TEXAS STATE
INGRAM SCHOOL OF ENGINEERING

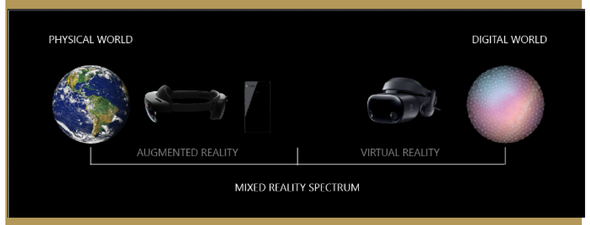
E2.02 – Mixed Reality Controller for Rover

A mixed reality controller to provide first responders the opportunity to teleoperate a fire-bot. This will allow them to control the autonomous fire-bot in case of malfunction or special use cases.

Motivation

According to the National Fire Protection Association, they estimate that there is one home fire-related death that occurs every three hours.[1]

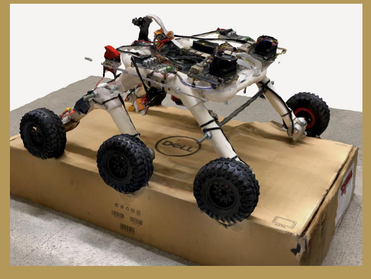
What is Mixed Reality?



"Where devices exist on the mixed reality spectrum" by Microsoft

Mixed reality is the interaction of holograms overlayed in your physical environment.

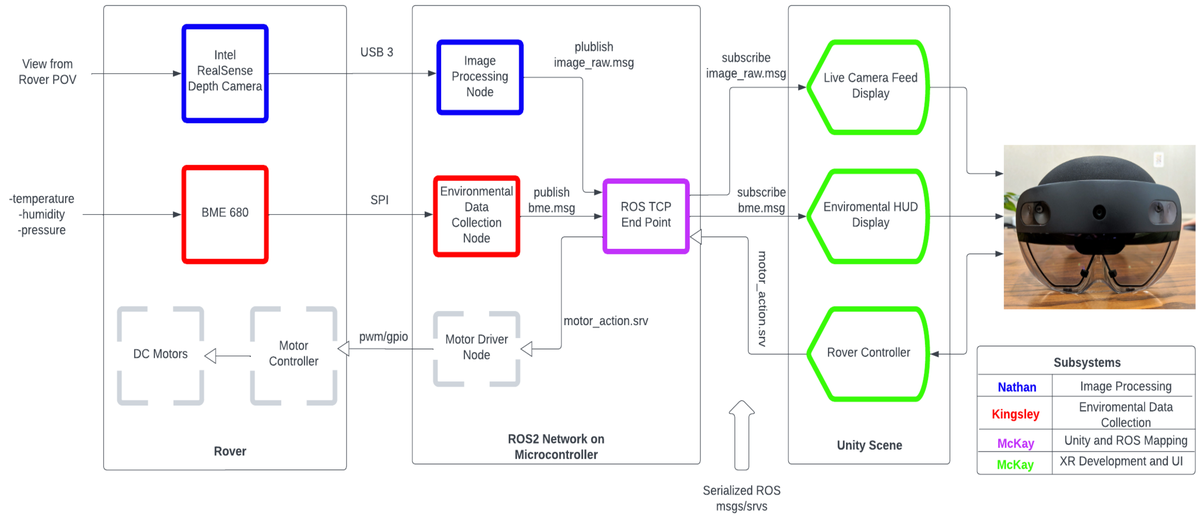
What is the Fire-Bot?



An autonomous rover prototype designed to go into burning buildings.

[1] According to the National Fire Protection Association

Block Diagram



Subsystem Testing Results

Image Processing

Testing Method	Pass/Fail
Camera feed displays to monitor	PASS - [640,480]
ROS2 frequency check	PASS - 30 FPS
Quality level of Compression	PASS - 10
Grayscale imaging feature	PASS

ROS2 to Unity Mapping

Test	Description	Results
User Input Response Time	Latency from user input to rover functionality	21 ms
Connection Success	Sending/Receiving ROS messages to/from microcontroller and Unity scene	PASS 100%
Range Test (Inside/Inside)	Furthest distance that a user can control the rover	138 ft
Range Test (Inside/Outside)		168 ft

Environmental Data Collection

Requirement	Method	Pass/Fail
Temperature	Tested sensor durability through stability and range tests for temperature endurance and limits.	-40°C to 85°C PASS
Pressure	No range testing on this because of the altitude access, but it had a stable air pressure in all temperatures.	300 hPa to 1100 hPa with +/- 0.12 PASS
Humidity	Placed the sensor in a stable humidity environment and record the humidity readings over an extended time	0% to 100% with +/-3 accuracy PASS

XR Development & UI

Test	Description	Results
User Testing	7 users were chosen to test the application and were asked a series of questions. • Were you confident that the camera feed could be used to navigate the rover? • Were you able to effectively see and utilize the environmental data display? • Were you able to easily understand and use the controller provided?	Camera Feed 7/7 PASS Environmental Data Display 6/7 PASS Controller 7/7 PASS
Customer Satisfaction	Asked sponsor and advisors to score each requirements and overall satisfaction of the user interface	Avg Overall Scores out of 10: CF = 9.25 PASS EDD = 9 PASS CTRL = 8.5 PASS OVR = 8.5 PASS

Team HoloRover



Kingsley Nathan McKay

Requirements

- Control a rover's movement remotely via the HoloLens 2
- Provide a camera feed to the user
- Show environmental data from the BME module on the rover

Senior Design Day Demo

Users shall put on the HoloLens 2 headset and control a rover remotely. One will be able to utilize the live camera feed on the rover to navigate around the room.

Project Handoff

This project is intended to be handed off to future researchers to keep improving the application. Some of the future work to be incorporated is to integrate the solution to the FireBot.

Acknowledgements

Project Sponsor: Dr. Semih Aslan
Faculty Advisor: Dr. Damian Valles and Fawzi Behmann