

TEKNOFEST

AEROSPACE AND TECHNOLOGY FESTIVAL

TECHNOLOGY FOR HUMANITY COMPETITION

PROJECT DETAIL REPORT

PROJECT CATEGORY: Social Innovation

PROJECT NAME: Pollution consuming Hydro Robo-Bug

TEAM NAME: Robalo

TEAM ID: 60574

TEAM LEVEL: Primary School-Secondary School

TEAM MEMBERS: Adan Shahzad and Minahil Anees

ADVISOR NAME: Shazia Masood

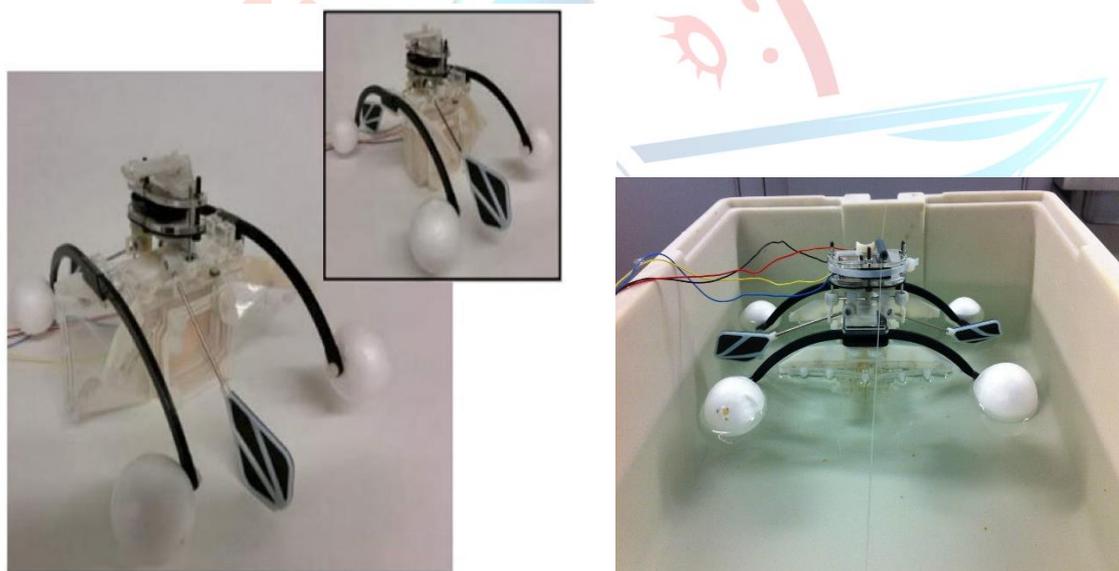
Project Detail Report

1. Project Summary:

Robo-Bug: An energetically autonomous artificial water Boatman. When it's hungry the Robo-Bug opens its mouth and rows forward to fill its microbial fuel cell (MFC) stomach with nutrient-rich dirty water. It then closes its mouth and slowly digests the nutrients. It aims to develop an autonomous swimming technique able to operate indefinitely in remote locations by scavenging its energy from nature.

Robo-bug uses its paddles to move forward and generates the power to do so by eating the microbes in dirty ponds and digesting them in its artificial stomach (MFC/ nature inspired engine.)

Its an artificial organism, combining of two sub-systems ; a bio-inspired energy source and bio-inspired actuation. The combination of these two sub-systems will produce closed-loop energetic autonomy. This also enables it for long term self power capability.



The inspiration for this project is taken from water boatman and basking shark. Water boatman is one of the few aquatic bugs that are not predatory and do not bite people. Instead, they suck juices from algae and detritus. They are common in ponds and other water bodies. Basking shark is Britain's largest fish but despite its size this shark feeds on tiny prey, filtering around two million litres of water per hour through its gills.

The design of the project is quite simple, involving basic paddles in order for the Robo-Bug to swim and it also has supportive stabilizers attached to it. It has motorized rowing mechanism as well as motorized feeding mechanism for the Robo-Bug to refuel automatically on microbes of dirty water bodies.

