



DEPARTMENT OF OCEAN ENGINEERING

Indian Institute of Technology Madras

Project Proposal

RoboBoat 2023

Aritra

Oceana DOE, IIT Madras



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Introduction

We aim to participate in a student international competition **RoboBoat**, with the vision of forming a culture within the Department of Ocean Engineering (DOE) IITM students of competing in similar global Competitions. To sustain this endeavour we will be incorporating this team **Aritra**, under the wing of **OCEANA**, which is the student organization of DOE IITM. The team will be mentored by the department faculty and will be coordinated by OCEANA.

What is RoboBoat?

RoboBoat is an international student competition organised by **RoboNation** every year. Teams from around the globe design autonomous, robotic boats (or ASVs) to navigate through a challenge course. Teams are expected to build a boat from scratch and demonstrate its maritime maneuverability while at the same time mimic the real world challenges faced by the maritime industry. Some of these challenges include coastal surveillance, port security and other types of oceanographic operations.



Figure 1: RoboNation

Why participate?

Participating in a competition like RoboBoat will be a start of an endeavor by our department in the field of **marine autonomy**. Apart from being an all-out international competition on the water, RoboBoat is a **systems engineering challenge** where skills from different engineering disciplines are tested. Competitions like these require skills ranging over disciplines such as core Naval Architecture,

Mechanical Engineering, Electrical Engineering, Electronics and Communication Engineering and Engineering Management. In the pursuit of building impressive self-sailing vessels, students will share knowledge, innovate, and collaboratively advance in the technology of autonomous surface vessel (ASV) systems.

Vision of the Project

- To form a team of **enthusiastic individuals** from the department and **participate in student international maritime competitions** like RoboBoat.
- Promote the student activities undertaken at Department of Ocean Engineering IIT Madras at an international level.
- Gain global and industry level exposure by interacting with teams from all over the globe.
- Develop student interest in curriculum by providing practical, hands on experience through such competitions.

Scope of the Project

- RoboNation organises a number of competitions in the field of marine autonomy and technology. In future, students may plan for competing in competitions other than RoboBoat as well. The experience that they might have gained while participating in RoboBoat will be valuable in those competitions.
- Department students can organise competitions similar to these at a National Level. Teams all over India can showcase their skills in the competitions. These competitions will be a part of **Wavez** which is the annual department fest of Ocean Engineering department.
- Department can organise workshops and provide hands on experience to the school and college-level students in the field of marine autonomy.

Plan of Action

Team Formation

A team of enthusiastic individuals is vital for the completion of project like RoboBoat. We think that a team of 10 to 12 students from the department will suffice for the project.

Division of Modules

RoboBoat is a systems engineering challenge where different engineering disciplines coordinate together to give out a final product. Hence, we think that division of the team into different modules will make the work more efficient and easy to manage. We divide our team into four modules, namely:

- Mechanical design and hull fabrication
 - The students in this module will be in-charge of design and analysis of different mechanical components specific to the tasks of RoboBoat including the hull design and its fabrication.
- Electrical and electronics
 - This module will be in-charge of designing all the electrical Circuits and electronic Components, integrating sensors and powering the propulsion systems. The vessel will be controlled by an on-board computer. This module will also be handling the integration of data from the sensors into the ROS (Robot Operating System) architecture running on the computer.
- Software Development
 - This module will be responsible for designing the core algorithms on the vessel which will carry out both the lower level and higher level autonomy. Development of simulation environments for testing these algorithms will also be done by students in this module.

- Public Relations, Social Media Management and Sponsorship
 - Students in this module will be in-charge of ensuring the Team’s presence on social media. They will also be designing a website for the team where all the progress related to the competition will be showcased.

Major Milestones

Defining certain milestones will be a good metric to measure the progress of the project. After doing a thorough analysis of the major requirements we have come up with the following list of milestones.

