TECHNICAL DESIGN REPORT OF MRT PURVI Goes To ROBOBOAT 2022

BARELANG Marine Robotic Team (BARELANG MRT)

POLITEKNIK NEGERI BATAM
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Abstract

The first step a team needs to enter a competition is preparation. With some of the team's deliberations, we're preparing to enter the ROBOBOAT 2022 competition with enough room and board. Some of the experiences and research from the need to follow a ROBOBOAT 2022 felt maximum and could go in a direction that could turn this movement into something more. The goal of entering the annual ROBOBOAT 2022 competition is to participate in the development of technology, especially in naval and robotics systems, which currently require the improvisation of student thought, which may later bring significant changes to the development of the naval world and robotics systems. Collecting numerous references from several teams who had participated in the ROBOBOAT competition the previous year, making a major investment in the design that this team was working on. The products generated are designed by optimizing the different systems used in the ship, ranging from the hull, the electrical systems, the robotics systems, and other support systems needed to maximize the performance of the vessel's products. The product would have to be made to maximize its challenges in the ROBOBOAT 2022 competition with some considerations in following the regulations set by ROBOBOAT 2022 organizers Team.

Key Word : Competition, ROBOBOAT 2022, The goals, Technology, Reference, Participant, Product, Team.

I. Competition Strategy

In this competition the team must prepare a strategy carefully which makes the system autonomous and designing the ship as stable as possible. In connection with this competition, there are several obstacles that must be passed in order to get the most points.

One of the obstacles that is passed is the ship goes well past 3 objects with different colors, namely red, yellow and green. This obstacle we try to use the srf sensor and lidar sensor to detect the object.

We tried to discuss for a vehicle system that has been designed to be as stable as possible. We will improve our flagship capabilities to create the best possible autonomous system that can be managed when time is limited. Our goal is to participate in the competition to get the most points, so we are satisfied with what we are doing.

II. Design Creativity

In order to capture the purpose of what was previously planned, we designed this product with a few considerations and evaluations of some of the ship's products that were previously produced. The selection of concepts and purposes of the design of the ship's products is to find sources of information such as journals, media information, and also with literacy associated with design, to assist the design mechanism and also to give innovative ideas that can be developed to apply to the

ship's intended products. Moreover, the concept that we apply to the vehicles that are designed must refer to the regulatory standards that the organizer has established.

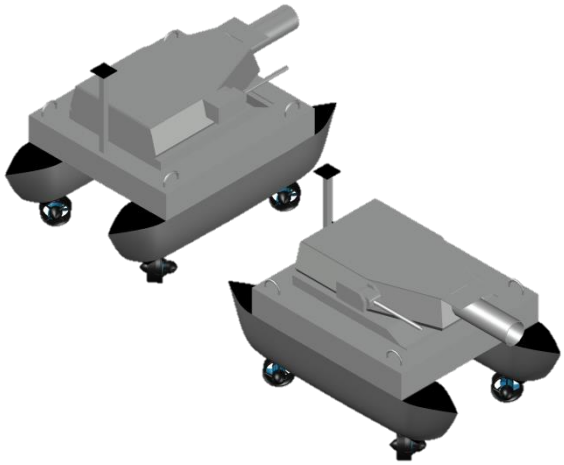

Fig.1. MRT Purvi

The ship we designed was based on the experience of designing a product previously designed by teams from the Politeknik Negeri Batam prior to BARELANG MRT team. To that end, the product we designed was the latest innovation in ship products designed by the previous team. The BARELANG MRT Team that there were parts of the ship's products that had previously been designed to have some weaknesses which obviously those deficiencies can be improvised so that the problem can be minimized or solvable. Some of the updates we've made on some of the systems in the previous design are expected to make this ship more optimal than ever.

A. Hull

A.1. Software

Design as well as design design, there are software used, among other things:

1. Maxsurf

Maxsurf is special software for 3d design and analysis on the ship. From the internal structures of the ship itself to the performance of its design.

