

# **Group 5 Project Proposal**

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**Solution:** Ocean cleaning up robot [**Ocean Roomba**]

**Organisation/Industry:** National Environment Agency [**NEA**], Applied Science

## **Background**

Plastic is a synthetic organic polymer made from petroleum with properties ideally suited for a wide variety of applications including packaging, building and construction, household and sports equipment, vehicles, electronics, and agriculture. Over 300 million tons of plastic are produced every year, half of which is used to create single-use items such as shopping bags, cups, and straws. As of 2021 in Singapore, every year there is an estimate of 900 million kilograms being disposed, and projections show tripling to 29 million tonnes by 2040 if no actions are taken.

The organization we have chosen is the National Environmental Agency (NEA) whose mission is to ensure a clean and sustainable environment for Singapore, together with our partners and the community. As it stands the NEA employs the measure of monitoring Singapore's coastal water quality for any chemical, physical and bacterial anomalies. Physical anomalies in this case refers to physical pollutants on the sea like plastic waste. The NEA currently does not have an efficient way to clean up the coastal plastic pollution. Often relying on volunteers to pick up the pollutants that are washed up on the beaches.

## **Problems/Challenges**

### **How does plastic usage leads to pollution in the ocean?**

Land-based activities such as urban and stormwater runoff, sewer overflows, littering, improper waste management, industrial operations, and illegal dumping are the main sources of plastic debris detected in the ocean. It can be carried there by the intense weather and strong winds. Pollution along coastlines gets swiftly hauled out by the tides as well.

### **Other factors causing plastic pollution**

The influence of solar UV radiation, wind, currents, and other natural factors helps plastic to decompose into small particles called microplastics – particles smaller than 5 mm) or nano plastics- smaller than 100 nm. The small size of these particles makes it easy for marine life to ingest it by accident.

### **Plastic pollution effects on marine life**

Each year, 100,000 marine animals become entangled in plastic trash, which restricts their movement and food intake, leading to wounds and diseases.

Because the colours and patterns of plastic garbage resemble those of their prey, marine animals like fish, whales, and turtles frequently mistake it for food.

Additionally, algae and bacteria, which are important sources of protein and energy, collect in the floating plastic debris can be tasty to some marine species, thus consuming it.

The toxic compounds that are present in the contaminants that are floating around the ocean can also be absorbed by plastics. As a result, they could unintentionally mistake it for food and consume it. As the plastic gives the appearance of a "full" stomach, it can penetrate through internal organs or induce a fatal blockage in the intestines, which can result in starvation as well as bring more prone to illnesses.

### **Plastic pollution effects on human health**

Humans consume an estimate of 39,000 to 52,000 of microplastic particles every week. This is because plastic pollution in the ocean is consumed by sea creatures which get hunted by humans for food. This causes humans to consume microplastics or toxins, such as mercury and toxic carcinogens, that the fishes had previously digested. This would lead to further issues such as cancer and heart problems. Young children could also experience birth defects and development issues. With marine life being an important source of food for humans, the pollution could cause humans to lose a potential source of food needed for survival. The ocean hosts Phytoplankton's which produce 50% of the earth's oxygen.

### **Plastic pollution effects on the tourism industry**

Plastic pollution could hinder the tourism industry economically and socially.

12% of the global GDP consists of tourism revenue and is responsible for 1 in 10 jobs globally. Plastic waste contaminates prominent tourist destinations such as beaches and historical rivers, making tourists feel appalled by the uncleanliness and driving them away from the country. In addition, this leads to less tourism expenditure, as more and more visitors spend less time traveling around the country and buying souvenirs. An example of this occurring happened in South Korea, on an island called Goeje. An estimated \$37 million in tourism revenue was lost because of marine pollution that was on the beach. Public reputation could also be badly affected due to social media criticizing the dirty landscape and discouraging other travellers from visiting the country. All of this reduces the revenue flow to the tourism industry and decreases profit earned, which causes mass job layoffs if no action is taken.

### **Methodology & Information Gathering**

We are going to use scratch - a coding software that uses a visual interface to program objects, rudimentary systems and basic functionalities. Scratch is easy to get into, as it requires little knowledge of coding. In addition, it also enables us to collaborate across an array of devices such as mobile phones, tablets, and laptops with ease. With everything available in one central location, it smoothens out the development process by lessening the hassle of transferring information from one point to another. All of these help to reduce the delivery timing of the project.

After a unanimous agreement, we decided to use waterfall approach as our main software development method. Waterfall approach lets us plan out the timeline of our project in detail, paving a clear direction and target setting for different project phases. Furthermore, it gives structure to the overall project and assures early detection of bugs during testing phases. All these aspects help to reduce misunderstandings among team members and ensures that everyone is on the right page.

We source our information from numerous websites such as MarineDebris, Waterwitch and the National Environmental Agency (NEA) using Google search engine. By doing so, we could accurately design and formulate an effective solution to the plastic coastal water pollution.

