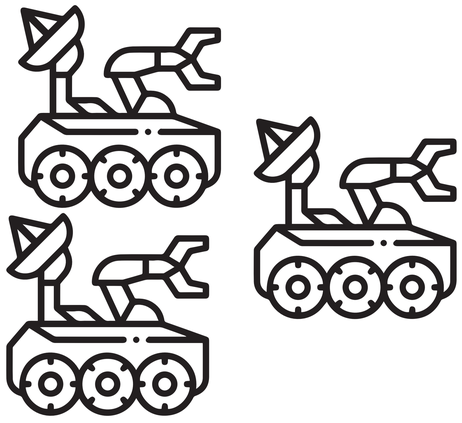
roboVR: A Mixed Reality Simulation for Blind and Low Vision Students

Carleton University

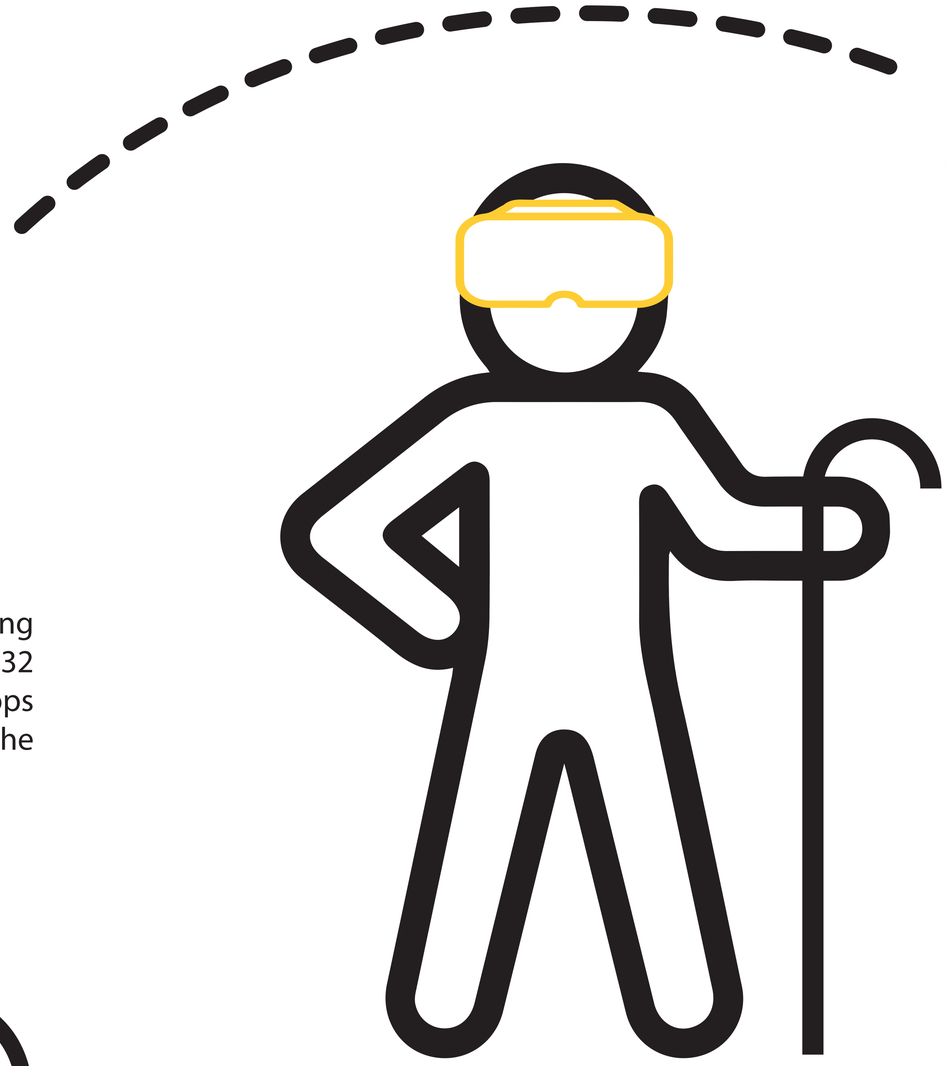
NYU SHANGHAI

This research explores the potential of combining virtual reality (VR) and robotic technologies to create a safe and interactive learning environment for people who are blind and low vision (BLV). The paper presents a case study called roboVR, which integrates motion capture, obstacle avoidance robots, and VR to simulate real-world scenarios for blind and low vision users. The goal is to provide a realistic training environment for individuals to navigate unfamiliar spaces, such as streets or metro stations. The research team utilized OptiTrack cameras and ESP32 robots to capture real-world position data and stream it to Unity for creating the VR environment. The results suggest that digitally augmented experiences can break down physical barriers and offer new possibilities for training and schooling.



Support Bots

Robots with motors and sensors, running firmware (based on Arduino ESP32 microcontroller), simulating physical props with simple prototyping materials in the environment.



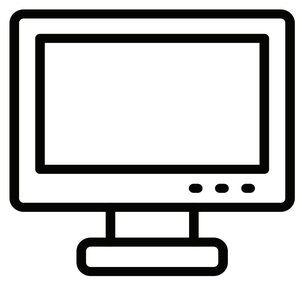
We collaborated with an BLV instructor to design an environment that has spatial audio, physical props, and visual keys that simulate real life experiences.

Motion Capture

Infrared cameras (Optitrack) keep track of the position of infrared markers mounted on the headset and the physical robots.

Server

The robots communicate with the rest of the system using a Message Queuing Telemetry Transport (MQTT) server, a machine to machine protocol that allows to publish their sensor inputs and suscribe to signals.



Game Engine

The virtual environment is rendered using a real time 3D game engine (Unity) that communicates with the MQTT server (Shiftr), and the motion capture software (Motive).

Future Work

- Run experiments with students with disabilities to validate roboVR focusing on independent walking, road recognition, and the use of white canes and understanding the users' interaction, and impressions of the system.
- Add interactive scenes such as asking for help in a crowd, subway station navigation, taking a lift, and locating blind path.

Rodolfo Cossovich
Carleton University
rodolfo.cossovich@cmail.carleton.ca

Antoine E. Oury
NYU Shanghai
vpo204@nyu.edu

Haoquan Wang
NYU Shanghai
hw1882@nyu.edu

Karen Cochrane
Carleton University
karen.cochrane@cunet.carleton.ca