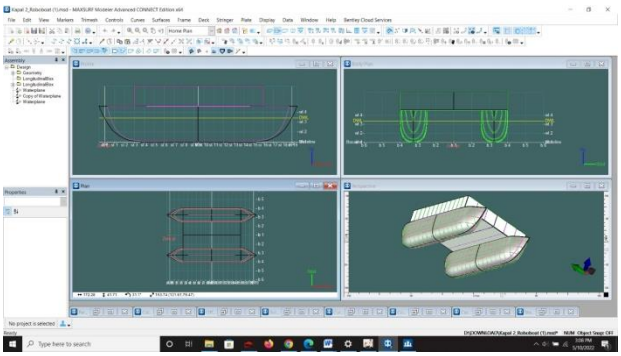

Fig.2. Maxsurf application

Inside the naval world, there are software used to complete the work related to the naval world especially in ship design. Of the many software programs, there are specialized computing devices that analyze the design calculations of the boat's maxsurf model as an example of a design program to analyze the design calculations in this that the maxsurf modeler used, and the maxsurf resistance. The maxsurf modeler was able to create a vessel design with a 3d model which the data next managed in the maxsurf resistance to be able to calculate all the components of resistance and it could be towed separately.

2. Auto CAD

Auto cad (computer design) isa automated software that USES computerized design tools that help engineers, architects, and other professionals with the planning industry. Cad allows you to prepare the picture fast and accurately, as well as it makes it easy to properly visualize ideas and ideas. Autocad is cad's computer software that draws the world's most popular, three-dimensional imagery.

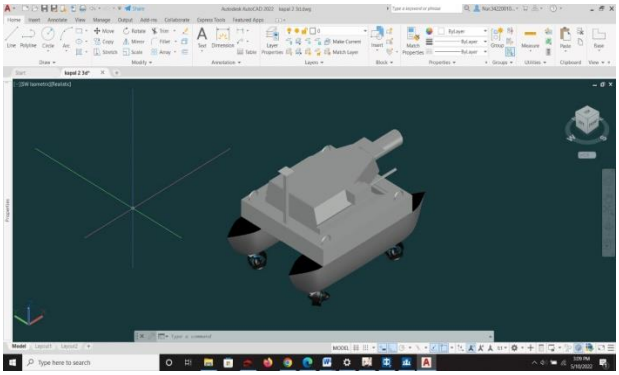

Fig.3. Auto CAD application

We need this application to create the image and the off-line line of the vessel's future production. We created a 2d concept to capture a 3d concept that will create a fabrication based on a previously worked design.

3. SolidWork

Solidworks itself is cad (computer design) program that runs on Microsoft Windows. The solidworks files use structured Microsoft format storage files. This means that there are various files embedded in each SLDDRW (picture files), SLDPRT (part files), sldasm (assembly files), with bitmaps preview and sub-file metadata.

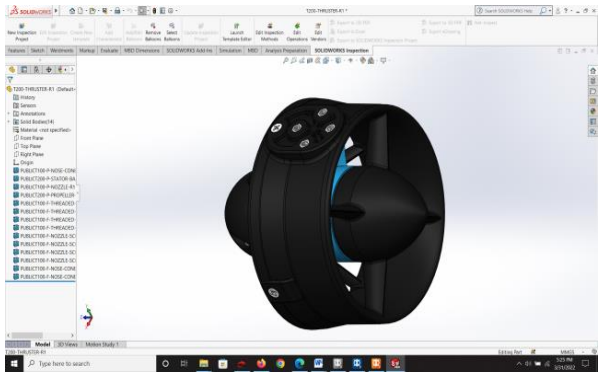

Fig.4. SolidWork application

The application is used to create 3d designs on several components needed in boat products, such as, propulsion systems in firing systems as well as automatic firing systems.

A.2. Hull of Boat

In selecting the design on the ship's products, you will need to conduct a study of literature on what you want to target. This requires gathering some statements and consideration that make the decision a deliberative one. And the catamaran design lays out an option that feels perfectly consistent with the considerations taken by the BARELANG MRT.

