

## Introduction

Office workers, including engineers, architects, and designers, spend most of their work time at their computer desks and may assume stationary postures for approximately 11 hours per day [1]. Occupational injuries and illnesses associated with work-related musculoskeletal disorders (WMSDs) can happen in any industry [2]. With long periods in sedentary postures, the development of WMSDs becomes more likely. This ongoing project proposes an automated postural assessment of workers using simulations, computer vision, and machine learning.

## Objective & Impact of Professor's Research

Dr. Becerik-Gerber's research is in human-building interaction to meet the needs of occupants. By adjusting the room temperature to make workers more comfortable or automatically adjusting the room's brightness to a person's preference, office workers will be more productive.

Dr. Soibelman's research focuses on using information technology for economic development, construction management support, process integration during the development of large-scale engineering systems, information logistics, artificial intelligence, etc.

Patrick Rodrigues, my SHINE mentor, is researching how to use machine learning and computer vision (which is part of the artificial intelligence field) to create a program that will provide real-time information about a person's posture [3]. By doing this, a worker will be able to regulate their own posture and prevent developing chronic musculoskeletal disorders; which include joint pain, neck pain, back pain, and more. Currently, the project aims to find methods to increase the amount of training data by employing synthetic images from biomechanical models (Fig. 1).

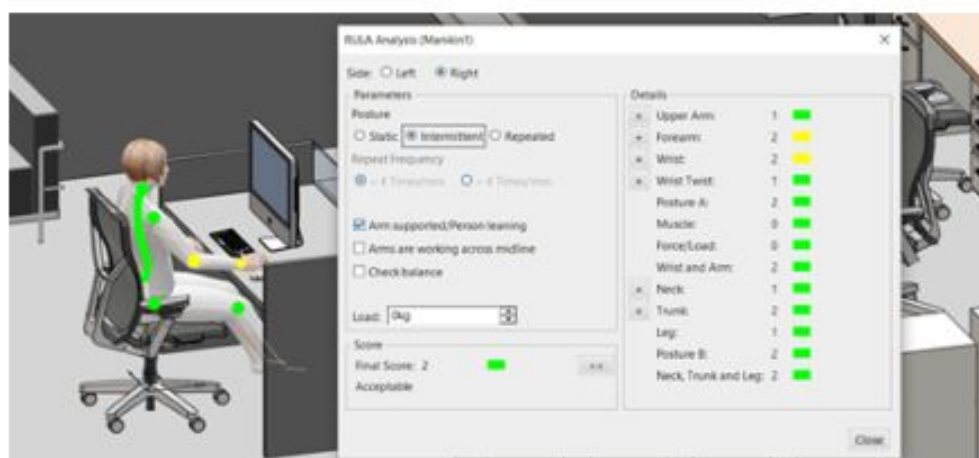


Figure 1: Image of simulated manikin posture with RULA score, or rapid upper limb assessment. PC: Clarise Grant

## Skills Learned

During my time in the civil engineering lab, I learned how to navigate new software such as 3D Experience and DELMIA. Within this software, I have learned how to create 3D modules and manikins to simulate natural office worker behavior. These models also produce supplementary data in the machine learning process. I received formal introductions to the Unity platform and virtual reality (VR) (Fig. 2).



Figure 2: Me trying out the virtual reality machine in the civil engineering lab building. PC: Patrick Rodrigues

Machine learning requires an immense quantity of data, which can be provided by simulations and synthetic images. This project taught me much about how ergonomics improves work life and how to evaluate a person's posture (Fig. 3) based on the RULA assessment.



Figure 3: Patrick participating in my experiment to collect postural data. The frontal view is on the left and the lateral view on the right. Both RGB images have been processed with OpenPose to locate and identify his joints. PC: Clarise Grant

I've learned many soft skills; how to be patient with trial and error, communicate my scientific understanding, both orally and in writing. I have learned about the research process, the importance of peer review, and how to take meaningful information from scholarly articles.

A surprising lesson I learned from adjusting the python code in integrated development environments, was that libraries update frequently. This piece of code was put together in 2019, based on code found on GitHub from 2016. Due to library updates, some pieces of code would not run since they were deprecated. Coding packages update often as well, so updating code is very important.

## How This Relates to Your STEM Coursework

This experience has given me a glimpse into the immersive field of scientific research. Before this internship, I didn't realize the depth of each scientific field. For example, I believed that civil engineering was about constructing public structures like buildings, roads, and industrial factories. However, I am now aware that fields like computer science, environmental science, and robotics can overlap with civil.

I now know how to create, develop, test, and reconstruct a pilot experiment from scratch. During my time in the civil lab, I constructed an interactive experiment (Fig. 4) that would give us time to capture images of natural human posture. It would also capture intentionally good or bad posture.



Figure 4: Screenshot of a digital 3D model of an office environment. Created by Patrick Rodrigues. PC: Clarise Grant

I can bring my classmates the tips methods to organize information like code, why "failure" isn't the end and that there is no progress without it, as well as how valuable using others' research to find solutions to problems is. My recent experience with time restraints and the consequences of procrastination can also be shared. In my sophomore year, I have the ability to be an active and reassured. Furthermore, I can share my experience with creating experiments.

## Next Steps

While I would love to return to the SHINE program and contribute to another research project, I plan on partaking in an EF Educational Tour to South Korea and Japan during the summer of next year. During the tour, I will get to see and possibly gain hand-on on experience with how robotics and engineering can be applied to today's problems.

I look forward to learning about other scientific fields such as mechanical and aerospace engineering, along with how they overlap with other scientific studies. If given another opportunity, I would be honored to come back to SHINE as an up-coming senior.

## Acknowledgements

I am very grateful that Dr. Becerik-Gerber and Dr. Soibelman for giving me the opportunity to participate in their lab. I am also grateful to my mentor, Patrick Rodrigues, for teaching me about a field that I barely knew and the importance of ergonomic studies. I would like to thank Dr. Mills and Marcus Gutierrez, my Center Mentor, for assisting me when my mentor was sick.

I am thankful to Michelle Emelle, Monica Lopez, and the rest of the SHINE team for this irreplaceable experience. I also want to acknowledge the generosity of Ms. Gross and Fiserv, Inc. for providing me with a scholarship.

## References

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