Wynwood artists and FIU's Wolfsonian Museum, to create exhibitions of physical, artistic representations or replicas of the Buddhist art recorded in Yungang caves, in combination with 3D/AR learning modules. This will allow the public in South Florida, as well as visitors, to use their mobile phone or android tablet to experience the splendor of the rock-cut Buddhist art.

A navigation and retrieval system will be built, using a state-of-the-art 3D visualization system for tablets (including mobile devices); also AR, using Unity, Vuforia, Mapbox locational-based AR, Maya and Scene, and 3D projection systems for a large audience, including students, teachers, historians, scholars and laymen. For this prototype, we will focus on one sample cave in Yungang and expand the workflow used for the prototype to all of the Yungang caves, when funding becomes available. Our participating students will research and develop narratives, adapt music and sound recordings, and other multi-media sources to the 3D/AR learning module. Metadata (descriptive information) for each digitized object will be collected, harmonized and aggregated, to serve as the building blocks for a search and discovery system, allowing users to navigate virtually throughout the cave and its related historical period and spaces, and better understand their context and evolution.

Scholarship and Public Interfacing:

1) Student participation -- We are selecting three students, one undergraduate student from the History Department at FIU, and two undergraduate students from Miami Dade College. The FIU student will be responsible for research related to art history for AR narratives, music, and sound recordings for the selected cave, under the guidance of Dr. Lidu Yi and Jennifer Fu. The Miami Dade undergraduate students, under the supervision of Professor Henry and Jennifer Fu, will be participating in the creation of AR learning modules, and responsible for organizing and preparing the public interfacing and exhibition of the Yungang cave art and its 3D/AR learning module.

2) Curriculum development and Art History learning -- Dr. Lidu Yi and Professor Henry will explore ways of incorporating the concept of digital preservation of historical heritage art pieces in Dr. Lidu Yi's Art History courses;

3) Public art display of the Yungang Cave AR at the FIU Libraries, and on Miami Dade Wolfson Campus walls

Project Team:

FIU PI: Zhaohui Jennifer Fu, Head of the FIU Libraries' GIS Center ,and Head of the FIU Libraries' Digital Collections Center. She has extensive experience with web geo-spatial technology, digital preservation, metadata management and its supporting digital repository systems. She led the development of dPanther (see also http://dpanther.fiu.edu), a digital repository for cultural and historical archives. A great example of applying geo-spatial web technology in combination with the digital repository is Unearthing St. Augustine Colonial Heritage (see also http://maps.fiu.edu/saug/), developed through collaborative efforts with the University of Florida, and funded by the National Endowment for the Humanities (NEH). Other related projects include Coral Gables Virtual History (see also: http://maps.fiu.edu/cgm/). The Coral Gables project was featured in this news story: https://www.facebook.com/cityofcoralgables/videos/240897176598075/. Recently, she secured Tech Fee internal and other external funding, invested over $150,000 in 3D scanning, VR, AR and drone equipment and software, and greatly increased the FIU GIS Center's capacity in capturing and processing 3D point clouds for caves and other settings. She earned her BA in English Language and Literature from Beijing University and her Masters of Library and Information Science (MLIS) from the State University of New York at Albany.

FIU Co-PI: Lidu Yi, Associate Professor of Asian Art History, is a historian of Chinese art and architecture and an archaeologist specializing in Chinese visual art and material culture. She is the author of *Yungang: Art, History, Archaeology and Liturgy* (Routledge, 2017). She is co-editor of the 30 volume book, *Yungang*, which won the national award in China for best academic book in 2016. Her recent research interests focus on Buddhist rock-cut cave-chapel art, architecture and archaeology. She is particularly interested in art, architecture, archaeology and liturgy of Buddhist cave monasteries of medieval China. Currently, she has two on-going research projects in China: one is the examination of the rock-cut cave monasteries on the Silk Road, and the other investigates the relatively unknown small cave monasteries in Shanxi Province. Yi earned both her M.A. and Ph.D. at the University of Toronto in Canada. Before joining the faculty of the College of Communications, Architecture and the Arts here, she was the visiting Gretta Chambers chair professor at McGill University for two years. She taught a wide range of courses on the topic of Asian art, including "Buddhist Arts of Asia," and "Buddhist Art in Medieval China: the Iconology of the Unhang Caves."

FIU Co-PI: Sheyla Santana earned her PhD in GIS and Urban Planning in 2014, when she began research on the uses of virtual reality, mixed reality and 3D modeling. During this period, she developed a 3D immersive system using GIS for the purpose of urban planning, which has been used by the municipal government of Belo Horizonte city in Brazil since 2015. This award-winning research was published in an internationally recognized geospatial journal, and qualified her for an "extraordinary ability" visa for working in the USA. Since 2016, Sheyla Santana has been the Coordinator of the FIU GIS Center. In her current position at Florida International University, she supports the GIS Center and FIU projects that have a geospatial component, on a variety of topics within GIS and remote sensing. Her most recent projects focus on 3D modeling, VR/AR, drone image processing, and photo-reconstruction using City

Engine, Infraworks, ArcGIS Pro, Unity, location-based AR Mapbox and Vuforia, Pix4D, and Faro Scene. In 2017, she got her FAA pilot's license to fly drones, and began using them in her research. Currently, she is processing drone images for a project involving starfruit cultivation in Homestead, FL. She is also supporting the initiative of the FIU Facilities department, using drone mapping, techniques of photo reconstruction, BIM&GIS integration, and virtual navigation using 3D point clouds. Sheyla's research interests are centered on 3D scanning, photo reconstruction, AR/VR/mixed reality, virtual navigation, and smart communities.