The hull is the hull of a boat or a ship. The hull provides buoyancy that prevents the ship from sinking. The design of the ship's hull is important because it will affect the stability of the ship, the speed of the ship's plan, the fuel consumption, the necessary depth in relation to the shipping port pool as well as the depth of the navigation line.

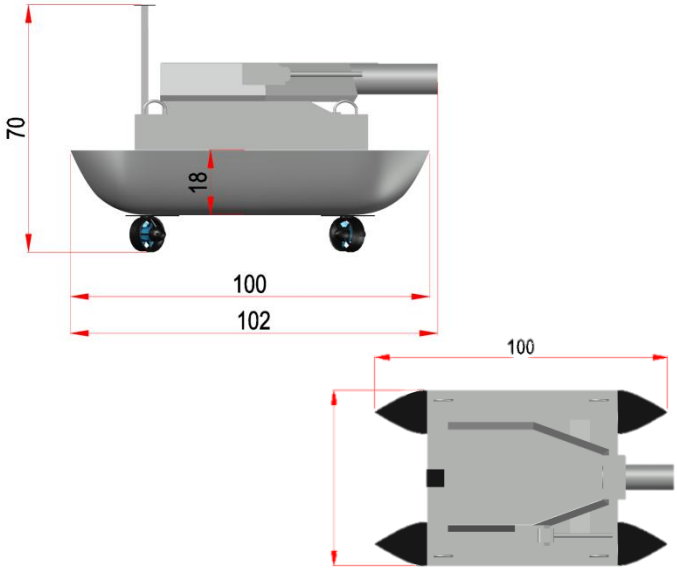

Fig.5. Dimension of boat

The design of the ship, which we designed according to the scale of the original ship with a ratio of 1:90 and by comparison we have a considerable outline of the property and of its surplus and of our profits in reaching the target previously planned by the tin BARELANG MRT.

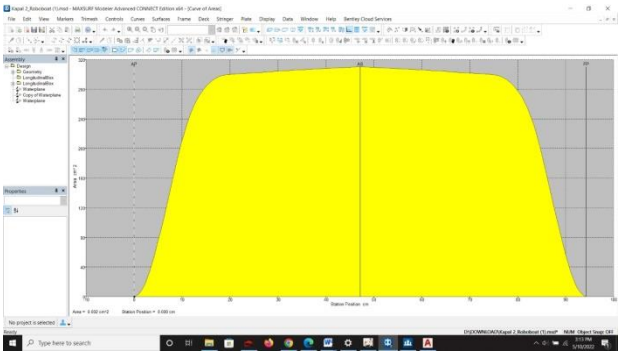

Fig.6. Curve of area

According to the curve of the area chart, the design of the ship has been fairly smooth and curvature of the design vessel, which in turn makes it increasingly useful to us because it reduces the drag of the resulting vessel. On the design of MRT purvi using the catamaran model, it is the form of the hull used for ships that require a high level of stability and also put the passengers at ease. It is hoped that by reference to rapid reflection and concept, the autonomous vessel can accelerate in both calm and high-water waters. The stern of the ship is designed rather wide to enhance the stability of the ship and also as loading dock for the boosters used on the ship, for inserting USES of a slightly smaller conclude model, this model is commonly used on boats that have a fairly small manufacturing compartment, where there are four propellers held in the hull, serves to protect the propellers from objects that can damage.

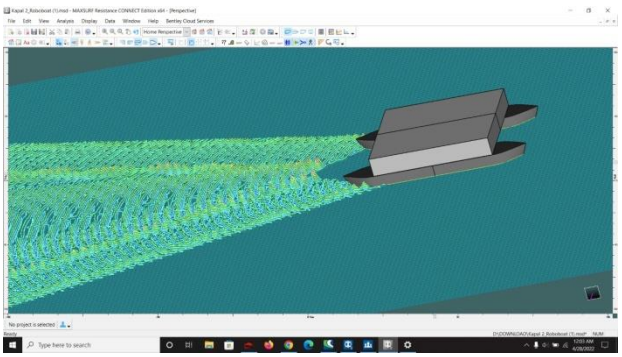

Fig.7. Resistance simulation

A.3. Material

Because of the resilience, strength, safety and safety of some of the elements they feel need some of that, with some research and practice being done, the ship USES the fiber-ground materials with a combination of resin and catalyst that gives the materials more solid and resilient, with strength, good security, and sufficient durability for the ship.

