Prospectus

Orthographic Drawing Machine

LIDAR and Technical Politics

By

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Introduction

The ultimate aim of an archaeologist is to "place the material remains in historical contexts, to supplement what may be known from written sources, and, thus, to increase understanding of the past" (Glyn, 2019). But before an archaeologist can do that, she has to describe, classify, and analyze the artifacts she studies. An adequate and objective taxonomy is the basis of all archaeology, and many good archaeologists spend their lives in this activity of description and classification (Joukowsky, 1982). Archaeologists analyze artifacts to learn about the people who made and used them. For archaeological research, it is important to appropriately record, document, and survey artifacts and sites because an accurate and complete documentation is a prerequisite for further analysis and interpretation of artifacts and archaeological areas (Barsanti, 2013).

The prevalent type of archaeological documentation today is the direct survey, which involves measuring objects, or excavation units in direct contact. One example of this would be using a caliper or tape measure to determine the length of a piece of pottery (Barsanti, 2013) . A survey of this type is highly time-consuming and is not very accurate. Contact measurements also allow for possible damage to archaeological objects to occur. The development of an indirect digital archaeological survey method through digital three dimensional modeling would provide a faster and safer approach to the documentation of fragile artifacts.

However, advancements in technology alone are not enough to ensure better documentation of archaeological artifacts. Human skeletal remains found at archaeological sites have the potential to provide a great deal of critical information on a society, including information on health, death, and ancestry. However, excavation of human remains has experienced lots of opposition from society and archaeologists must take special precautions when they come across human remains (Higginbotham, 1982). Therefore in order to properly improve archaeological documentation, the social aspects behind archaeological documentation must be better understood. If the issues facing the archaeological industry are only addressed through technical innovation a major challenge to the success of the design, would be left unresolved.

In order to design an effective solution to improve archaeological artifact documentation both the technical and socio aspects must be addressed. Below, I propose an automated drawing device that will improve archaeological documentation via three dimensional modeling. Then I will take a closer look at LIDAR technology to learn more about how a design can empower certain groups while marginalizing, or excluding others.

Technical Project

Models and visual representations are imperative to understanding the design and architecture of a particular artifact. They afford engineers the ability to better comprehend spatial organization and component integration. In the past, the portrayal of three dimensional objects was a task of great difficulty; there was no single standard of representation. Orthographic projections were devised to communicate a three dimensional object to the rest of the world. Orthographic projections are drawings in which the object depicted is viewed along parallel lines that are perpendicular to the plane of the drawing. They are typically made from three perspectives: the top view, front view and side view. Photogrammetry is a technique that uses overlapping images or projections derive reliable and precise measurements. It is also known as the art of turning images into three dimensional models (Poulin, 1998).

The capacity to produce orthographic projections is essential to the creation of 3D models that allow archaeologists to accurately analyze a three dimensional artifact (Hess, 2017). However the current methods for producing the orthographic images that contribute to the creation of models and allow this analysis to occur are inefficient (Brutto, 2012). Drawing projections by hand is timely and provides room for human error. An alternate approach is using lasers to scan the object and then manipulating the data into projections. This method is unnecessarily expensive and difficult for archaeologists with little electromagnetic signal experience. Therefore there is a gap in the technology that facilitates orthographic image production and if this is left unresolved archaeologists will continue to waste time and money in order to develop three dimensional models of precious artifacts. The issue also has the potential to prevent archaeologists from making any three dimensional models at all during the documentation and classification phase of a particular object. Which ultimately hinders society's ability to form inferences pertaining to the past of mankind.

To solve this problem I propose an automated drawing machine that will be able to create orthographic projections from a physical artifact. It will work by autonomously photographing the given object and converting those pictures into orthographic images that the device will then physically draw out. The device will be able to take photographs from different angles, scale the image up or down, and detect the edges of the object in order to produce the orthographic images. The drawing motion will be facilitated by two simultaneously moving gantry carts on a table frame. One of the carts will move up and down while the other cart moves left and right. The movement of these carts will be controlled by pulley systems that are driven by two stepper motors. This design will provide a faster, cheaper and easier method for creating orthographic images which will lead to faster, cheaper and easier three dimensional photogrammetric modeling, ultimately improving archaeological documentation.

