Case Study of Educational VR from Assisting the *Inhabiting Byzantine Athens* Project
(Technical Topic)

The Potential of Military Mixed and Augmented Reality as an Interface of Dissociation
(STS Topic)

A Thesis Prospectus
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By
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On my honor as a University student, I have neither given nor received unauthorized aid
on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Virtual Reality and Augmented Reality have taken great strides in recent years (Heater, 2023). These technologies pose significant physiological, psychological, and societal effects, both good and bad (NSPCC, n.d.; *The Future of Virtual and Augmented Reality in the Workplace*, n.d.). As such, it is important that we gauge the impact that these technologies could have on society if they were to become more widespread. I wish to approach this from two angles.

The first angle comes from a personal viewpoint working as a Research Assistant under Professor Fotini Kondyli of the University of Virginia on her *Inhabiting Byzantine Athens* project. Through this project she has spent the past few years reconstructing buildings from Byzantine Athens based on archaeological work conducted by her, her peers, and other archaeologists before them. This is all towards the end of eventually incorporating these findings into a complete virtual experience through which people can, in however small a part, see the world around them as it used to be. It should be noted however that, as I have only recently (Nov. 2, 2023) been offered the position, I cannot yet know its outcomes or my contributions to them until it is completed in Spring of 2024. Even still, I find that the project highlights some of the primary strengths of VR/AR especially as an educational tool which I would argue (in this particular case at least) is a fairly undeniable social good.

The second angle comes from a more theoretical perspective analyzing the risk of Augmented Reality in creating emotional distance between those on both sides of the mask. Specifically, I would like to narrow the scope of my research to the effect that AR has on infantry users within the military. Even if AR inherently maintains a user's connection to the real world, I wish to investigate whether these devices can create a disconnect between the two regardless.

The sources available for this research will of course be limited by the recency of AR's adoption both for general and military applications as well as the secrecy and restricted nature of information surrounding any current military technology. I therefore intend to augment my studies with the inclusion of related technologies that can function as analogs to any detachment caused by military AR such as drones, long-range weapons, and possibly nightvision goggles.

I find that these two subjects provide a good balance between the various ways studying this technology can be approached. On one side, I propose a first-hand, anecdotal look into Virtual Reality and, on the other, a broader, literature-based investigation into Augmented Reality.

Technical Topic

As stated above, I am only just now joining the *Inhabiting Byzantine Athens* project. Because of this, I will better understand as time goes on the specific aspects of the research and my place within it all; however, it could of course happen that my role in this team is not quite fitting for a paper focused on computing, in which case I will decide upon another Technical Topic to study.

From what I have been informed of so far, the team is composed of Professor Kondyli herself, ten student research assistants, and a few other specialists in various long-term and freelance capacities. The project (or at least the project under its original objectives) is now in its final stages. Gradually over the past few years, the team has designed 3D models of various

Byzantine buildings from a particular section of the Athenian Agora. Recently, this has allowed work to begin in earnest on compiling these models into a full-fledged Virtual Reality Experience.

I have further been told that the organizational structure of the project is very free and flexible. As such, I and the other students who are joining at the same time as me will develop our roles and niches as we find out in what areas we can best assist. Tied into this idea is that we should all play a part in guiding the process rather than simply executing her vision. The professor emphasized that she wants her students to suggest and critique along the way in order to elevate the quality of the project.

Team meetings are conducted remotely once a week as the professor is currently in Greece to facilitate the hands-on research necessary for this project. Communication between meetings is done through Slack channels.

While an archaeological project of this size is unlikely to affect the general public in a sweeping way as would work at a large tech company for example, I nevertheless think it does greatly benefit the community it is aimed at, those being scholars. Virtual Reality has a great potential to teach, particularly in this case. I wholeheartedly agree with what the professor said during my interview: VR has the ability to bring the past to life in a way that words and drawings on the page cannot fully do. Besides helping to communicate the findings of their research, it has also helped the team improve the findings themselves. As the professor explained to me, when reconstructing a building, there is a great benefit in having a more tangible, truer to life view of your prototype so that it can be effectively iterated upon.

One thing I hope to help do, if it is not being planned already, is to expand the audience for the project. While the final product being released for free on a dedicated website (if it is) would make it accessible, accessibility means very little without visibility. For this reason, I think it would be a good idea to simultaneously publish the project for free to a platform such as Steam where it might attract not just the attention of those in the sphere of academia, but that of others as well.

STS Topic

For my STS topic meanwhile, I would like to approach the subject of VR/AR from a less concrete standpoint. I wish to investigate the potential danger of AR use among foot soldiers as a source of detachment in conflict zones between those soldiers and the communities they interact with.

While my research will focus on the consequences of AR's mass adoption by militaries, it should of course be noted that neither of these technologies is in any way guaranteed a path towards popularization, even less so by any specific group with its own particular needs that may turn out to be incompatible with the technology's affordances. Already, many hurdles have become apparent as the US military has accelerated its development and integration of Augmented Reality (Jowitt, 2023; Kallberg et al., 2022).

