Plans and progresses:

It’s quite often when you visit a big shoreline city that you’d find the water around the city is full of plastic pollution that not only destroys the aesthetic look of the city but more importantly it devastates the marine life in the surrounding region. Having said so, our team has decided to revolve our project around finding a way to solve that problem. After a lot of brainstorming Hoang came up with the great idea of making a floating robot that cleans up the buoyant plastics int calm waters such as docks, marinas, and small lakes.

Hoang’s idea was inspired by Roombas which is a small robot that maps and determines the best way to move around the house vacuuming the floor. Our robot’s initial design consisted of a boat like design with an opening in the front for the plastics to enter through and a mesh net attached to the bag to hold the plastics. The robot would be propelled by both a propeller as well as water jets as inspired by the PBR boat from the Vietnam war. The propeller allows for the robot to steer and navigate well at low speeds while the water jets would suck in rubbish as well as provide additional propulsion needed for the robot to drag around the big net of plastics. The robot would be programmed to know when the net is full so that it would be able to navigate its way back to the docking hub to dispose of the plastics. To keep the robot from venturing too far into turbulent water a border would have to be set around the arena where the robot would be safe to clean.

A gyroscope would also be included in the robot so that it would not go out to clean or continue cleaning while the water conditions is not safe. Like the Roomba the robot would also have a docking hub where it would be able to charge its batteries and dump the plastics in the mesh. The docking hub is designed with solar panels and a wind turbine to provide a sustainable source of clean energy for the robot’s operations. After finishing the first design of the robot the biggest concern that we had was the safety of the robot as it is not built for rough water and having the robot breakdown often would defeat its purpose. So we decided to add rubber inflatable bumpers that would go all the way around the upper part of the hull of the robot and due to the hull’s inward curve the bumpers would be the only part that would come in contact with outside surfaces. Having the bumpers on the top part of the hull would also mean that we would have the extra protection for both the robot and any surrounding properties. Without having to worry about the bumpers messing up the aerodynamics of the boat creating more drag. As an added precaution the docking hub would have access to 24/7 weather reports and if the reports meet certain parameters the docking hub would then allow the robot to start cleaning. The docking hub would also automatically run tests on the robot when it docks to make sure everything is running smoothly.

Another problem that we faced was the gyroscope’s safety system responding to false positives. As the robot will mostly operate in areas full of other marine vessels and as these vessels move around the wake created could trigger robot’s safety system which would force the robot the dock in the docking hub then start the cleaning process all over again. To solve this problem, we have decided to program the safety system in a way that it would only be triggered if the gyroscope Is moving around consistently meaning that it is not just a vessel passing by. Having said so this would also mean that in case of a real emergency the robot would start reacting to the gyroscope’s signals much slower than usual. In the event that the robot is unable to return to its hub, (e.g., low power, unable to drive through rough waters), a message would be sent to the user to signal a rescue of the robot or otherwise fix the issue. A device similar to a plane’s black box would also be included on the robot. This device like the black box would record crucial data on the robot’s performance so that feedback could be gained from the incident by knowing what systems we’re working and what malfunctioned so we could then peruse the why it malfunctioned and improve the robot and in case the robot sinks it would transmit an emergency beacon to alert the user of its current position.

Before deciding on having the net mesh one of the ideas that we had that proved to be a dead end was elongating the boat to have a plastics storage unit with the hull. The advantages of this would be the improver aerodynamics which would mean that the robot would not create as much drag creating a lack in necessity to have 2 propellers and 2 water jets to navigate the robot. Sadly, this idea turned out to be a dead end as making the hull bigger would result in the robot becoming incredibly hard to manoeuvre to pick up the plastics.

To proceed further with this project our team would need to learn multiple skills in order to be able to transform our idea from dreams to reality .these skills would include but are not limited to programming skill to design intricate software for both the robot and the docking hub so they can communicate effectively to get the job done. We would also need to learn many engineering skills that spread over different fields of engineering such as marine engineering and mechatronic engineering to be able to refine our designs even more. Once we are comfortable with the designs enough, we would then start building a prototype for testing. We would first start with a miniature version of the robot that will be tested inside an enclosed swimming pool. This would provide us with a safe environment for testing at a more affordable price as you would not need to have all the expensive parts needed to make a working up to scale dock cleaning robot. Once the team is satisfied with the miniature robot then we can start working on building the full-scale version. The team would also start the testing phase in an indoor pool so there is minimal risk of damaging the equipment. After documenting the first testing phase we would then try to look for funding for the final testing phase where we would deploy the robot and the Docking hub at a marina or a dock where it would be expected to only need some fine tuning to be working at an optimal level.

Testing:

For our project we will have 3 different types of tests that we will run the robot through to make sure that it is up to standards and would be able to survive in the dock. The first test would be conducted in a wave pool for safety reasons we would use the wave pool to mimic different scenarios that the robot might have to go through. These scenarios include but are not limited to a marine vessel’s wake and rough waters due to a storm. The second test would revolve around testing the maximum capacity the robot can carry while still being able to make its way back to the dock hub. The test will consist of filling up the mesh net with till the robot is unable to navigate correctly. Finally, the third test would test the mesh net’s ability to hold microplastics. To do that we will need to run different sizes and types of microplastics through the robot and document what types and sizes stayed within the mesh net and what went through.