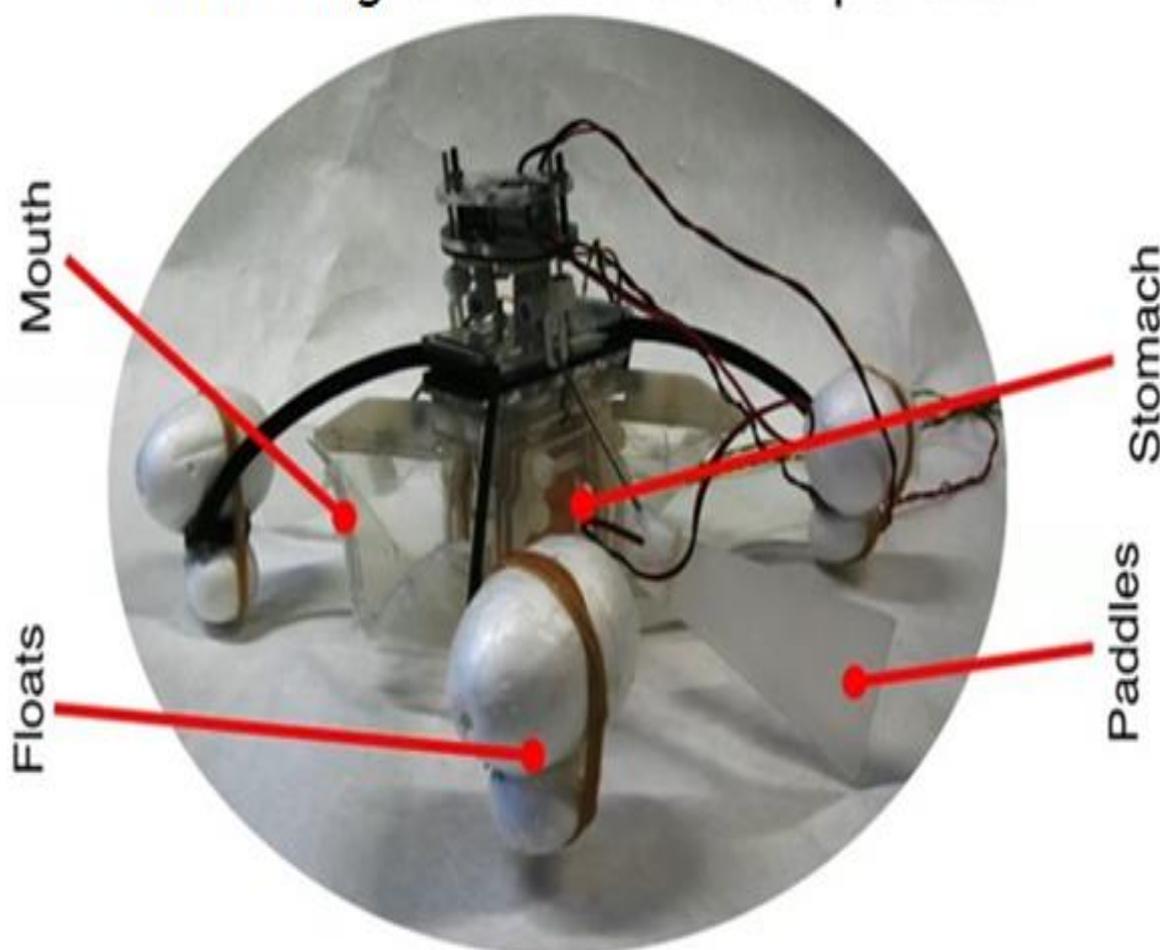
2. Problem/Issue:

Water is an essential part of everyone's lives. Everyone needs water in order to survive. But although it is an essential, it is still scarce in many developing nations like Ethiopia, The Republic of Chad, The United Republic of Tanzania and DRC these are the few nations which do not have access to clean water supply. Almost 29 percent (2.1 billion) people in this world do not have access to clean drinking water. Unclean water is responsible for almost 1.2 million deaths each year. A solution must be worked in order to solve this global problem.

