# TEC-V

## Milestone 5

**TEC-V (Topographic Exploration Cave Vehicle**


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**2. Faculty advisor from CSE: name and email address.**

- Marius Silaghi, *Professor | Electrical Engineering and Computer Science*
  - msilaghi@fit.edu

**3. Client: name and affiliation**

- Dr. Stephen Wood, *Professor | Ocean Engineering and Marine Sciences*
  - Program Chair for Ocean Engineering

**4. Date(s) of Meeting(s) with the Client for developing this Plan:**

- **Team Meetings:** Mondays 12 p.m.
- **Client Meetings:** Monday 2-11 at 12 p.m.
- **Advisor:** Thursday 3-14 at 3 p.m.

- **Progress of current Milestone (Progress Matrix):**

| Tasks | Completion% | Michael | Zealand | To Do |
|---|---|---|---|---|
| **Multi Fild Upload** | **60%** | **60%** | **0%** | **Testing** |
| **Styling** | **90%** | **90%** | **0%** | **Gain user Feedback** |
| **Forward Facing Sonar** | **30%** | **30%** | **0%** | **Review File Types and API** |
| **Autonomy** | **80%** | | **80%** | |

**6. Discussion (at least a few sentences, ie a paragraph) of each accomplished task (and obstacles) for the current Milestone:**

- **Task 1: (Multi File Upload)**

  Our primary aim was to alter our system's file upload and transcription capabilities, moving beyond the constraints of the previous version. Formerly, our system only accepted TXT files containing arrays of coordinates (X, Y, Z), which were then displayed on the screen. Now, our plan is to enhance versatility by enabling users to upload various file formats and merge them for comprehensive data collection. This expansion aimed to enrich our dataset and provide a more cohesive understanding of the environment.

  Central to this endeavor was the development of data processing algorithms capable of handling diverse file types and mitigating potential sources of error. We planned to address challenges such as craft rotation, turns, elevation changes, and other factors influencing data accuracy. By implementing some form of error detection and correction mechanisms. Overall, aimed to ensure the integrity of the collected data, empowering users with reliable insights.

- **Task 2: (Application Styling)**

  In this milestone, a significant overhaul was undertaken to enhance the user experience by revamping the application's layout. Previously, all options and buttons were situated on the left side of the screen, which posed usability challenges. To address this, we strategically redesigned the layout, relocating essential functions to the left side while visually impactful components remained on the right. This reorganization aimed to streamline navigation and improve accessibility, ensuring users could easily access key features without visual clutter. **See images 1 & 2.**

  Furthermore, responsive design improvements were implemented to address concerns raised by members of the ocean engineering team regarding screen size compatibility. By optimizing the webpage's responsiveness, we ensured a seamless experience across various devices and screen sizes, enhancing usability and accessibility for all users. Additionally, efforts were made to establish a cohesive brand identity by creating and integrating the team logo into the website, further enhancing the overall aesthetic appeal and professionalism of the application.

- **Task 3: (New Sonar)**

A significant challenge arose concerning the upgrade of the AUV's sonar system from the Ping360 to the Omniscan 450FS. The Ping360 operates by emitting signals along a flat plane, and upon detecting an object, it receives an echo signal, providing data in the form of a 1200-variable array with values ranging from 0 to 255 based on signal strength. However, due to the sonar's angle dependency, this method often yielded inconclusive and unreliable data, necessitating the development of an algorithm to sift through the array and identify likely variables. **See images 3 & 4.**

To address these limitations, our team aimed to transition to the Omniscan 450FS sonar, which would increase variable collection capabilities, thereby enhancing the accuracy and depth of our data acquisition process. However, despite extensive efforts and countless hours spent working with the new sonar system, we encountered significant obstacles. Specifically, we faced challenges in both reading the outputted sonar files using the current application and establishing a direct connection with the sonar to retrieve data, similar to our approach with the Ping360.