- Propulsion systems test bench setup
- Sensor procurement and integration
- Hull design, fabrication and propulsion systems integration
- Integration of all the modules
- Code and testing of the software Onboard
- Competition

A timeline for these milestones can be seen below:

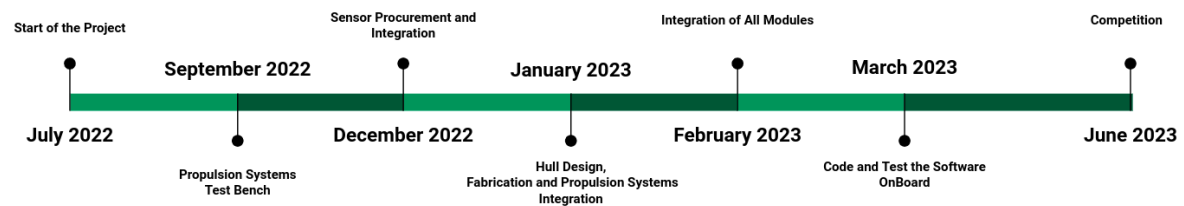


Figure 2: Milestones

Project Schedule

A thoroughly planned detailed timeline of the project can be seen below. The project is divided into five major tasks, with each module having its own sub tasks. The gantt chart below [Figure 3](#) and [Figure 4](#) details down the rough timeline and the sub-tasks of the major tasks that could be followed to ensure a successful completion of the project. The google sheet link for the same can be found here [Project timeline](#).

Following are the five major tasks:

- Design and analysis of hull structure
- Team building
- Electrical electronics and logistics
- Software development and model testing
- Full autonomy testing

Deliverables

- A fully functional autonomous platform with autonomous capabilities.
- A team capable of participating in future competitions similar to RoboBoat.

The sensors onboard the platform can be used for other department projects if required.

Budget

After a thorough analysis based on our experiences with the MATSYA ASV (the one that we have been working on), and the previous year technical design reports of other teams, we estimate that an ASV platform that can compete and win a global competition like RoboBoat will require a budget of around **₹37.10 lakh**. The [Figure 5](#) below details down the breakup of the amount that we reached in our analysis. [Figure 6](#) and [Figure 7](#) detail the module wise and quarter wise costs that

are required to build the proposed project, respectively. Our team will participate in such international competitions every year. As the competition format and problem statements keep changing every year, the proposed budget of ₹37.10 lakh will be needed every year.