A number of solutions were available but every invention had its flaws. Keeping in mind the errors and faults made by the predecessor, we tried to create the flawless Robo-Bug.

The previous inventions that were created to purify water but they all lacked one thing that is being time-efficient & self-operating. They took hours in order to clean a few cups/litres of water, moreover they were costly and were not afforded by developing nations, where the supply of clean water is actually low.

Robo-Bug: a robot that eats pollution



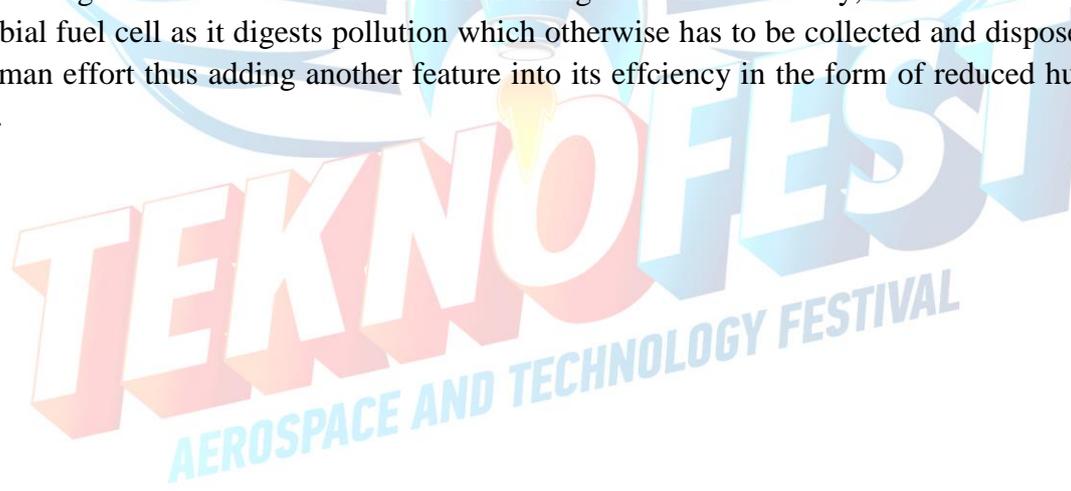
Robo Bug proves itself as the perfect solution by being a nature friendly, pollution consuming machine which also keeps in view the time constraint so it does not need to be charged time and again, just keeps on working non stop through the nature provided fuel.