A.4 Propulsion System

The propulsion system used on this ship USES four azimuth propellers designed in such a way as to get movement in all directions. The aim is to be expected with the movement of free vessels as the main points of the vessel in order to complete certain obstacles that are prepared.

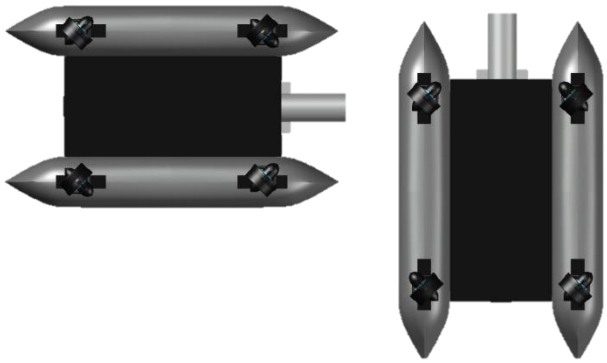

Fig.8. Azimuth propeller

The calculating postulation was thought about and designed to get the correct position and the objective required by four propellers, a setting of call arranged by determining the balance of a vessel and by calculating the distance between the hull and the square in each vessel. And make sure the distance between the propellers on each hull is consistent.

B. Electrical

B.1. Wiring

A propulsion system is a machine that produces thrust to push an object forward. on this boat there is a propeller that rotates cw (clockwise) and ccw (counterclockwise), so that the propeller can function on the boat, a motor is needed to rotate the propeller, namely the brushless motor is a dc motor. different from other dc motors, brushless motors require an ESC (Electronic Speed Controller) module.

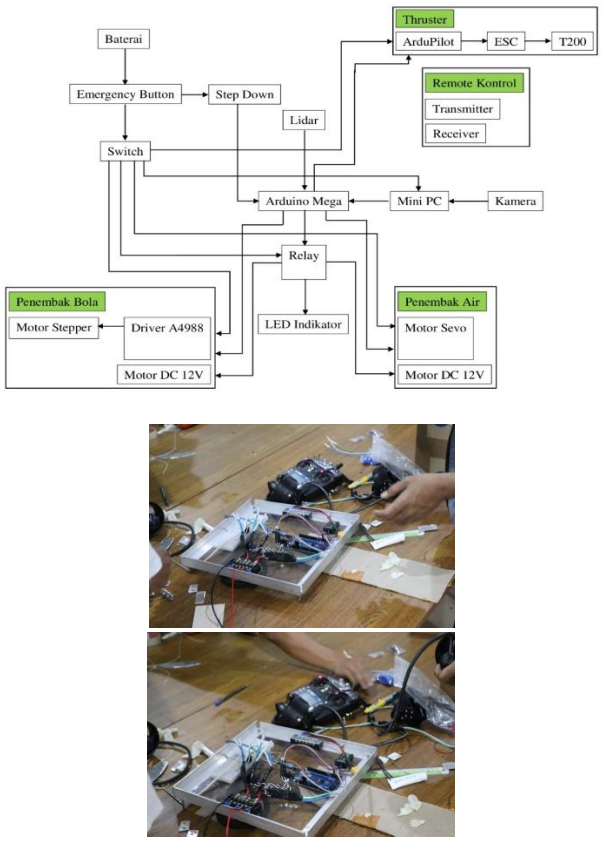

Fig.9. Wiring system in the boat

The power management system used in this ship we design by using a battery for input to the power controller that allows us to know the condition of the voltage and then to the microcontroller as this power controller is also used for the output to the thruster and also other components.

