The background is a dark blue gradient with stylized illustrations of an underwater environment. On the left, there is a vertical branch of coral. In the center and right, there are larger coral structures and a school of fish swimming. Small white circles representing bubbles are scattered throughout the scene.

# Virtual Reality Visualization for Underwater AUVs




Amanda Lau, Catzby Paul, David Zhao

August 7th, 2024

# The Team




Amanda



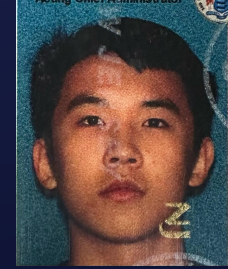
-  Marlboro, NJ
-  Rising Junior at Rutgers
-  Mechanical Engineering and Computer Science




Catzby



-  Hillside, NJ
-  Rising Junior at Rutgers NB
-  Data Science with minor in Math

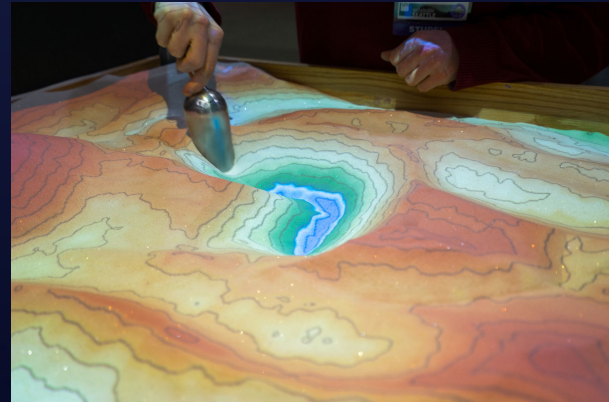
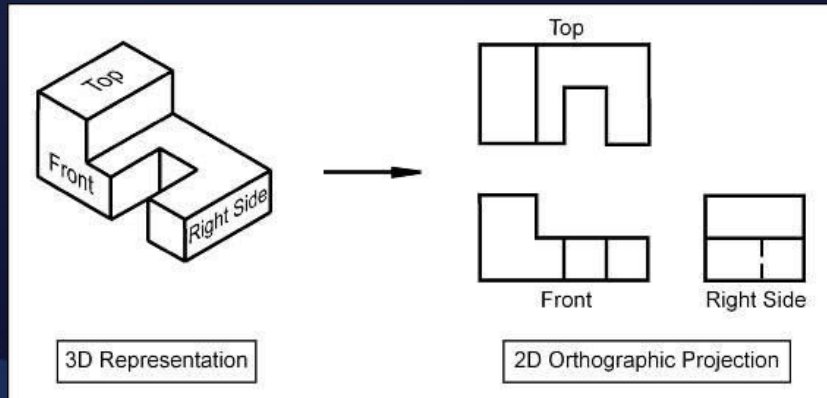
David



-  East Brunswick, NJ
-  Rising sophomore at Rutgers
-  CS and Math

# Project Motivation

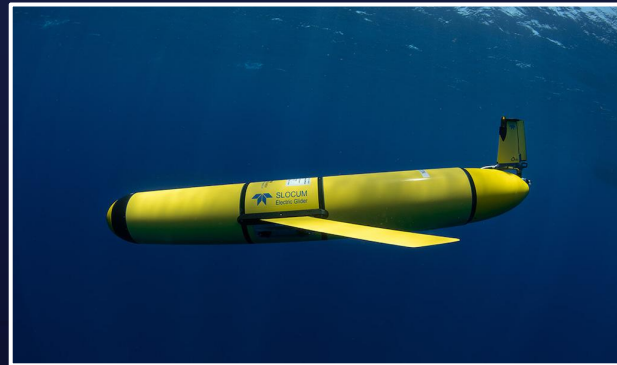
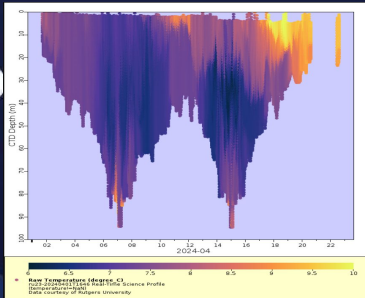
- Viewing 3D data on a 2D screen hides many details
- Need for immersive and interactive exploration of complex datasets



# Project Objective and Technology

Goal: To develop an innovative and user-friendly VR visualization tool for 3D glider data from the Rutgers Center for Ocean Observing Leadership (RU-COOL).