FIU Student: Christine Monge (cmonge@fiu.edu) is an undergraduate student in the History Department at FIU. She is currently also working on a Southeast Florida Library Information Network grant on digitizing archives.

Miami Dade College PI: Robert R. Henry is a Humanities Instructor at Miami Dade College and a doctoral candidate (2012) at Florida State University, with a focus on African Caribbean Studies. His untitled dissertation will be a discourse analysis of Obeah, a magical religious tradition of the Anglophone Caribbean, and its intersection with art, culture, folk healing, kinship, law, literature and material culture. Prior to his doctoral studies, he earned a Master of Law degree (LL.M.) in Intercultural Human Rights from St. Thomas University School of Law in Miami (2007). He also earned both an M.A. (2004) and a B.A. (2003) in Interdisciplinary Humanities, with a focus on modern culture in Humanities, Human Rights, and Religion, from Florida State University. Since graduating in 2004, Robert has taught many students as a teaching assistant, adjunct professor, and instructor at Florida State University, Strayer University, and at Miami Dade College, respectively. Together, his experience adds up to more than fifteen years in higher education. One of his students was the recipient of the Jack Kent Cooke Transfer Scholarship, and was awarded a $40, 000 scholarship. He has interest in religion, world cultures, and education. He is a trained interdisciplinary researcher in humanities disciplines, such as art, music, film, literature, law, material culture and religion. Humanities education and curriculum design are his contribution to this project, also issues concerning cultural and intellectual property rights.

Miami Dade Students: Bruny Alonso (bruny.alonso@mymdc.net) and Maria Jose Madrinan (maria.madrinan001@mymdc.net) are both second-year Honors College student at Miami Dade College's Wolfson campus. Their focus in is the Liberal Arts. Bruny has an interest in Chinese culture, and learning Mandarin is one her extracurricular activities, apart from taking fifteen credit hours per semester.

Advisories:

Yucef Merhi is the inaugural Curator of Digital Collections at the Wolfsonian Museum, and an award-winning new media artist whose practice lies at the intersection of language and technology. Past projects include an immersive wallpaper installation, displaying a datagram of the hacked personal emails of Hugo Chávez, then candidate for president of Venezuela; a multiplayer poetry game built with vintage Atari consoles; and a 40,000-ft electronic sound visualization that translates real-time sounds into colorful geometric patterns choreographed by voice interaction. He has been featured in dozens of

solo and group exhibitions around the world, and his work is held in various public collections, including the Orange County Museum of Art and the Library of Congress. He earned his Bachelor's in liberal arts at New School University, and a Master's of professional studies in interactive telecommunications at New York University. He has lectured and published widely, while completing a laundry list of high-profile fellowships, residencies, and commissions with institutions such as the Los Angeles County Museum of Art, the Bronx Museum of the Arts, and Eyebeam. He also previously served in curatorial and archival roles at White Box; the 2010 International Biennial of Contemporary Art in Mérida, Venezuela; and the Esther Klein Art Gallery at Philadelphia's Science Center. In addition, Merhi founded and directed Canal, a technology-oriented cultural space in Caracas, Venezuela, and has organized and curated new media venues for the Museum of Contemporary Art, Los Angeles; The Americas Society; Rhizome; and more. Yucef will provide input to the project team on public exhibits and community engagement in Arts and History.

John Stuart is the Associate Dean for Culture and Community and Executive Director at the Miami Beach Urban Studios at the College of Communication, Architecture + the Arts (CARTA). John is a registered architect and principal of John Stuart Architecture, with research interests focused on architectural design, its contexts, and its impact. He is currently a 2007-08 New York Prize Fellow at the Van Alen Institute. During his residency at the institute, he will develop "TimeZone," a built project intended to empower communication between diverse people in public spaces, in an effort to address global poverty and the "digital divide." He is the author of "The New Deal in South Florida: Design, Policy and Community Building, 1933–1940" (Gainesville: The University Press of Florida, 2008). His designs are part of the permanent collection of the Avery Architectural and Fine Arts Library at Columbia University. Stuart has undergraduate degrees in classics and applied mathematics from Brown University, a graduate degree in classical archaeology from Princeton University, and completed his professional architecture degree at Columbia University. John will provide input and feedback in the design and development of the 3D/AR learning modules.

Budget

The project team is requesting a total of $10,000 for the one-year project, starting from August 2019.

Activities/items	FIU	MDC
Students' hours $10/hr@20 hours per week for 5 weeks	$1,000	$1,000
Travel to and bring Chinese partners on site	$2,000	$2,000
Technical support for 3D and AR development	$2,000	
2 Physical Exhibits at FIU and MDC		$2,000
Total	**$5,000**	**$5,000**