Navigating these hurdles proved to be a complex endeavor, requiring problem-solving and close collaboration among team members. Despite the setbacks encountered with the Omniscan 450FS, our team remains committed to exploring alternative solutions to further enhance the capabilities and reliability of our AUV's data collection system. **See images 5 & 6.**

- **Task 4: (Implementing Autonomy in the Robotic Simulation)**

The development of a robotic simulation featuring integrated sensor technology marked a significant achievement in Milestone 5. Utilizing Gazebo—an open-source robotics simulator known for its robust yet occasionally challenging performance—we successfully created a virtual robot equipped with advanced sensory capabilities. The robot, in simulating a “pool”, was able to avoid all obstacles in the way. The robot currently always chooses left, which we hope to improve upon in the next milestone.

The simulated robot is outfitted with three distinct types of sensors, each playing a crucial role in obstacle detection and navigation:

1. **IMU Sensor:** The Inertial Measurement Unit (IMU) is pivotal for determining the robot's orientation by providing quaternion outputs. It also measures angular velocity across three axes (X, Y, Z) and tracks linear acceleration, facilitating precise movement control.
2. **Contact Sensor:** Integrated into the wall, this sensor triggers an alert upon making contact with another object. This feature is instrumental in collision detection, enabling the robot to identify and respond to physical barriers in its immediate environment.
3. **Lidar Sensor:** Standing for "Light Detection and Ranging," the Lidar sensor is essential for obstacle detection. It measures the distance to surrounding objects, including walls, allowing the robot to navigate its environment with heightened awareness and accuracy.

The robot successfully used the above sensors to navigate the environment. At this moment it will always choose left to avoid the obstacle, thus in the next milestone the goal is to improve in these to choose the best option among left or right.

