CS476 – Senior Capstone Design in Computer Science
Project Description

Project Title: **Virtual Excavation**

Sponsor Information:	Dr. Kayeleigh Sharp, Ph.D., RPA, Assistant Teaching Professor, Archaeology & Anthropology Director, Digital Archaeology Lab, NAU Director, Northern Gallinazo Archaeology Project, Lambayeque Department of Anthropology Northern Arizona University kayeleigh.sharp@nau.edu

Project Overview:

Archaeological field schools are an extremely important part of the discipline. They are designed to provide hands-on training for up-and-coming scholars of the past. They are also increasingly required for students seeking archaeology careers and even those with a strong interest in archaeology but without professional ambitions

Despite their appeal, however, traditional archaeological field schools can cost $3,000-$8,000 plus travel expenses which makes them extremely cost-prohibitive and inaccessible for most students who need them. Equally so, during the first few days of rigorous fieldwork, many students find that they do not wish to continue in the field but rather, that they are inclined to pursue their archaeological passion while working with artifacts and analyzing data in the lab – essential work conducted concurrently and/or following the fieldwork. The third major caveat that serves to make archaeological field schools even more exclusive is that differentially abled persons or persons in wheelchairs find that they are immediately excluded from archaeology as a discipline because they are unable to attend field schools or access archaeological sites in the traditional way.

What if there were a way to train students in the field while creating a low-stakes experience where budding archaeologists can test the waters?

This project asks you to build a new Web-based VR experience that will help to bridge the gap between the traditional field school and simulated experience. An excellent foundational example is found in the YouTube Virtual Tour: Inside Chauvet CAVE: https://youtu.be/htFsh56dKIY?si=2yRRe6CandGERLtH. The gamified VR archaeology experience created here, however, will resolve above issues in exciting new ways that challenge previous ideas about what VR gamification and online learning can do, while contributing to the discipline's ongoing efforts to be a more inclusive and equitable learning tool. The Virtual

Excavation Experience you will create will be deployed on the Digital Archaeology Lab website https://legacy.nau.edu/anthropology/digital-archaeology-laboratory/ for classroom use and beyond.

The envisioned product:

This experience will allow you to step into a simulated archaeological setting in 2nd or 3rd person using an archaeological avatar to discover and make evidence-based decisions about where to excavate at archaeological sites and analyze artifacts and data on curated collections from your laptop. Your team will focus on 4 key themes while developing a new VR experience:

1. Unlike typical VR reconstructions of archaeological sites and/or virtual tours, your virtual field school will not only incorporate real-world data from archaeological sites and excavations based on Dr. Sharp's long-term archaeology fieldwork in both the American Midwest and northern Peru. It will also provide opportunities for users to experience and learn to overcome problems of site accessibility, artifact preservation, looting and climate impacts that can make fieldwork time consuming and unproductive.
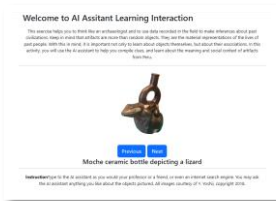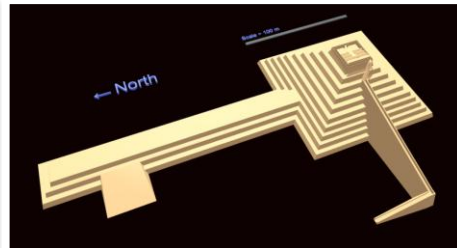
2. The experience will also include an interactive AI docent to guide you and pop-up knowledge checkpoints before users are permitted to advance to the next level of survey, excavation, and analysis.

3. Finally, the experience will use dynamic 3D reconstructions of real excavation units such that users can select previous excavation areas with known artifacts to test their archaeological skill set using evidence to support their claims.

