# Developing a Control Room in Virtual Reality to Improve Underwater Remotely Operated Vehicle Piloting

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Abstract

We developed a prototype virtual reality (VR) control room to streamline underwater remotely operated vehicle (ROV) operations during missions. Typical ROV control rooms consist of a wall of fixed monitors, each displaying a separate piece of telemetry data. Our prototype displays this telemetry data over live footage from the ROV's 180°, 4K stereo camera, creating an immersive multi-user 3D VR experience, enhancing piloting and pilot-scientist collaboration.
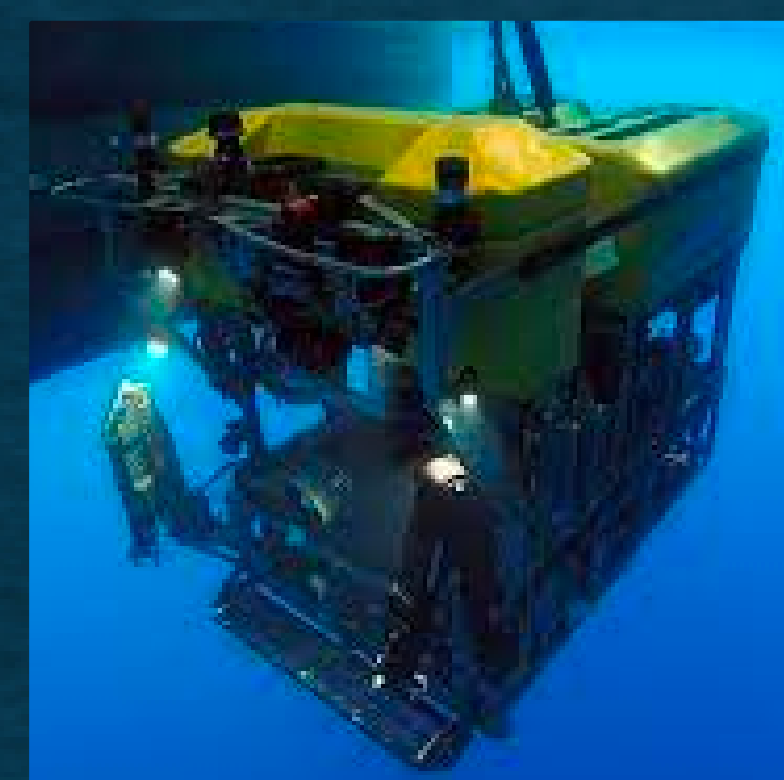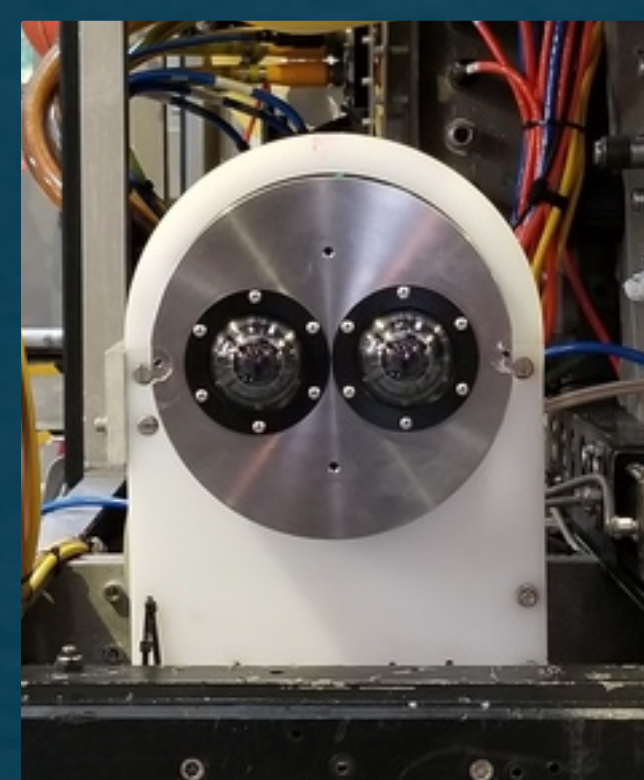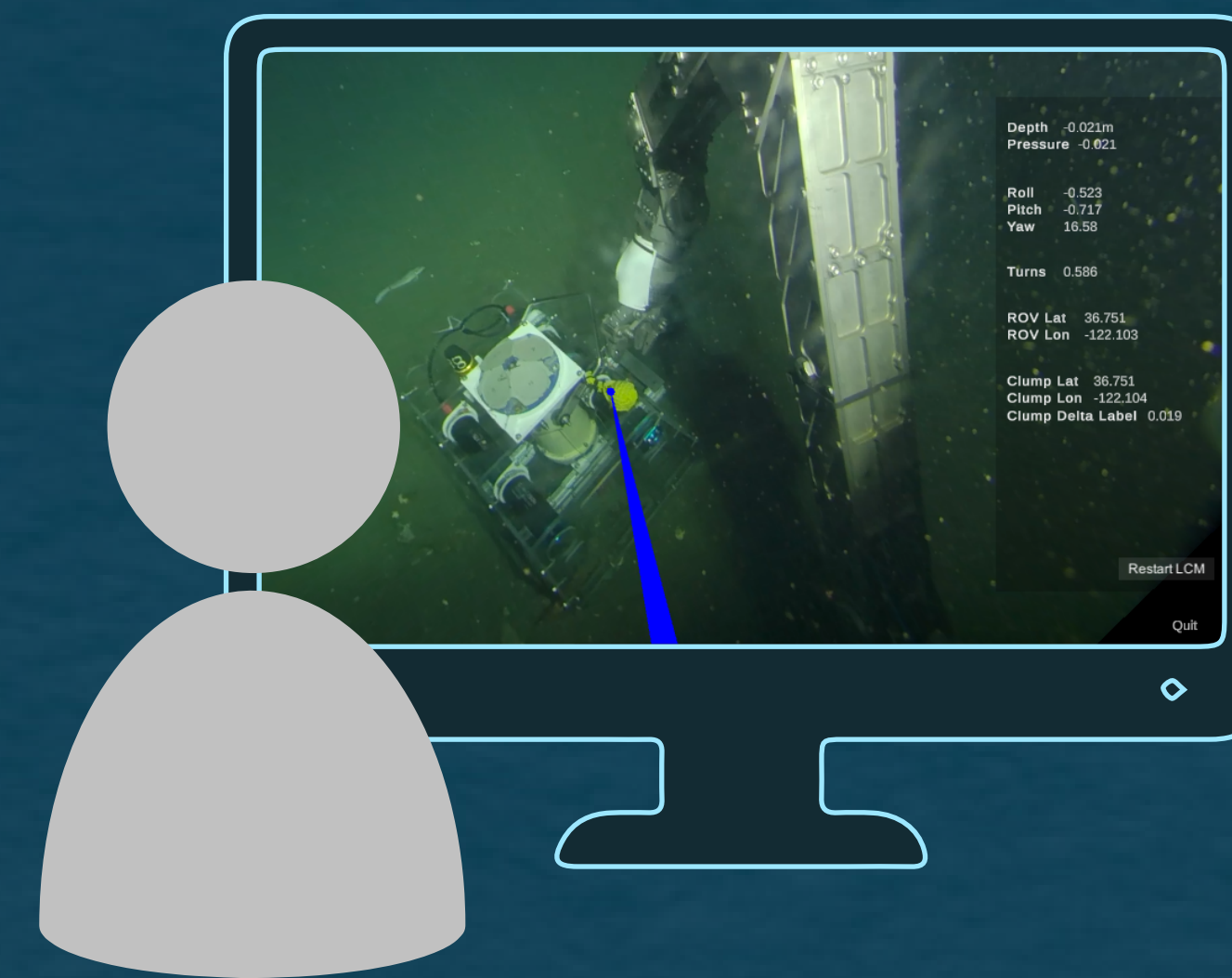
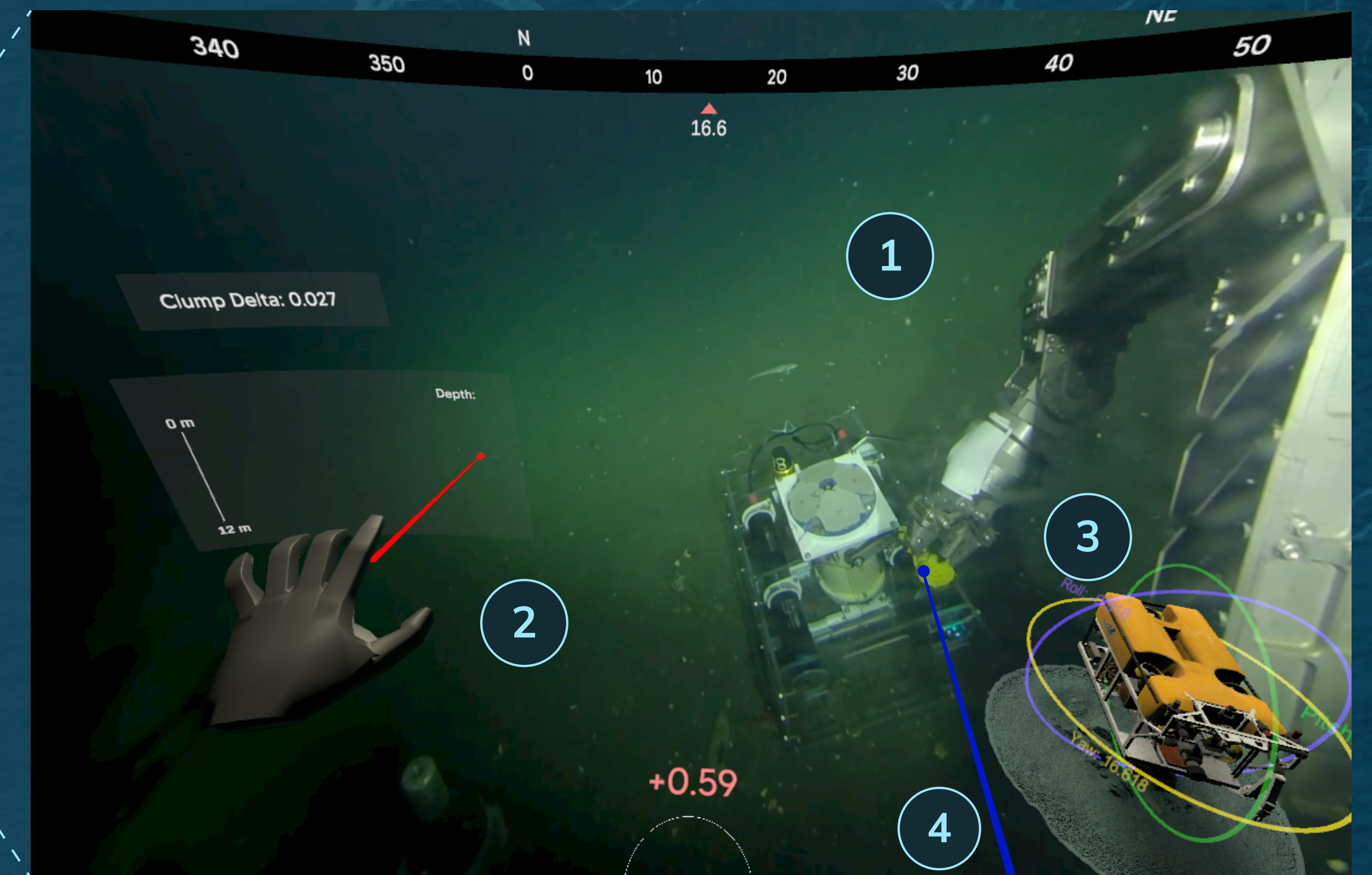ROV   Camera   Control Room