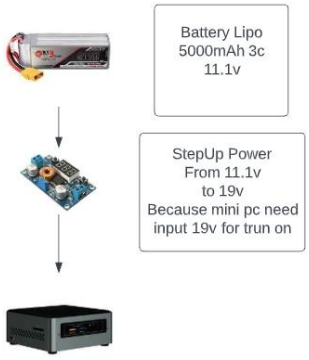

Fig.10. Component

We use 2 batteries lippo 5000mAh 4 cells for the thrust and controller and the fan we use step down for the volt because to turn on the dan need 12v for the power, And for the mini PC we use 1 battery lippo 5000mAh 3cells with step up for the voltage from 12v to 19v because the mini PC need power 19v to turn on.

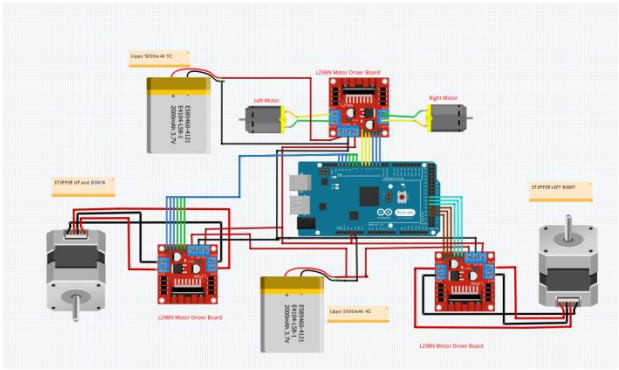

Fig.11. Wiring of catapult

B.2. Motion

There are several concepts for propulsion on a boat. the first concept is that the front and rear thrusters are horizontally positioned as shown in the picture on the side, this concept has been tried but there are drawbacks, such as for right and left movement, right and left rotation, and maneuvers cannot be applied. the next concept is a horizontal rear thruster and a front thruster in a half cross x position, this concept only has drawbacks such as the right and left movement cannot be applied.

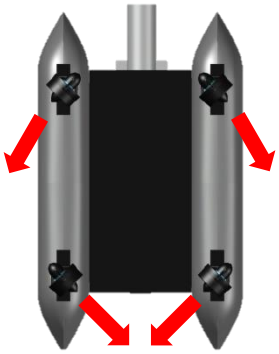

Fig.12. Layout propeller position

And the last concept is the concept of cross x, this concept is the one that will be used, because for movement in all directions it is more efficient than some of the previous concepts. for the speed of movement is not much different about 5 km per hour.

B.3. Sensor

Control the sensor optimization in this robot. On this robot. We using camera for input control system. the camera can be see and tracking object on front of robot. We use a camera for the input control system, where this camera will see what objects are in front of the ship. The camera will detect ball objects and gates with the data we created.

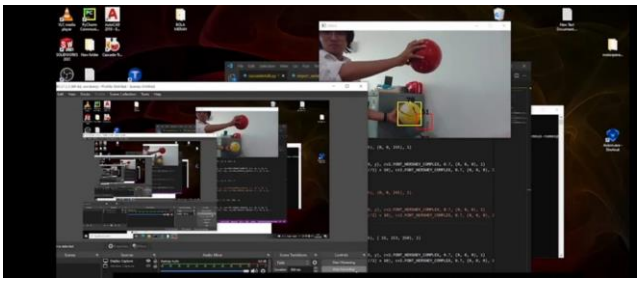

Fig.13. The process of reading objects

In processing the existing data, we use the Cascade GUI Trainer image processing feature in OpenCV where the data we collect will be processed into a file with xml output. Ultra sonic sensor is useful for measuring distance, this sensor will later be used in ship mode for docking so that we know the distance limit from the ship.

III. Experimental Results

To know the worthiness and success of research, it is necessary to test and exercise to see if the research done correlates with what was previously calculated or even remote from what was calculated. A plan that could buy time in order for some of the progress to be implemented and completed in accordance with both the target and the time line guidelines for completing the product's previous design.

A. Mandatory Navigation Chanel

In the mandatory navigation channel, the boats must navigate autonomously between gates without touching the buoy. And by placing multiple points latitude and compass, GPS, and accelerometers automatically feel navigation information title, longitude, latitude and update changes. In performing planning on this system following the standards or standards given for competing competitions, this could be the principal prerequisite on the ship. With the knowledge and experience this system has in research in such a way as to get the maximum results.