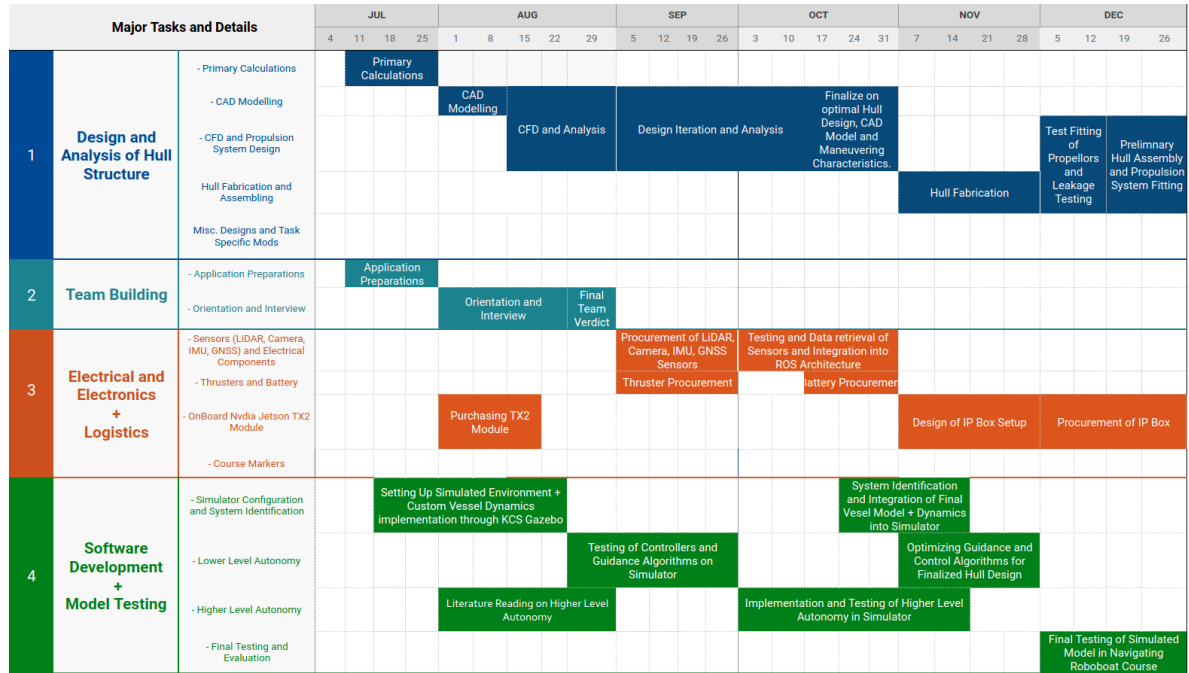


Figure 3: Project timeline July to December

RoboBoat 2023

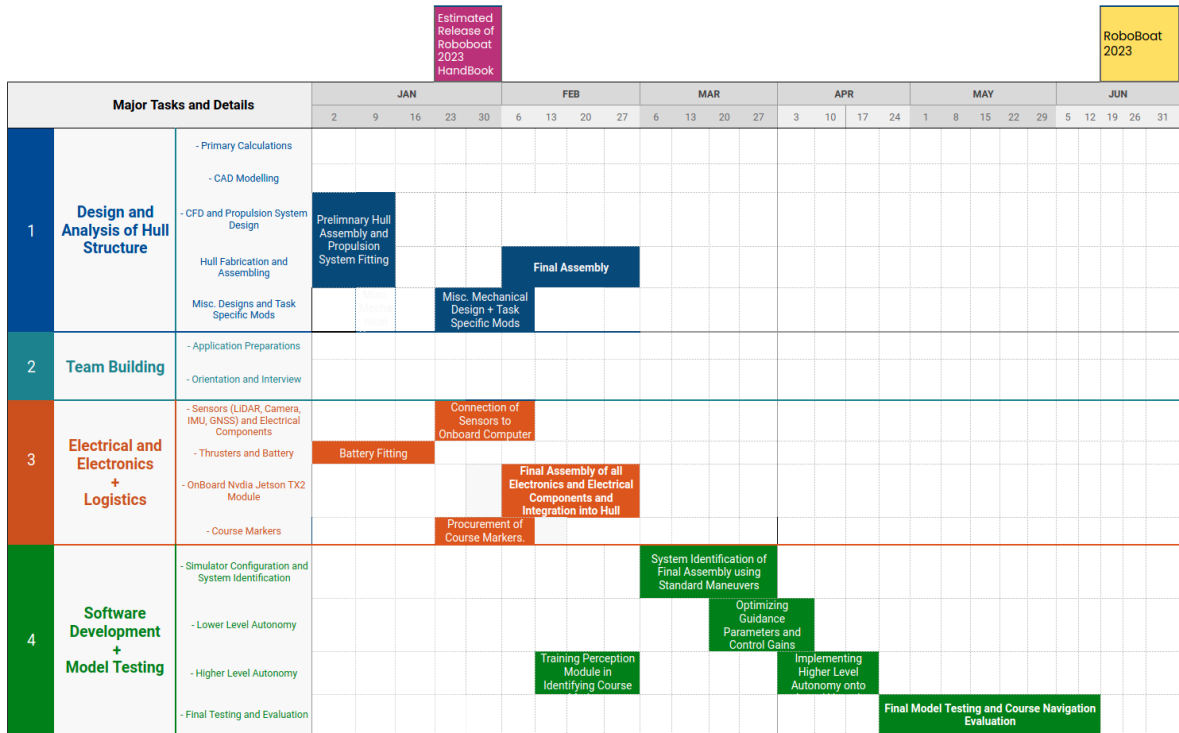


Figure 4: Project timeline January to June

Category	Particulars	Details	Estimated Price
SENSORS	IMU	SBG Ellipse-D	₹1,062,000.00
	GNSS	ArduSimple RTK2BSBC + MultiBand GNSS Antenna + LR Kit for RTK (Rover + Base Station) + Assembly accessories	₹500,000.00
	LIDAR	Livox MID100 3D LiDAR	₹375,987.85
	Camera	Intel D455 RealSense Depth camera x 4	₹214,900.00
HULL FABRICATION		Estimates based on the experience on MATSYA ASV and previous year documentation on RoboBoat	₹350,000.00
PROPULSION SYSTEMS	Azimuth Thrusters	5 * T200 Thrusters by BlueRobotics	₹103,900.55
ELECTRICAL AND ELECTRONICS	LiPO Batteries	11.1V 22000mAh LiPO Link	₹62,304.00
	OnBoard Computer	Nvidia Jetson TX2	₹61,265.00
	RF Module	FlySky FS-I6-X and reciever	₹10,000.00
	Miscellaneous Electrical Components	Based on the experience on the MATSYA ASV Speed ESC's Buck Converters Relay Switch Connecting Wires with appropriate guages Arduino Microcontrollers	₹70,000.00
OTHER MECHANICAL COMPONENTS	Cart to carry the vessel and Obstacles in the course	Based on the requirement of the competition and competition course	₹150,000.00
	Task specific Components	Based on the RoboBoat 2023 Handbook (...yet to come) Rough estimate made based on previous year	₹50,000.00
LOGISTICS and TRAVEL			₹700,000.00
TOTAL			₹3,710,357.40

