Development of Vision Augmentation

Bryan Ramirez, Damian Barba, and Patrick Rodrigues
Innovation in Integrated Informatics (iLAB)
STEM Academy of Hollywood, Class of 2025
USC Viterbi Sonny Astani Department of Civil and Environmental Engineering, SHINE 2023

USC Viterbi School of Engineering

SHINE Summer High School Intensive in Next-Generation Engineering

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Introduction

In recent years, robots have become more prevalent in the Construction Industry. These robots are employed using a teleoperation interface deployed on remote construction sites. Complications arise regarding the efficiency and effectiveness of the robot, essentially its depth perception, aim, time, and workload.

Working on these nodi, we focus on augmenting the screen of the teleoperation interface by adding contours and details regarding its respective object target.

1. Added target
2. Added distance
3. Added color f(x)

Vision Augmentation

Objective & Impact of Professor's Research

Dr. Burcin Becerik-Gerber's and Dr. Lucio Soibelman's research revolves around understanding sensory information needs to improve teleoperation interfaces for remote construction robots. The research aims at understanding optimal sensory information from operators to propose the best teleoperation depending on the complexity and the environment. More on our research, we compared standard interfaces (i.e., control system like levers) to augmented interfaces (i.e., sensory operated systems).

This research may be used to:

1. Improve the depth perception, aim, accuracy, and time of the teleoperator

2. To inform the design of human-centered interfaces

Methods & Results

Brief: Prepare a robotic arm with a standard and augmented interface with an attached sensor; determine the difference between both interfaces.

Method:

1. Prepare robotic arm for use and testing, attach an ultrasonic sensor for distance and wire all to the raspberry pi. (Fig. 1)

2. Design the augmented interface using (Fig. 2) [SOURCE]:
   - Python: Program the raspberry pi, control applied sensors, and serve as a back-end for the website in which to host the augmented interface
   - Flask & OpenCV: Major Python modules to host the local server and add augmentation, respectively
   - JavaScript, HTML5, & CSS: Front-end development of local website and display augmented interface

3. Setup environment for experimenting (Fig. 3):
   - Setup target objects for the operator
   - Preface and details for context for the experiment

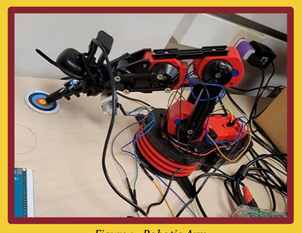


Figure 1. Robotic Arm

Figure 2. Augmented Interface (Website)

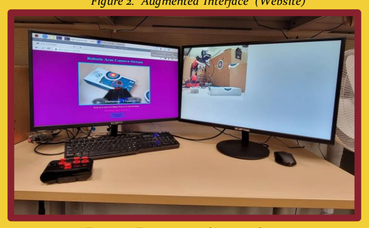


Figure 3. Environment Operator Setup

Results: After selecting ten operators, we gathered data regarding distance and time. Comparing the standard interface to the augmented interface (proposed), we saw a significance of $p < 0.001$ for distance (Fig. 5) and a ns* (not significant) for time (Fig. 4).

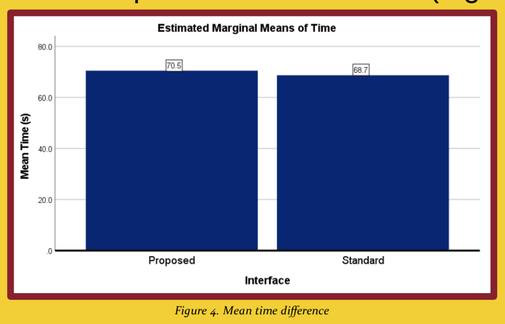


Figure 4. Mean time difference

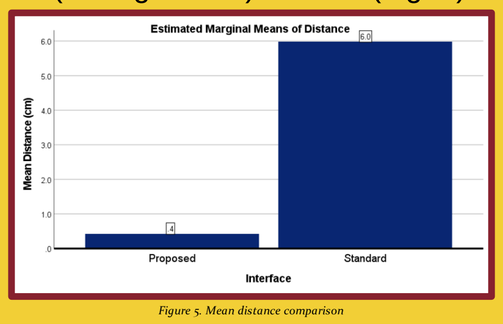
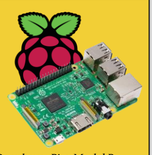


Figure 5. Mean distance comparison

Skills Learned

- Strengthened skills in python programming (and OpenCV) (Learned Flask, JS, CSS, and HTML5)
- By working full-stack on the augmented interface, I strengthened fundamentals in the raspberry pi, learned how to write cleaner code, and design using HTML5 & CSS.

Flask, Python, OpenCV



Raspberry Pi 3 Model B

Next Steps for You and Advice for Future SHINE Students

Next Steps for You

With my newly fostered knowledge, strengthened ability, and propensity, I plan to work and engage in more projects and research of my own or others. Projects and research revolving around what I've worked on in my lab: robotics, computer programming, design, web development, and engineering.

Advice for Future SHINE Students

Try to do as much as possible in your time during SHINE! Benefit from this program as much as possible; ask questions, innovate, and get involved. I encourage exploration of your lab and other labs; investigate what resources you can potentially incorporate into your lab from other labs. Most importantly, build your network to expand your potential and understanding.

Acknowledgements

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Citations

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