STS Project

In North America, the argument has been made that the archaeological study of ancient Native American people is a violation of the religious freedom of living tribe members. Some Native American spokesmen have made a claim on religious grounds, for the right to control archaeological remains regardless of the age, location, or the degree of ancestry of the specimens (Higginbotham, 1982). Despite the long absence, Native Americans are now asserting control over their ancestral identities with regards to archaeology. It appears the historical group has generally accepted the position that the dead should not be disturbed even if information of the past could be gained (Mcguire, 1992). In addition, many Native Americans believe that artifacts that have been previously excavated should be returned to their original locations in compliance with their religious beliefs (Brothwell, 1981). This opinion directly conflicts with the sentiments of the majority of professional archaeologists which is best summarized by the late Clement W. Meighan, then professor of anthropology at the University of California. Meighan saw the Native American wish for reburying bones and artifacts as "the equivalent of the historian burning documents after he has studied them" (Meighan and Green, 1984). Archaeologist believe it is their duty to uncover artifacts and remains using whatever tools necessary in order to provide a better understanding of the world.

Light Detection and Ranging (LIDAR) technology is one technology archaeologists utilize to produce detailed three-dimensional maps of the Earth's surface in small amount of time. It works like a table scanner except it is used for aerial imaging. While connected to a GPS the system sends laser beams to the ground in order to generate a point cloud image of the ground surface (Johnson and Ouimet, 2014) . One advantage of LIDAR is that it can see through some aquatic and forest environments to locate site that would otherwise be obscured and go by unnoticed (Johnson and Ouimet, 2014).

A popular current belief is that the machines of modern material culture can only be accurately judged for their contributions of efficiency and productivity, or their positive and negative environmental side effects (Weber, 1997). However, this claim does not address the ways in which they can embody specific forms of power and authority. If researchers and designers continue to think along these lines and deny that certain technologies in themselves have political properties, they will miss some of the most important implications of certain technological imperatives.

The LIDAR technology presents a huge advantage to the historical preservation societies and companies that acquire the technology. The presence of this technology in industry has increased archaeological capabilities and effectively given power to the archaeologist in support of excavation. The new technological resource furthered the study of artifacts and remains despite the fact that this action is against the Native American intentions. Over time this struggle over archeological jurisdictions has been incorporated into a larger political struggle over increasing recognition of Native American rights, making the political consequences of the LIDAR technology increasingly impactful.

To analyze this phenomenon I will use Langdon Winner's Theory of Technological Politics. Winner claims that one way artifacts can contain political properties is "instances in which the invention, design, or arrangement of a specific technical device or system becomes a way of settling an issue in a particular community" (Winner, 1980). I will apply this notion to determine how LIDAR excavation technology both privileges and disenfranchises conflicting social populations just because of its mere existence.

Technological politics describes the power of technology to continually shape the political landscape in ways that beneficially and adversely affect certain groups of people based on various demographics (Weber, 1997). Ultimately, the Theory of Technological Politics will allow the reader to understand that while the purpose for engaging in archaeological documentation is imperative to understand the meaning behind artifacts, the technologies devised to achieve this goal have unintended consequences. Specifically, marginalizing Native American groups who wish for artifacts and remains to be left untouched.

Conclusion

In this paper, both the technical and social solutions address methods in which archaeological documentation can be improved. The proposed automated drawing machine is a technical answer dedicated to improving archaeological documentation. It will allow orthographic images to be created quicker and with less skill requirements than the current approaches. However this remedy would be incomplete without the research necessary to understand the inherent political ramifications that archaeological advancement technologies can have on society. Using the Theory of Technological Politics I will perform an analysis to broaden the understanding of how technology has political implications and social consequences. The improvements of archaeological documentation depends on the development of the technical design in order to be able to quickly create models that archaeologists can use to visually represent and classify artifacts so that they may discover the context in which it exists. The discovery of how a technology can have inherent political properties also contributes to the improvement of archaeological documentation because it provides insight into the power struggle surrounding archaeology and how the development of new technology can unintentionally favor one of those groups.

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