Funerary platform

Metallurgy area

Household area
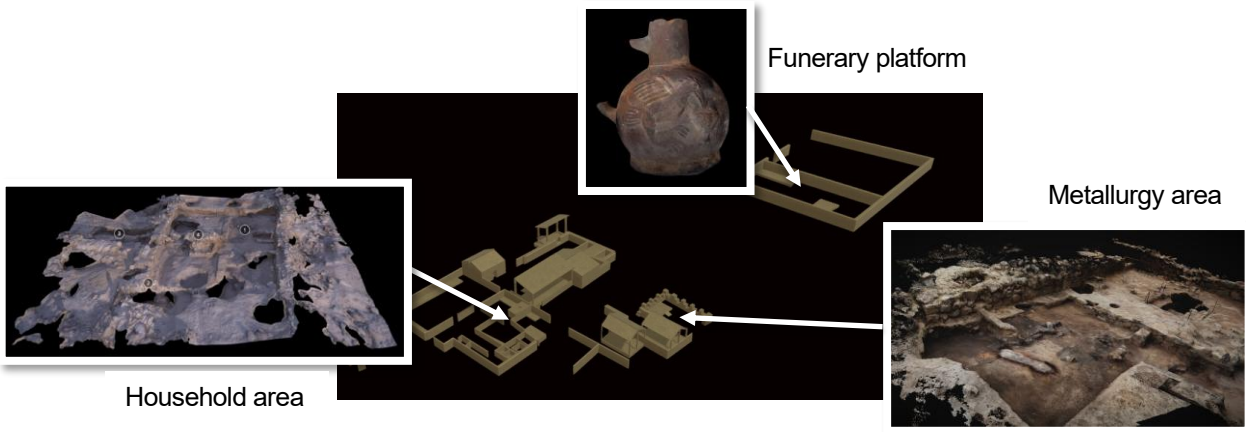
As our methods grow increasingly non-destructive, traditional field school methods are becoming more outdated year by year. Your virtual archaeological field school will provide foundational training in contemporary archaeological field methods and laboratory analysis techniques in a way that is accessible, equitable and engaging for 21ˢᵗ century archaeologists.

Minimum Viable Product:

- A VR experience that uses real-world archaeological data using Web-based VR
- Creation of a dynamic and interactive excavation that parallels real-world archaeological field work.
- Integration of an original bracketed AI assistant to provide guidance and details about sites that are not available online.
- Integrates assessment quizzes as part of VR experience that the client (Dr. Sharp) can offer that AI cannot.

The very cool datasets you will work with will include but are not limited to:

- high-resolution 3D models of excavation units and architectural features
- original artifact assemblages (pottery, metallurgical debris, lapidary materials)
- geospatial data showing site layouts, functional distinctions and regional contexts
- unpublished sites
- landscape data spanning several thousand years in different regions.

The solution components that would be really cool (stretch goals):

- Ability to change avatars to practice different skills (e.g., drone pilot, excavator, artifact analyst, geochemist) on self-contained datasets.
- Ability to change scenes to study different aspects of sites and local ecosystems.
- Incorporates a central, secure data storage and service solution that will support the integration of expanded datasets ad they come available and/or are contributed by citizen scientists.

Knowledge, skills, and expertise required for this project:

- Unity, Unreal Engine or Wonderland game development engines
- Familiarity with image editing and model editing with open-source software including Blender and Meshlab
- Preparation and editing of 3D models generated by the client and her team using proprietary Agisoft Metashape.
- Knowledge of C# or C++ to program quizzes and assessments

Equipment Requirements:

- There should be no equipment or software required other than a development platform and software/tools freely available online.

Software and other Deliverables:

- A well-tested, cross-platform deployment system that facilitates deployment of VR experience in Web-based VR or headset and allows interactive assessment for educational tools.
- A strong as-built report detailing the design and implementation of the product in a complete, clear and professional manner. This document should provide a strong basis for future development of the product.
- Complete professionally documented codebase delivered both as a repository in GitHub.
- A VR experience that incorporates experiential learning tool for excavation and excavation techniques.