Fig.14. Mandatory navigation test

B. Obstacle Challenges

Obstacle challenges follow according to flexible regulations. Testing has been done on several levels to determine the outcome and the best systems of design ever devised. In this section, evidence and validation of the proposed course approach is presented. Encompassing all of the challenges, except for the object delivery. Focused on evaluating different systems that detect buoys and how the system would perform without augmenting the data-set with synthetic images as done in previous work. The results show that very accurate performance can be achieved as the networks were able to capture important features of objects of interest.

Fig.15. Test of obstacle challenges

The testing of products is done, in accordance with the stages of the production of early product production, to the end of product production. Experiments are conducted to seek an evaluation of the work done on the done products. The initial stages of testing are in the hull, testing is done whether there is a leak in the hull or not, and evaluation of the results afterward.

C. Speed Gate

Challenge of the speed gate, it has made multiple attempts to test sensors and controllers that have previously designed on boats. In the first experiment, the sensors have felt it's navigational information accurately, but some oscillations occur in multiple courses, it's mainly because change parameters are affected by water waves and light refraction

The solution follows the same principle as the mandatory navigation, heading in of the a perpendicular path in relation to gates until it finds the middle buoy, the returning to the original position. The simulation shows the ASV crossing the gate, and following astraight line perpendicular to the gate itself. After a few seconds, the boat was able to identify the third buoy, and started to circum navigate it to return to the gate.

Fig.16. Test of speed gate

IV. Acknowledgements

Pride and happiness may not be able to blend in with words. Thank all those involved in the project, thank to Faculty Advisor Ryan Satria Wijaya, and also Naufal Abdurrahman Prasetyo who has led the team to compete in the international sphere, and thanks to those who help provide the necessary tools and infrastructure for the 2022 Roboboat competition. And we are proud to participate in this competition

V. References

[1] Roboboat 2022 Rules and Task Description, March 2022
[2] Blue Robotics Product Overview: BlueROV2, Available : https://youtu.be/GY0PfnvzzW

VI. Appendix A : Component Specification

Component	Vendor	Model / Type	Specs	Custom / Purchased	Cost	Year of Purchase
ASV Hull Form/Platform	Self Developed	Catamaran	L : 85 cm, B : 60 cm, H : 28 cm.	Custom	$170	2022
Waterproof Connectors	-	-	-	-	-	-
Propulsion	Blue Robotics	T200 Thruster kit	https://bluerobotics.com/my-account/view-order/153432/	Purchased	$944	2022
Power System	Lippo	500 mAh 4s, 3s	Voltage : 14.8V 4s1p, Weight : 474g	Purchased	$246,85	2022
Motor Controls	Blue Robotic	Basic ESC	https://bluerobotics.com/product-category/thrusters/speed-controllers/	Purchased	$144	2022
CPU	Asus	PN51-S1-B	https://www.tokopedia.com/ciptamandiricomp/asus-mini-pc-pn51-ryzen-7-nvme-256gb-ddr4-8gb	Purchased	$548,77	2022
Teleoperation	-	-	-	-	-	-
Compass	-	-	-	-	-	-
Intertial Measurement Unit (IMU)	Modul 9 DOF	GY-BNO055	https://shopee.co.id/product/377387332/12629881990?smtt=0.117371424-1650017962.3	Purchased	$17,15	2022
Doppler Velocity Logger (DVL)	-	-	-	-	-	-
Camera(s)	Logitech	Webcam Logitech Brio	https://www.tokopedia.com/luckyelektro/webcam-logitech-brio-1080p-camera-ultra-hd-pro-4k-webcam-pc	Purchased	$205,79	2022
Hydrophones	-	-	-	-	-	-
Algorithms	Internally Developed	-	-	Custom	-	2022
Vision	Internally Developed	-	-	Custom	-	2022
Localization and Mapping	-	-	-	-	-	-
Autonomy	Internally Developed	-	-	Custom	-	2022