Vision Augmentations effect on Depth and Aim

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SHINE Summer High School Intensive in Next-Generation Engineering

Introduction

Depth perception is vital in order to properly understand the distance, position, and size of an object near you. When using a flat screen or monitor to observe said object through teleoperation, you will lose much of the needed depth perception. This can make it difficult for an operator to understand an object's distance and position, both involving depth perception [1]. Creating an interface using augmented features can assist in improving depth perception [1-3].

Objective & Impact of Professor's Research

Dr. Becerik's and Dr. Soibelman's research focuses on human-robot interaction and human-building interaction. In this project they are creating a teleoperation interface that will be used with a demolition robot. This will allow it to be remotely operated, while still allowing for a safer environment for the operators.

Acknowledgements

I would like to thank my mentor, Patrick Rodrigues, for guiding me through the project and keeping me on track. I would also like to thank Professor Burcin Becerik-Gerber and Dr. Lucio Soibelman for giving me this opportunity and my Center Mentor, Kelly Yu, for offering her support and answering my questions.

Research & Learning Process

In order to use visual augmentations, we first had to mount a camera on our robotic arm, but also an ultrasonic sensor . This sensor would be determining how far something is from the head of the robot. Fig. 1 shows the robotic arm and its sensors.

We used a Raspberry Pi in order to create the visual augmentations, run the calculations for the ultrasonic sensor, and to display everything to the user on two computer screens (Fig. 2).

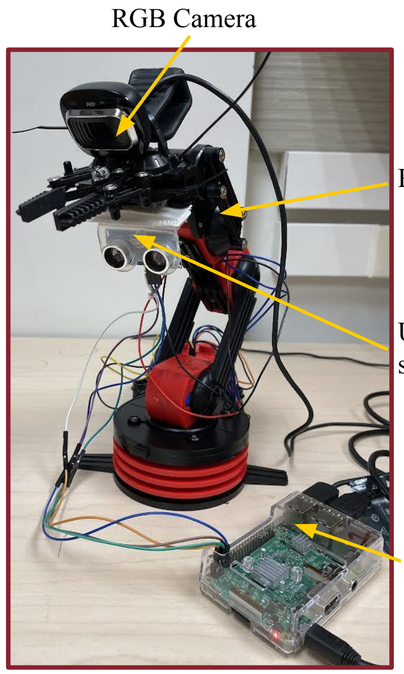


Figure 1: Robotic arm and sensors

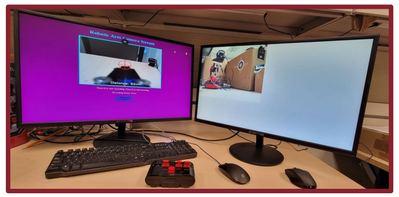


Figure 2: The interface and displays.

Methods & Results

1. The objective is for the participants to touch the center of the target with the end-effector of the robotic arm (Fig. 3)

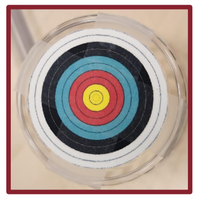


Figure 3: The target.

2. This experiment was done on 10 different participants and each participant would test with both conditions, but in different orders.
3. We tested for distance from target (Fig. 4), aim (Fig. 5), and time (Fig. 6).

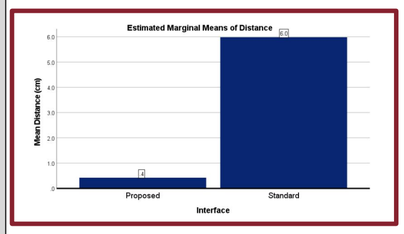
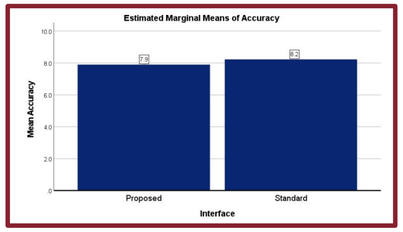


Figure 4: Mean distance from target with and without the augments $p<0.001$

Figure 5: The mean accuracy with and without the augments. ns*



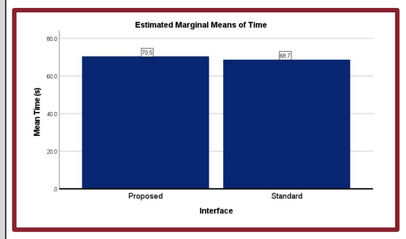


Figure 6: The mean time with vs without the augments. ns*

ns*: not significant

Results Analysis

The results are showing, that on average, the robotic arm will be much closer to the target with the visual augments rather than without them ($p < 0.01$). Both the mean accuracy and time were not significant to indicate that there was a difference or whether one interface is better than the other.

Next Steps for You & Advice to Future SHINE participants

The next steps for me is that I will continue to pursue the skills I have learned and seen in SHINE to be able to create my own personal projects and pursue my endeavors.

My advice to future SHINE participants is to be as involved with the optional assignments and meetings to be able to take more experiences out of SHINE.

Citations

[1] Arévalo Arboleda, S., Dierks, T., Rücker, F., & Gerken, J. (2021). Exploring the visual space to improve depth perception in robot teleoperation using augmented reality: the role of distance and target's pose in time, success, and certainty. In Human-Computer Interaction–INTERACT 2021: 18th IFIP TC 13 International Conference, Bari, Italy, August 30–September 3, 2021, Proceedings, Part I 18 (pp. 522-543). Springer International Publishing. doi: 10.1007/978-3-030-85623-6_31.
[2] Diaz, C., Walker, M., Szafir, D. A., & Szafir, D. (2017, October). Designing for depth perceptions in augmented reality. In 2017 IEEE international symposium on mixed and augmented reality (ISMAR) (pp. 111-122). IEEE. doi: 10.1109/ismar.2017.28.
[3] Kondo, D. (2021). Projection Screen with Wide-FOV and Motion Parallax Display for Teleoperation of Construction Machinery. Journal of Robotics & Mechatronics, 33(3). doi: 10.1007/978-3-030-85623-6_31.