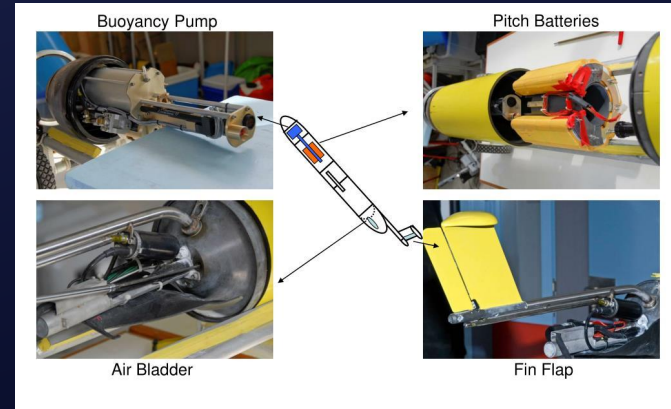
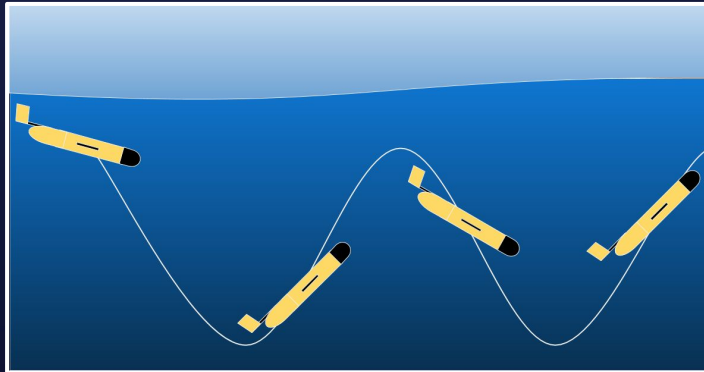
- Data Source: ERDDAP database, RUCOOL gliders
- Technology: Unity Game Engine with C# scripting, Meta Quest 3, Meta XR All-in-One SDK



# Unity

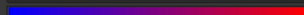


# About the Glider

- Mission: Ocean Monitoring
- Integrated Instrument Platform
- Propulsion: Buoyancy changes with ballast engine

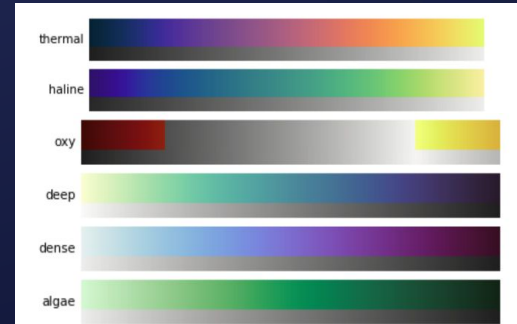




# Loading Process

Dataset_Id	ru43-20240612T1658-profile-sci-rt
Vars	chlorophyll_a, pH, temperature, salinity, oxygen_concentrati
Sampling Rate	5
Var Gradient	
Date Time Gradient	
Camera Rig	<input checked="" type="checkbox"/> OVRCameraRig (OVR Camera Rig) 
Map Width	8000
Map Length	4000
Map Height	500
Download New Data	<input type="checkbox"/>
Max Interpolation Length	20
Gradient File	cmocean.json

Using user parameters,  
access and download data  
from ERDDAP



User Specifications

Web Scraping

Data Reading

User inputs basic  
parameters:

- Dataset ID     b
- Variables of interest
- Gradient file

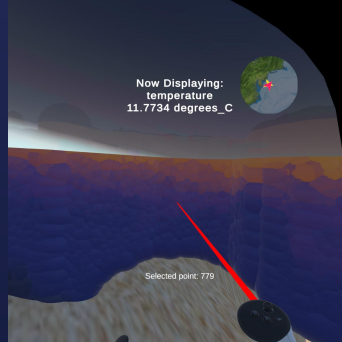


1	latitude	longitude	depth	sci_water_temp
2	degrees_north	degrees_east	m	Celsius
3	16.434225	-68.99541666666667	0.029822633	29.2797
4	16.434225	-68.99541666666667	NaN	NaN
5	16.434225	-68.99541666666667	NaN	NaN
6	16.434225	-68.99541666666667	NaN	NaN
7	16.434225	-68.99541666666667	NaN	NaN
8	16.434225	-68.99541666666667	0.03976351	29.2876
9	16.434225	-68.99541666666667	NaN	NaN
10	16.434225	-68.99541666666667	NaN	NaN
11	16.438014990077303	-68.99273847628305	NaN	NaN
12	16.43885901964369	-68.99214204414943	NaN	NaN
13	16.439088333333334	-68.99198	NaN	NaN