Assuming it does at least become adopted by some militaries, my primary concern is that it may inject a barrier into what would otherwise be a direct social relationship. However thin or transparent this barrier is, it nevertheless becomes the new, unavoidable, and exclusive interface through which someone sees the outside world and is seen by it. This leads me to worry that a

sense of detachment or disassociation could set in among some people whereby they no longer feel as close to their actions and those impacted by them as they would and should otherwise.

I intend to approach this topic using an Actor Network Theory Framework which acknowledges the various actors involved in interactions which would be changed by the inclusion of this new medium (*Actor Network Theory - an Overview | ScienceDirect Topics*, n.d.).

My methods on the other hand will of course be restricted due to the subject matter. Based on my preliminary research, I do not find it likely that many articles exist on my exact research question, if any do at all. This necessitates that I look at related technologies to see if similar problems have already arisen. By and large this will be conducted through an investigation of scientific literature. If possible, though it is unlikely, this will be accompanied by interviews with military and government actors who would have a significant impact on the character of AR's application.

Conclusion

My research will be composed of two parts. The first, my technical component, and the second, my STS component.

My technical research will be an experiential paper based on my upcoming assistance with Professor Kondyli's work reconstructing Byzantine buildings from the Athenian Agora and adding them to a virtual space. I will specifically look at the ways in which the technology of Virtual Reality has facilitated and improved the outcomes of her research. This should provide a

useful case study covering best practices for and pitfalls of incorporating VR into research and education.

My STS research meanwhile will be a study of the possible risks that may come with the use of Augmented Reality by military forces due to how it could create a detachment between soldiers and those non-combatants caught in the line of fire. It is important that we comprehend as much as possible the consequences of changes to such pivotal areas of society before we follow through with them blindly.

By the end of this two-part research project, I intend to have one paper for each topic.

References

Actor Network Theory—An overview | ScienceDirect Topics. (n.d.). Retrieved November 6, 2023, from https://www.sciencedirect.com/topics/social-sciences/actor-network-theory

Asaro, P. M. (2013). The labor of surveillance and bureaucratized killing: New subjectivities of military drone operators. Social Semiotics, 23(2), 196–224. https://doi.org/10.1080/10350330.2013.777591

Benjamin, G. (2022). Drone culture: Perspectives on autonomy and anonymity. AI & SOCIETY, 37(2), 635–645. https://doi.org/10.1007/s00146-020-01042-7

Cipresso, P., Giglioli, I. A. C., Raya, M. A., & Riva, G. (2018). The Past, Present, and Future of Virtual and Augmented Reality Research: A Network and Cluster Analysis of the Literature. Frontiers in Psychology, 9, 2086. https://doi.org/10.3389/fpsyg.2018.02086

Heater, B. (2023, May 31). A brief history of VR and AR. TechCrunch. https://techcrunch.com/2023/05/31/a-brief-history-of-vr-and-ar/

Heemsbergen, L., Bowtell, G., & Vincent, J. (2021). Conceptualising Augmented Reality: From

   virtual divides to mediated dynamics. Convergence: The International Journal of

   Research into New Media Technologies, 27(3), 830–846.

   https://doi.org/10.1177/1354856521989514

Jowitt, T. (2023, September 18). Microsoft Wins US Army Order Upgraded HoloLens. Silicon

   UK. https://www.silicon.co.uk/e-innovation/wearable/microsoft-wins-us-army-order-

   forupgraded-hololens-report-529994

Kallberg, J., Beitelman, V., Mitsuoka, V., Pittman, J., Boyce, M. W., & Arnold, T. W. (2022). The

   Tactical Considerations of Augmented and Mixed Reality Implementation. Military

   Review, 102(3), 105–113.

Katell, M., Dechesne, F., Koops, B.-J., & Meessen, P. (2019). Seeing the whole picture:

   Visualising socio-spatial power through augmented reality. Law, Innovation &

   Technology, 11(2), 279–310. https://doi.org/10.1080/17579961.2019.1665800

Müller, O. (2021). "An Eye Turned into a Weapon": A Philosophical Investigation of Remote

   Controlled, Automated, and Autonomous Drone Warfare. Philosophy & Technology,

   34(4), 875–896. https://doi.org/10.1007/s13347-020-00440-5

NSPCC. (n.d.). Virtual Reality Headsets. NSPCC. Retrieved November 5, 2023, from

   http://www.nspcc.org.uk/keeping-children-safe/online-safety/virtual-reality-headsets/

The Future of Virtual and Augmented Reality in the Workplace. (n.d.). @verizon. Retrieved

   November 5, 2023, from https://www.verizon.com/about/blog/vr-in-business

U.S. Army to use HoloLens technology in high-tech headsets for soldiers. (n.d.). Source.

   Retrieved October 21, 2023, from

   https://news.microsoft.com/source/features/digitaltransformation/u-s-army-to-use-

   hololens-technology-in-high-tech-headsets-for-soldiers/

Wu, Y., He, Y., Li, N., Wang, G., Zhang, L., Zhang, F., & Zhu, Y. (2023). A Review of Intelligent Vision Enhancement Technology for Battlefield. Wireless Communications and Mobile Computing, 2023, 1–13. https://doi.org/10.1155/2023/6733262