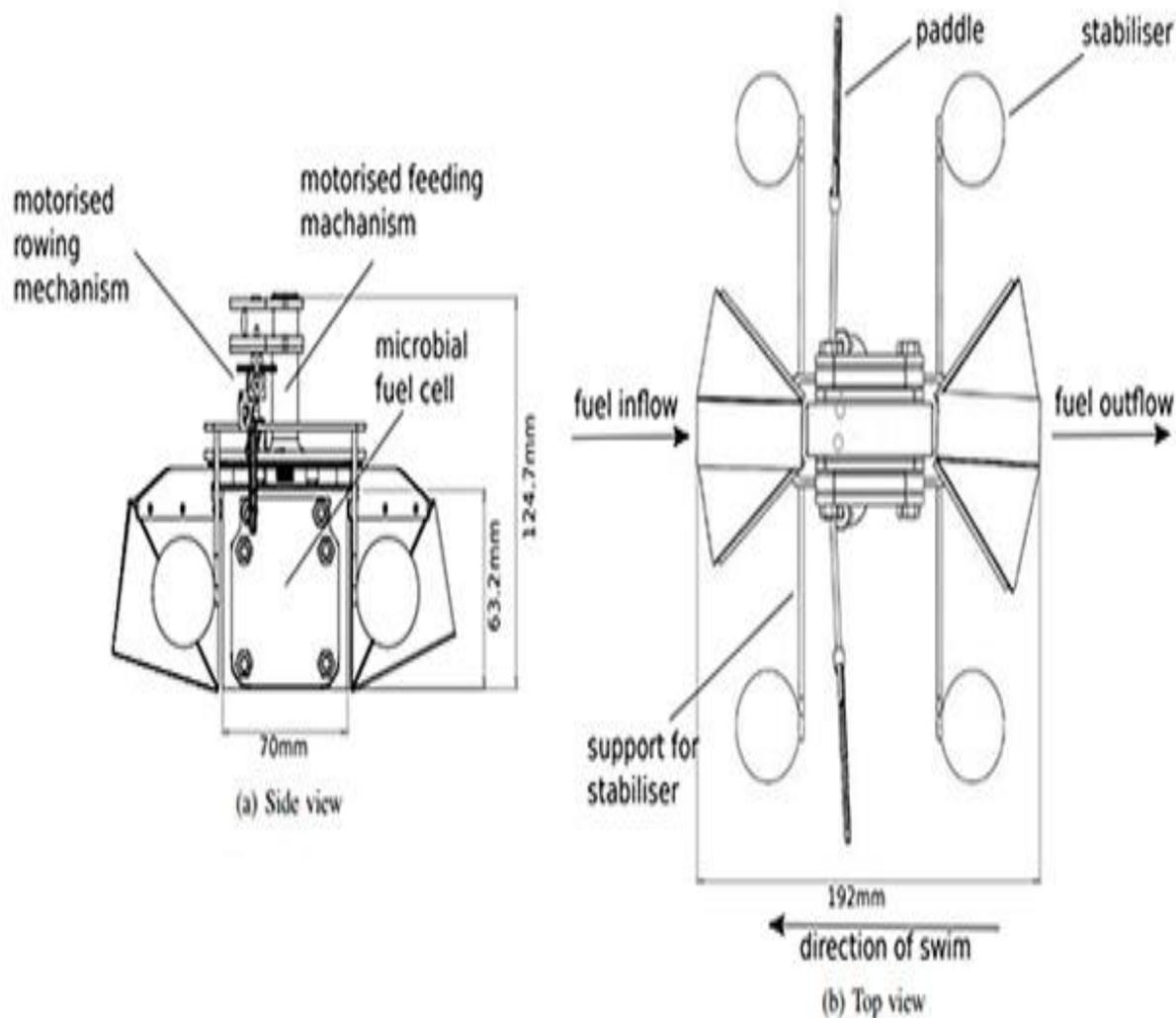
3. Solution

As we are creating something that is for the betterment of the world we must keep in mind all of the other factors which are causing climate change, global warming or any kind harm to our planet. Robo-bug is an environmentally safe/friendly robot that does not need batteries to be recharged instead it fuels up on microbes in water bodies and propels itself.

Conserving non-renewable energy sources is of utmost priority. Taking this into consideration, our robo bug doesn't operate on any source of chemical or electrical energy. Excluding batteries as the power supply prevents the contamination of water too, as the electrolytes and chemicals in the batteries can pollute the ground water as well as the surface water.

The robo bug has also cut down the time for cleaning a certain water body, thanks to its efficient microbial fuel cell as it digests pollution which otherwise has to be collected and disposed of by human effort thus adding another feature into its efficiency in the form of reduced human effort.

