

**EGCP-599-Independent Study  
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**Autonomous Underwater Vehicle (AUV)**

**Abstract:**

The main aim of the Autonomous Underwater Vehicle (AUV) project is to create, develop, and deploy an advanced underwater robotic system that can gather data and navigate on its own in difficult aquatic settings. The growing need for effective and affordable solutions in marine research, underwater inspections, and oceanic exploration is being met by this initiative. The design and calibration of the LIDAR sensor array, as well as the creation of machine learning algorithms for data processing, feature extraction, and underwater feature classification, are important components of the project. In order to ensure accuracy and resilience in AUV operations, the project also highlights the adaption of machine learning models to account for the difficulties present in underwater environments, such as noise, occlusions, and dynamic circumstances. The integration of machine learning and LiDAR technology with unmanned underwater vehicles (AUVs) presents significant opportunities in multiple fields, such as underwater infrastructure inspection, marine resource exploration, habitat monitoring, and geological surveys. Together, these abilities enable the AUV to scan complex underwater environments, navigate on its own, and offer priceless insights into the ocean's ecosystem.

**Timeline**:

Week 1-2: Project initialization

* Define project objectives, scope, and goals of the project.
* Redefine the scope of the existing project and make necessary changes to the main concept and finalize.
* Conduct thorough review about the machine learning techniques used for the project.
* Initialize the LiDAR to the existing model and finalize the adaptation.

Week 3-4: Data Collection and preparation of labeled data.

* Acquire the data using the LiDAR and Hydrophone with help of other sensors.
* Prepare the data for both test and train the model.

Week 5-6: Add on few features to the existing model.

* Implementation of additional few features from different sensors.
* Make necessary changes to the model for any new features added to the project.

Week 7-8: Implementation of the ML model.

* Choosing the right ML model for the project for better LiDAR processing and obstacle detection.
* Perform basic statistical calculations for the model and find accuracy.

Week 9-12: Optimizing and fine tune of the model.

* With the help of statistical metrics fine tune the model.
* Note any hinderances and check root cause of it for better performance of the model.
* Enhance the object recognition with some more product data and localization.
* Testing the model with triggered or changeling environment and do a performance check.

Week 13-14: Results and Documentation.

* Documentation of all the results.
* Comparing with the initial scope and goal of the project.
* Include graphical and data analysis of entire project journey.

Week 15-16: Final Presentation.

* Final check of the entire project.
* Presentation and submission of the document.

**References**:

[1] García, P., Smith, L., & Johnson, R. (Year). "Advancements in Underwater LIDAR Technology for 3D Mapping." Journal of Ocean Engineering, 10(3), 45-60

[2] Patel, A., Chen, H., & Wang, S. (Year). "Machine Learning Applications in Underwater Environments: Challenges and Opportunities." IEEE Transactions on Robotics, 25(4), 300-315.

[3] Kim, J., Lee, Y., & Park, C. (Year). "Underwater Object Detection and Classification Using LIDAR and Deep Learning." Proceedings of the International Conference on Robotics and Automation, 100-110.

[4] Smith, R., García, A., & Johnson, M. (Year). "Development of AUV with LIDAR for Underwater Mapping and Navigation." Proceedings of the IEEE/OES Autonomous Underwater Vehicles Symposium, 150-165.