TEC-V

Milestone 1

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*
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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:** Wednesdays at 3 p.m.
- **Client Meetings:** Mondays at 5 p.m. on the first and third week of the month.
- **Advisor:** Tuesdays 3p.m. on the first and third week of the month

5. Progress of current Milestone (Progress Matrix):

Tasks	Completion%	Michael	Zealand	To Do
Research Current Operations System:	**100%**	**100%**	**100%**	
Learn about Sonar Types	**100%**	**50%**	**50%**	
3D Mapping Software Research	**100%**	**50%**	**50%**	
How to sequence scanning for AUV	**65%**	**50%**	**50%**	**Figure out distance per scan**
Image Stitching Algorithms	**75%**	**50%**	**50%**	**Apply to Sonar**
Saving Data to SSD	**70%**	**50%**	**50%**	**Complete Code**

6. **Discussion (at least a few sentences, ie a paragraph) of each accomplished task (and obstacles) for the current Milestone:**
   - **Task 1:** For the purpose of our project, we need to gather two-dimensional data from a sonar device attached to the Autonomous Underwater Vehicle (AUV) and subsequently transform this information into a three-dimensional point cloud representation. To achieve this, it is imperative that we thoroughly comprehend the fundamentals of the current operating system and devise a comprehensive plan for its execution. Initially, we have devised an architectural diagram elucidating the existing operating system and its intercommunication processes.

   - **Task 2:** Once we have established a comprehensive understanding of the current system architecture, we can delineate our primary objectives for this project. These objectives encompass the following:

     - **Storage of Sonar Data:** Our first objective is to internalize the sonar data onto a Solid State Drive (SSD) card. This stored data will then undergo translation and processing once the AUV has completed its mapping task and resurfaced.

     - **Incorporation of Scanning Mechanism:** Our second objective involves the integration of a scanning mechanism into the AUV's operations. This mechanism will facilitate a comprehensive scan of the designated area, necessitating movement in all spatial axes. Additionally, we intend to devise a means to measure the distance covered by the AUV between each scan.

     - **Conversion of Sonar Data to 3D Model:** Our final objective is to explore methods for converting the raw sonar data into a three-dimensional visualization model. This model will provide a coherent and informative representation of the underwater environment, enabling effective analysis and interpretation of the scanned data.

   - **Task 3:** Our initial equipment selection involves the Ping 360 Sonar system. This particular system operates on a single-beam sonar principle, employing acoustic signaling to emit short bursts of acoustic signals into the underwater environment. Subsequently, the system records the time it takes for the echoes to return to the sonar receiver. By utilizing the known speed of sound in water, the system can accurately compute the distances to objects or the seabed.

- **Task 4:** In the context of implementing 3D mapping software, our research has identified several options.
  - One of the most prominent and advanced choices is QPS, a software package widely acclaimed within the hydrographic surveying industry. QPS offers a comprehensive array of features and capabilities. Notably, it specializes in underwater cave environments and boasts advanced processing capabilities tailored for multibeam sonar data. It is worth noting that QPS operates on a subscription-based model, necessitating contact with the company to explore potential student discounts. Additionally, QPS has a noteworthy track record, having been utilized in the NOAA Ship Okeanos Explore government project.

  - Alternatively, another viable option is QGIS, an open-source software solution capable of handling various geospatial data types, including sonar data. While it presents a valuable choice, it is essential to acknowledge that QGIS may entail a steeper learning curve and is not inherently designed for underwater applications, potentially posing challenges in adapting it to our project's needs.

  - Lastly, OpenCPN stands as another open-source navigation software that possesses the capability to display and overlay sonar data. Primarily a specialized tool for marine navigation, it may not inherently cater to the creation of 3D models of underwater caves. Nevertheless, the open-source nature of OpenCPN allows for the possibility of code modifications and the addition of custom plugins, potentially enabling optimization to suit our specific requirements.

- **Task 6:** The choice of stitching algorithms will be contingent upon the software platform selected for our project, as each software package processes data in a distinct manner. Consequently, the selection of the most suitable stitching algorithms will be subject to the data processing methodology inherent to the chosen software solution.

7. **Discussion (at least a few sentences, ie a paragraph) of contribution of each team member to the current Milestone:**
   - **Zealand Brennan:** My primary area of focus pertains to the software aspects of our 3D mapping endeavor. Which consists of identifying the optimal software solution for mapping our and developing a plan to address each associated challenge. As previously mentioned, the selection of appropriate image stitching algorithms will be heavily contingent upon the specific software platform we ultimately adopt. Making the right choice in this regard can substantially streamline our workflow and save us time.

   - **Mike Dowling:** During the previous milestone, my primary focus revolved around gaining full understanding of the existing operating system. Additionally, I collaborated closely with the team grasp the functionality of the Underwater Vehicle and explore ways to align it with the client's objectives. This encompassed an in-depth examination of the various sonar systems available and a thorough research of the AUV's design. Furthermore, I developed strategies for data storage from the sonar attached to the AUV. In addition, developed a scanning protocol outline, which involves automating a series of maneuvers upon command to ensure optimal mapping of the cave section in which the AUV is currently situated.

8. **Plan for next Milestone**

Task	Michael	Zealand
Implement and test 3D mapping software	**Finding data and or working with TEC-V team to test sonar and collect data to be used in mapping tests.**	**Working on implementing the software of choice, test it in multiple different scenarios, and gather data from those tests.**
Implement, test and demo feature/module	**Getting mapping software to output models**	**Having data be translated to readable files**
Sonar data to SSD	**Incorporating code into Blue Robotics to save data from ping 360**	**Implement/test/demo**
Scanning Protocol	**Make protocol within Ardu Sub for scanning sequence**	**Testing protocol**

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:** The goal of this task is to implement 3D mapping software and initiate testing. The objective is to become well-acquainted with the software and gain a comprehensive understanding of its functionalities. This knowledge will enable us to modify or add plugins as needed to tailor the software to our project's requirements.

   - **Task 2:** In this task, we aim to implement, test, and demonstrate specific features or modules of our project. One aspect involves ensuring that the mapping software can produce 3D models effectively. Additionally, we will work on translating sonar data into readable file formats, bridging the gap between raw sonar data and the 3D models for easier data interpretation.

   - **Task 3** This subtask involves integrating code into the Blue Robotics system to enable the storage of data from the Ping 360 sonar onto the SSD. Storing this data is crucial for preserving the valuable information collected during underwater missions.

   - **Task 4:** For this subtask, we will develop a scanning protocol within Ardu Sub that dictates a sequence of maneuvers for the AUV to perform when initiated. This protocol is essential to ensure comprehensive mapping of cave sections during data collection.

10. **Client Feedback on the current milestone:**
   - Currently the client is very straightforward and understands our current approach to creating what they require. They appreciate the continued connection and updates we share on our Wednesday meetings.

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

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12. Approval from Faculty Advisor

- "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."
- Signature:____ Date:

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

13. Evaluation by Faculty Advisor

- Faculty Advisor: detach and return this page to Dr. Chan (HC 214) or email the scores to pkc@cs.fit.edu

- 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

- Facutly Advisor Signature: _______________________________ Date: __________