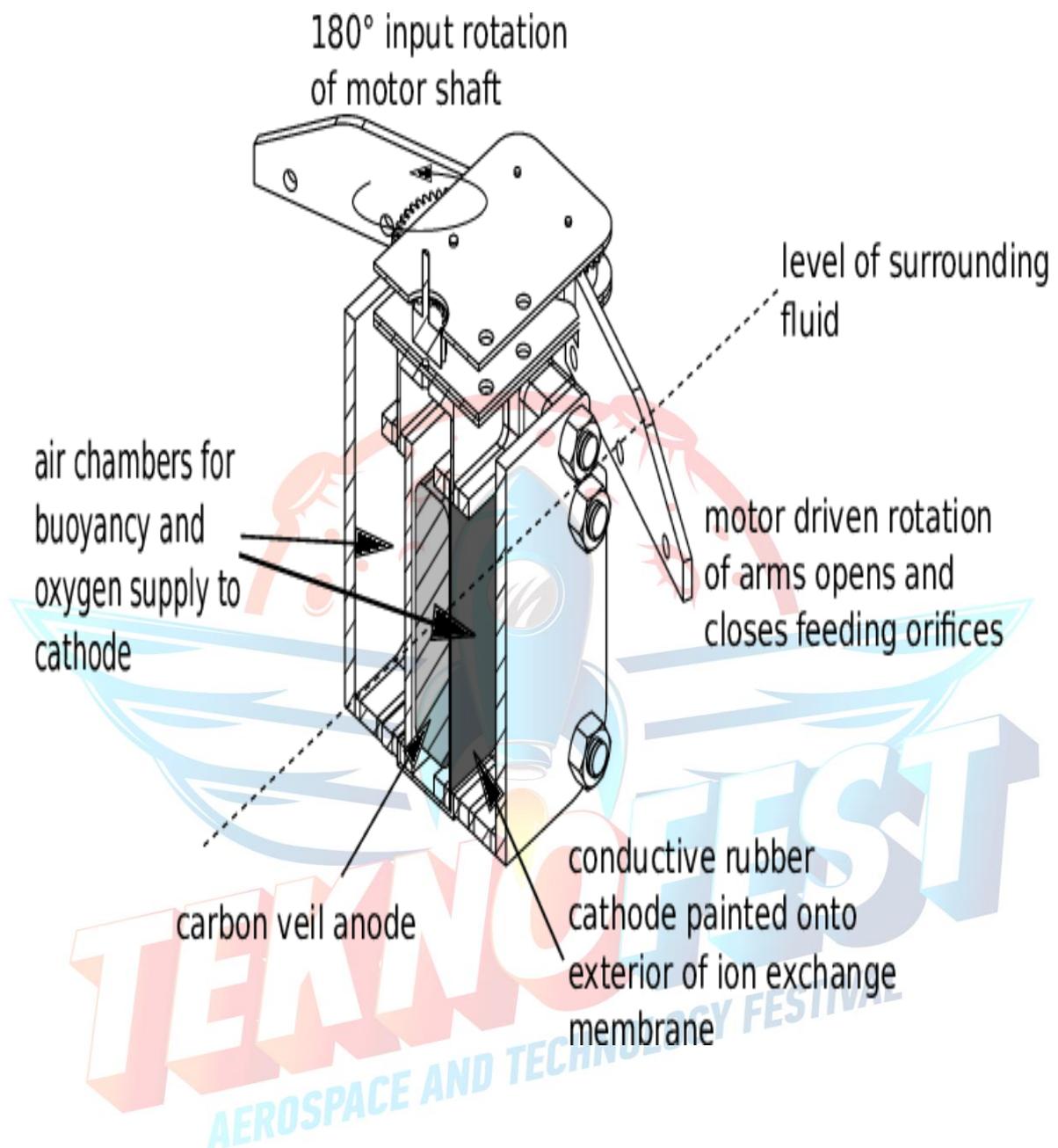




4. Method

The Robo Bug is placed in a dirty pond or any other water body, the dirtier the water body the better it would work as it would be receiving more than sufficient supply of food to continue propelling itself on the hunt for more.

The MFC has two electrodes held in separate chambers. The anode chamber that contains the bacteria is anaerobic. This means that it does not contain oxygen. The cathode chamber is aerobic. That means it does contain oxygen. The oxidation process occurs inside the bacteria living in the anode chamber. Bacteria digests waste and chemicals and uses commercially available voltage step-up hardware to produce usable voltages. The set-up is able to produce 25 watts per cubic meter of food and bacteria. The energy generated exceeds the energy requirement to complete the mechanical actuation needed to refuel.