**Image 1: ()**

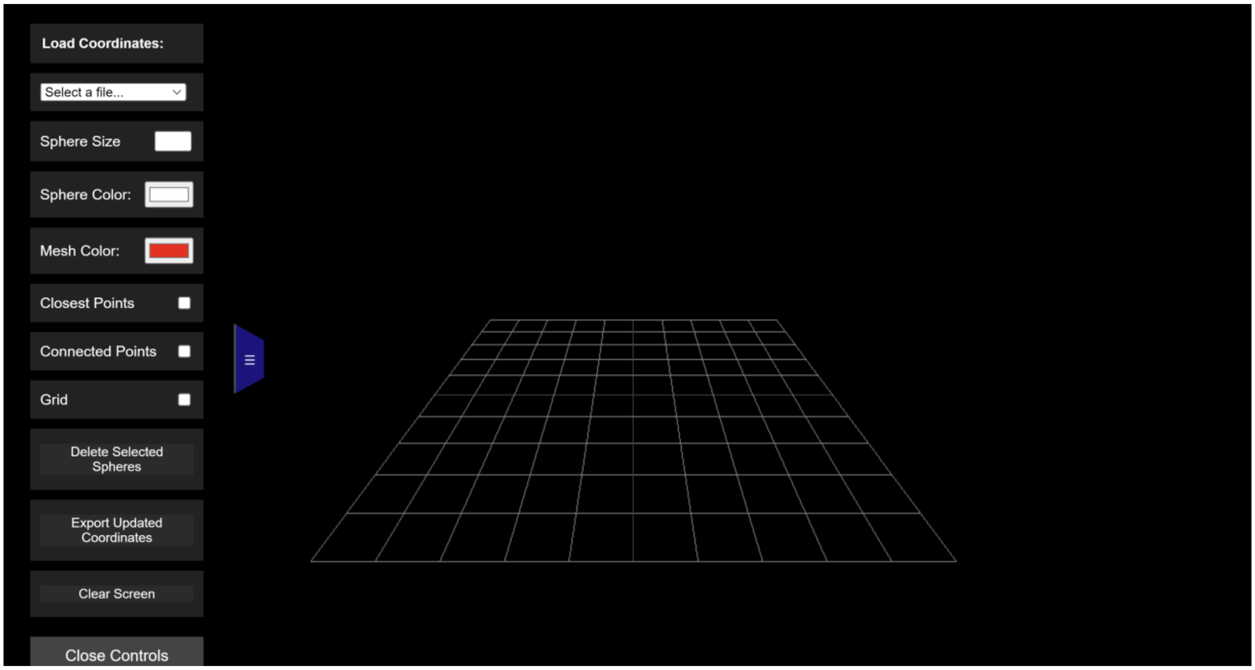
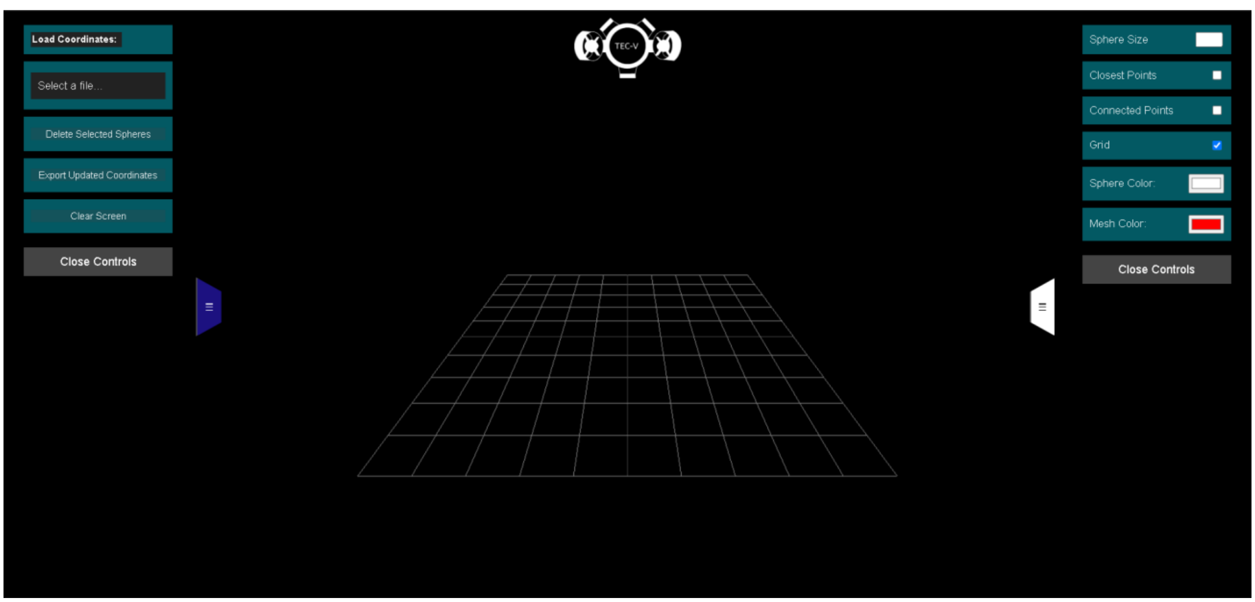



**Image 2: ()**




- Image 1 shows the previous version of the webpage layout and Image 2 shows the updated UI.