Figure 5: Budget analysis

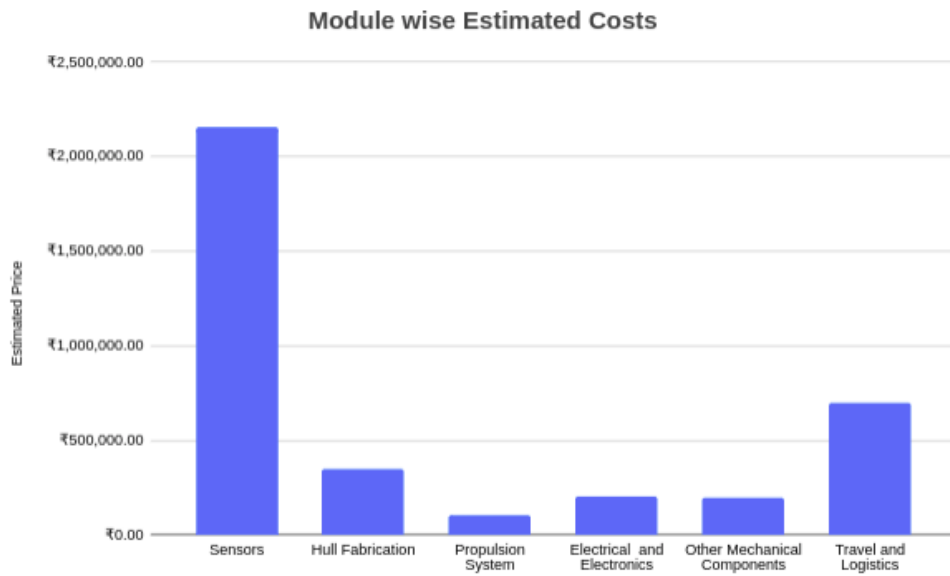


Figure 6: Module wise breakup of total cost

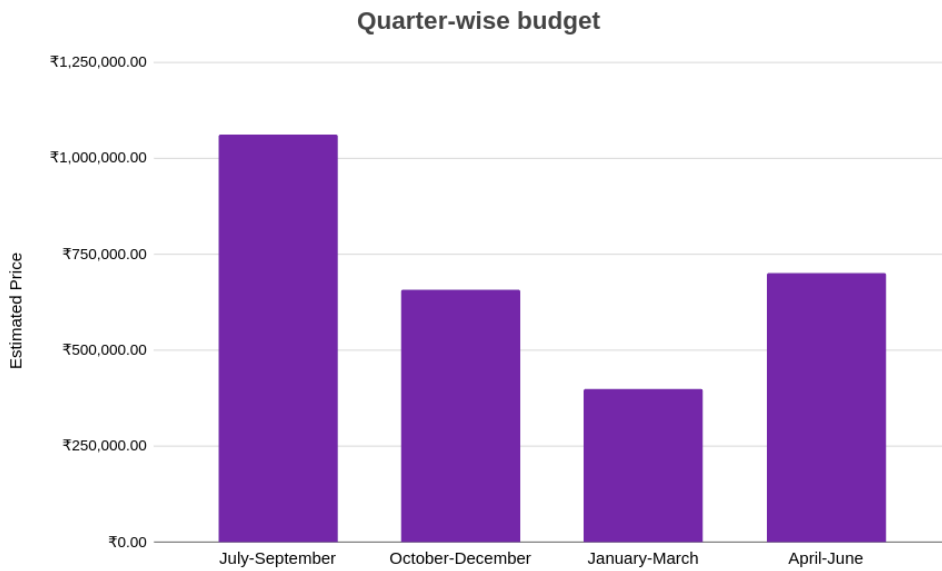


Figure 7: Quarter wise budget