## **Solution**

Our proposal is to use an unmanned miniature boat equipped with a garbage basket that goes around the shoreline. The main purpose of the mini boat is to collect floating rubbish along the coastline. Once the capacity limit for the mini boat has been reached it will return to its docking station where the trash will be collected. The unmanned boat will move up and down a designated route that has been pre-loaded into the system. A failsafe will be in place which allows the user to take remote control of the boat during emergencies. The main design of the mini boat will be low in height and have a “mouth” which takes in rubbish/plastic. Behind the “mouth”, will contain the area in which the rubbish is stores temporary. The boat will be propelled by an electric motor that is powered by batteries and solo panels that charges the batteries. The boat will run on an if-else conditional statement system as its main decision-making process. For example, if it encounters an obstacle that's blocking its path, it will try to navigate left or right and continue along its path. Another example is, if current weight load has reached a certain limit. If this limit is reached, it will automatically return back to the docks regardless if the boat has completed the designated path.

### **How it helps National Environment Agency (NEA)**

Even though the current situation for Singapore’s coastal plastic pollution has not escalated drastically, there is still pollution present along the coastline of Singapore’s water.

The National Environment Agency (NEA) can use the solution to help them clear the shoreline more effectively, without dedicating much manpower on cleaning rubbish. In addition, this cuts down time spent on ocean cleaning, allowing the National Environment Agency to prioritise on more urgent tasks sooner. In the future, the National Environment Agency could automate the ocean cleaning process by mass deploying these robots at regular intervals, therefore there is no longer a need to hire any personnel to be present on site. The NEA could also use the solution to gather data on plastic pollution. Information such as the type of plastics thrown, the frequency of rubbish thrown, and coastal areas most susceptible by plastic pollution. Through this, the NEA could feedback data to the government, who will enforce future

policies and fines regarding ocean pollution – further reducing the plastic pollution rate.

## **Feasibility**

The solution is highly feasible as it is possible to code out the ocean Roomba's action and decision-making process on scratch. Scratch offers customizable coding blocks that allow for us to easily change the perimeters of the Roomba's action. Testing can also be done through scratch to see how the Roomba will function.

However, there are financial limitations with our proposal, large funding is required to construct a working prototype of the ocean Roomba. But the gap could be breached if the NEA collaborates with international organisations such as the Ocean Cleanup. The NEA could also try to garner public support from both local and international communities, which helps to urge companies to fund the development of the robot and expedite the process. Given enough time, support and investments, it is possible to mostly rid the ocean of plastic pollution in the long run.

## **References:**

**Marine plastic pollution.** (n.d.). IUCN. <https://www.iucn.org/resources/issues-brief/marine-plastic-pollution>

**News Medical.** (2019, June 19). *Impact of plastics on human health and ecosystems.* News-Medical.net. <https://www.news-medical.net/news/20100320/Impact-of-plastics-on-human-health-and-ecosystems.aspx>

**Plastics in the Ocean Affecting Human Health.** (n.d.). Case Studies. [https://serc.carleton.edu/NAGTWorkshops/health/case\\_studies/plastics.html](https://serc.carleton.edu/NAGTWorkshops/health/case_studies/plastics.html)

***The Economic Impacts of Marine Debris on Tourism-Dependent Communities | OR&R's***

***Marine Debris Program.*** (n.d.). <https://marinedebris.noaa.gov/research/economic-impacts-marine-debris-tourism-dependent-communities>

**Witch, W.** (2022, February 15). ***Why the travel and tourism industry need to combat plastic pollution.*** Water Witch. <https://waterwitch.com/combating-plastic-pollution-in-the-ocean-sea-cleaner/>

**A., A.** (2019, November 22). ***Why is marine life so important? – MassInitiative.***  
<https://massinitiative.org/why-is-marine-life-so-important/>

**WWF Singapore.** (2022, April 4). ***Towards a plastic-lite Singapore.***  
<https://www.wwf.sg/plastics/>

***Diploma in Environmental & Water Technology (N74).*** (n.d.). Ngee Ann Polytechnic (NP).  
<https://www.np.edu.sg/schools-courses/academic-schools/school-of-life-sciences-chemical-technology/diploma-in-environmental-water-technology>

***Diploma in Environmental & Marine Science.*** (n.d.). School of Applied Science.  
<https://www.rp.edu.sg/SAS/full-time-diplomas/Details/diploma-in-environmental-and-marine-science>

## **NEA:**

**Wikipedia contributors.** (2022, July 1). ***National Environment Agency.*** Wikipedia.  
[https://en.wikipedia.org/wiki/National\\_Environment\\_Agency](https://en.wikipedia.org/wiki/National_Environment_Agency)

***Air and Coastal Water Quality Monitoring.*** (n.d.). <https://www.nea.gov.sg/our-services/pollution-control>