**Image 3: ()**

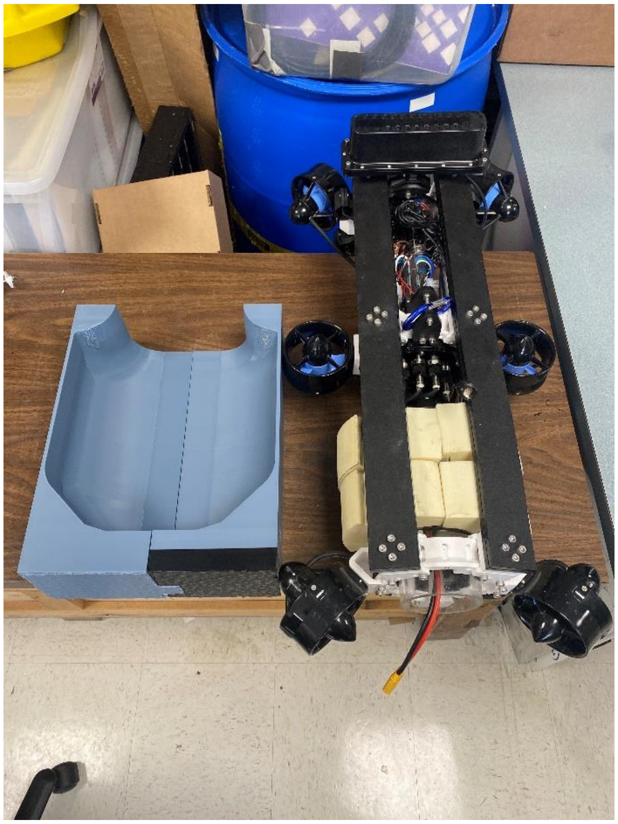
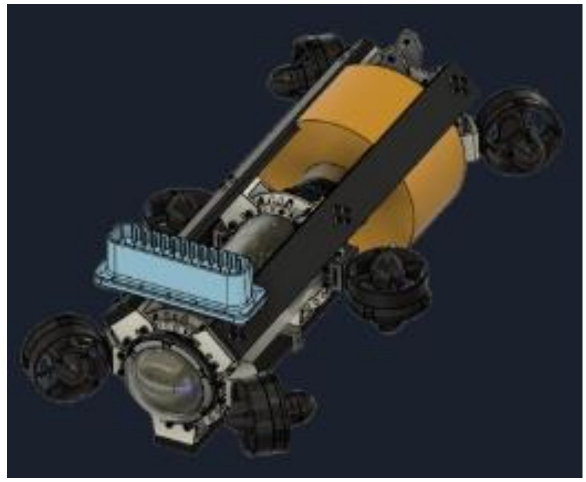
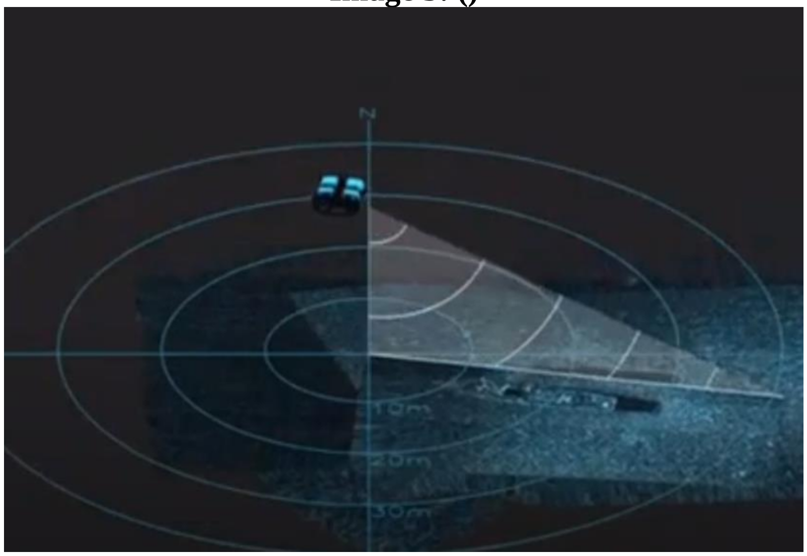