Data is read from CSV and  
stored as runtime variables  
Gradients are assigned to  
variables

# Loading Process (cont)

Data drawn relative to the 3D world map  
User is teleported to position of data

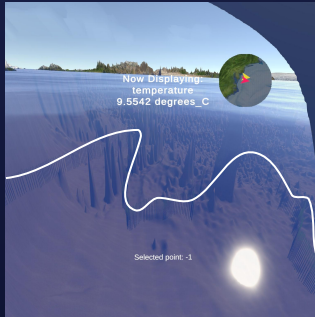


Downloaded data is retained  
Subsetted data is retained in CSV format

Plotting and  
Rendering

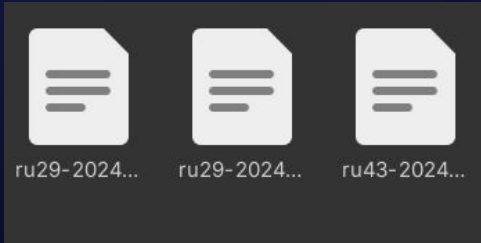
Interactive  
Environment

Application End



User can interact with the world

- Toggle variables
- Explore the world
- "Ride" the glider
- Save data subsets



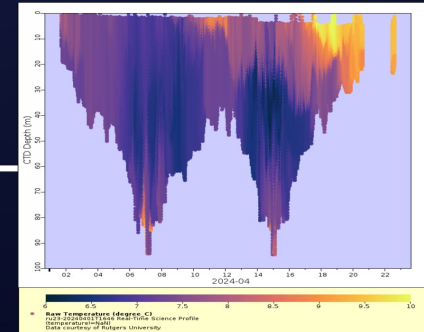
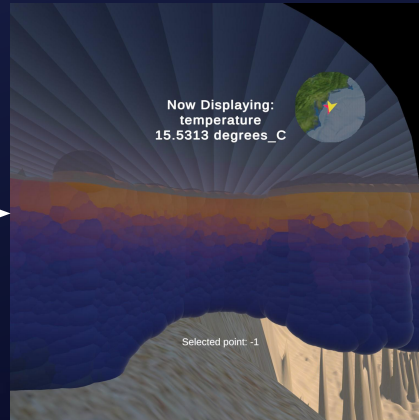
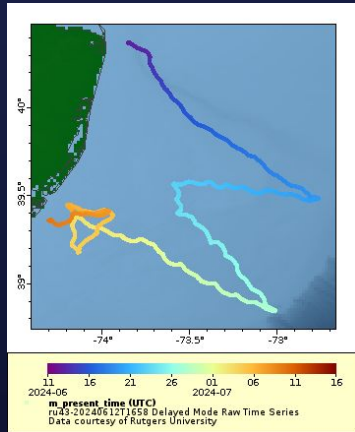
# Demo Video





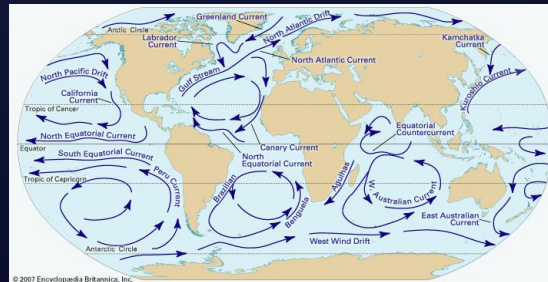
# Potential Applications

- Visualization tool for the RUCOOL team
  - Discussed implementing features for observing data
- Mission planning tool for glider deployments
- Interactive learning tool for students



# Future Plans and Improvements

- Optimization of data extraction and path creation
- Gauges to display current data
- Implementing ocean current patterns
- Visualization of marine organisms
- Adding a time scrubber for more flexible time forwarding and rewinding



# Acknowledgements

We would like to thank Ivan Seskar, Jennifer Shane, and Dr. Wade Trappe for guidance, as well as the researchers at RU-COOL for their data expertise. This work was supported by RU-NB CSI Scarlet Vision.