Prototype

Scientist
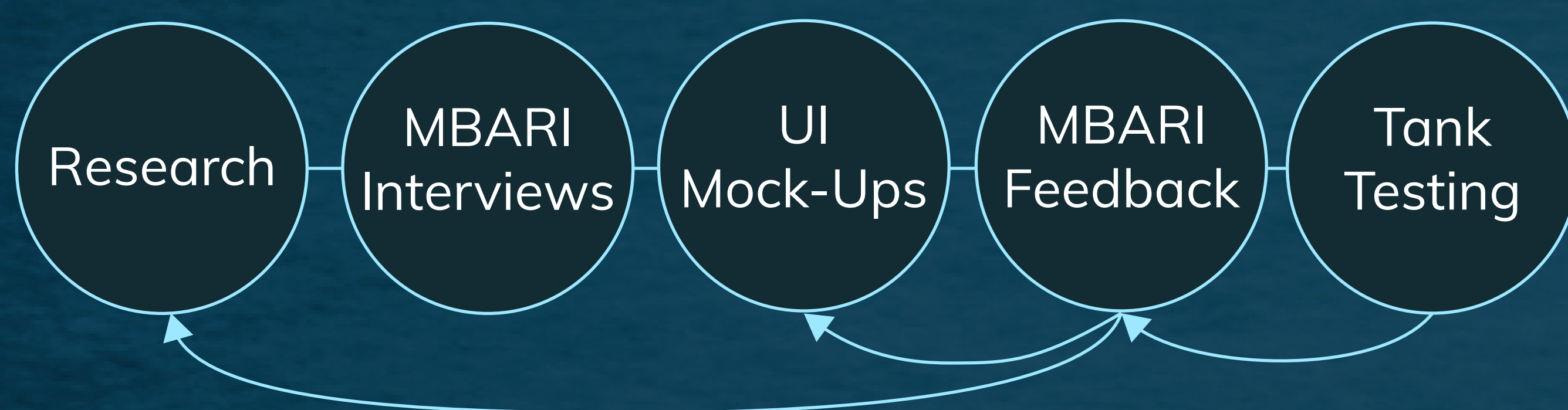Digitally selects points of interest for exploration

Pilot
Controls ROV while wearing VR headset

340   350   N   0   10   20   30   40   50
16.6
Clump Delta: 0.027
0 m   Depth:
12 m
+0.59
1
2
3
4

Design Process

Research → MBARI Interviews → UI Mock-Ups → MBARI Feedback → Tank Testing

Features

1. **Live stereo footage**
   creates an intuitive sense of scale with depth perception

2. **Hand-based control**
   allows pilots to easily reconfigure UI elements

3. **3D data overlays**
   provide pilots with live telemetry data in a novel format

4. **Multi-user support**
   helps scientists communicate points of interest to pilots

Impact

Makes piloting more intuitive
by giving pilots full spatial awareness

Increases flexibility
by making displays reconfigurable

Enables advanced features
by consolidating data streams

Enhances collaboration
by including collaborative features for pilots and scientists

Future Work

Improve UI
based on further pilot-scientist testing in MBARI's test tank

Test in the deep sea
to ensure the system is robust

Integrate more advanced features
such as automated specimen recognition and tracking

System Architecture

Ship

ROV

ROV Data → LCM Network → LCM Packets → Control Room PC → unity → VR Application

Stereo Camera Feed → Capture Card → Camera Feed → Control Room PC → Data Overlays & UI → Desktop Application

Dewarped Camera Image

Acknowledgements