**Image 4: ()**



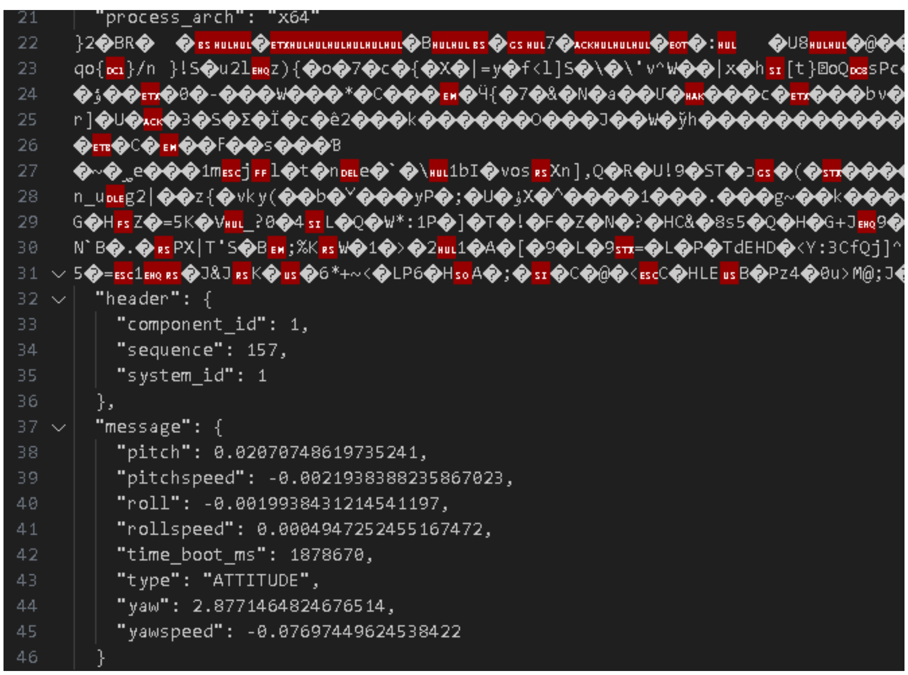
- Images 3 & 4 shows the current craft with the new sonar mounted on the top front.

**Image 5: ()**




- Image 5 shows the software designed by Blue Robotics working with the Omniscan 450.

**Image 6: ()**




- Image 6 shows the ".sl2" filetype format being read in a standard text editor.

**7. Discussion (at least a few sentences, ie a paragraph) of contribution of each team member to the current Milestone:**

**Mike Dowling:**

1. **Multi File Upload:** Designed a new framework to allow for multi-file upload and cohesion of data properties.
2. **Styling**: Worked with users and team members to gain feeback and improve current UI for Cloud Plot Webpage.
3. **Forward Facing Sonar:** Worked with the team and understanding API documentation on the sonar to try and parse the files or control the sonar directly.

**Zealand Brennan**

1. **Autonomy:** Gazebo has been instrumental as a testing ground where we've initiated partial pathing experiments using existing datasets. These initial steps lay the groundwork for developing partial navigation algorithms within the robotic simulation environment.

**8. Plan for next Milestone:**

| Task | Michael | Zealand |
|---|---|---|
| **Testing** | **Gain valuable data from an actual cave system and see how well we can rebuild it.** | |
| **Homepage Website Redesign** | **Simplicity and usability must be altered.** | |
| **Cloud Plot Webpage** | **Determine possible risks and solutions to vast datasets.** | |
| **Autonomy** | | **Implement decision making** |

**9. Discussion (at least a few sentences, ie a paragraph) of each planned task for the next Milestone or "Lessons Learned" if this is for Milestone 6**

- **Task 1: Testing**

  - For Task 1, our primary objective revolves around conducting comprehensive testing using the Ping360 sonar device. We've made the strategic decision to mount the sonar at the rear of the craft, altering its orientation to enable more effective data collection, particularly within cave environments. This adjustment aims to optimize the sonar's scanning capabilities, allowing for a more thorough examination of the surroundings. Testing serves as a pivotal phase in our project, offering valuable insights into the performance and reliability of both the website interface and data collection methods.

    Throughout this milestone, we plan to conduct a series of tests across diverse bodies of water, including the college's pool, Anchorage Harbor (owned by Florida Tech), and potentially a cave system in Florida pending official permission. Each test will be meticulously planned and executed to ensure comprehensive data gathering and problem-solving. By conducting multiple tests in varied environments, we aim to identify and address any potential issues or errors, refining our approach and enhancing the overall effectiveness of our data collection methods. These tests are crucial for validating our system's capabilities and ensuring its readiness for real-world deployment.

- **Task 2: Homepage Website Redesign**

  - Task 2 focuses on the redesign of the homepage website to improve usability and user experience. While the current homepage may be visually appealing, feedback from our team and stakeholders has highlighted usability shortcomings. Our objective is to create a more user-friendly and informative homepage, presenting essential details about the craft's specifications, progress updates, and related information in a cohesive and accessible manner. While not directly impacting project functionality, enhancing the homepage contributes to the overall professionalism and accessibility of our project presentation, potentially increasing engagement and understanding among stakeholders. Although this task is not considered critical, we recognize its importance in providing a positive first impression and facilitating effective communication of project details to our audience.

- **Task 3: Cloud Plot Webpage**

  - Task 3 involves the development of the Cloud Plot Webpage, which will play a crucial role in our data analysis process. Leveraging the data collected from our testing endeavors, we aim to implement a multi-file system within the webpage to enhance positioning accuracy and aid in the interpretation of dive data. This stage represents a significant advancement in our project, as it will enable us to effectively visualize and analyze the data gathered during dives. Our goal is to ensure seamless functionality of the system, allowing users to easily access and interpret the collected data.

    Throughout this task, our team will focus on refining the webpage's functionality and addressing any potential issues that may arise during testing. By conducting thorough testing and validation processes, we aim to identify and remedy any discrepancies or errors within the system promptly. Additionally, we will work to optimize the user interface to enhance user experience and facilitate efficient data analysis. Ultimately, the Cloud Plot Webpage will serve as a valuable tool for our team, enabling us to extract meaningful insights from the collected data and make informed decisions moving forward.

- **Task 4: Autonomy**

  - Building upon the achievements of Milestone 5, our focus for the next milestone will be to enhance the decision-making capabilities of the simulated robot in the virtual environment. Specifically, we aim to improve the robot's navigation strategy by implementing a more sophisticated path planning algorithm. Currently, the robot always chooses to move left, limiting its ability to navigate effectively in complex environments. To address this limitation, we will develop and integrate a dynamic path planning algorithm that considers multiple factors such as obstacle proximity, terrain complexity, and desired destination.

    Additionally, we will explore ways to optimize the performance of the integrated sensors, particularly the Lidar sensor. While the existing sensor setup provides valuable data for obstacle detection, there is room for improvement in terms of accuracy and efficiency. We will conduct experiments to fine-tune the sensor parameters and calibration settings, ensuring optimal performance in various environmental conditions. By refining the sensor integration process and enhancing the robot's decision-making capabilities, we aim to create a more robust and versatile robotic simulation platform for future testing and experimentation.

**10. Client Feedback on the current milestone:**

- The feedback from the client on this milestone has been overwhelmingly positive, particularly highlighting the enhanced user interface's simplicity and efficiency in visualizing scanned data. They have expressed appreciation for the intuitive functionalities introduced, such as the dynamic manipulation of the cloud plot with features that allow for varying viewing angles, detailed zoom capabilities, and the selective removal of spheres for optimized analysis. Moreover, the ability to export the updated plot for in-depth external examination has been recognized as a significantly useful feature. The client has commended the streamlined experience and the comprehensive suite of tools provided, which significantly improved the overall process of data visualization.

**11. Faculty Advisor feedback on each task for the current milestone:**

- **a.**
- **b.**
- **c.**
- **d.**

**12. Approval from Faculty Advisor**

a. "I have discussed with the team and approved this project plan. I will evaluate the progress and assign a grade for each of the three milestones."
b. Signature:_______________________________________________ Date:

**----- on a separate page ---------**

**13. Evaluation by Faculty Advisor**

a. Faculty Advisor: detach and return this page to Dr. Chan (HC 214) or email the scores to pkc@cs.fit.edu
b. Score (0-10) for each member: circle a score (or circle two adjacent scores for .25 or write down a real number between 0 and 10)

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Michael Dowling | 0 | 1 | 2 | 3 | 4 | 5 | 5.5 | 6 | 6.5 | 7 | 7.5 | 8 | 8.5 | 9 | 9.5 | 10 |
| Zealand Brennan | 0 | 1 | 2 | 3 | 4 | 5 | 5.5 | 6 | 6.5 | 7 | 7.5 | 8 | 8.5 | 9 | 9.5 | 10 |

- Faculty Advisor Signature: ________________________________ Date: __________