5. Innovative Aspect

The innovative aspect of this project is that it is environmental friendly and is not time consuming when it comes to purifying water. It's also not costly like other products previously made.

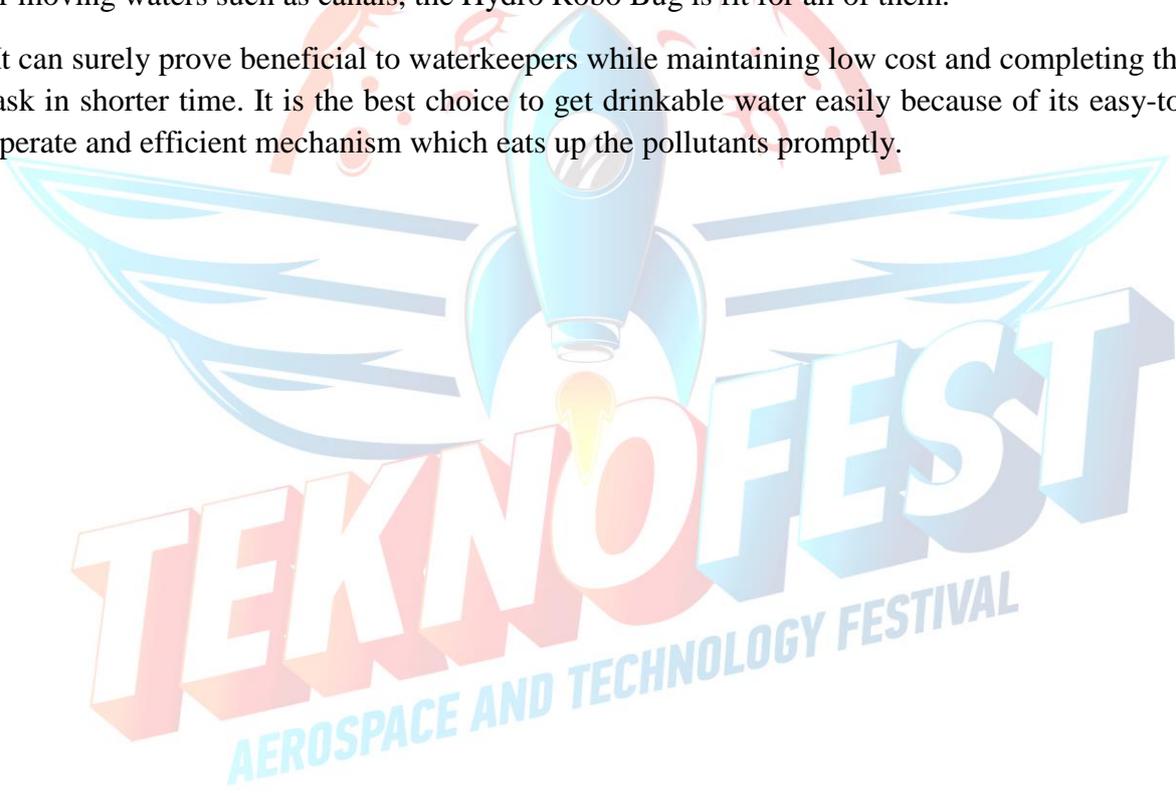
As the latest studies show that this type of project takes a lot of time. Realistically it takes 3 hours to purify 3 litres of water which is pretty decent but we have made further improvements as we need to purify large water bodies, we would extend the capacity by using a better MFC as it is a main component in the purifying process so that it does the task of purifying water in

atleast half the time taken before or even less then that. We would also use a more environmental friendly product in the form of the Hydro Robo-Bug as we would not use any plastics and use a better alternative like stainless steel or even better bamboo for the base of the Hydro Robo-Bug. Previously when it was built they used plastic for the base which is again harmful for the environment.

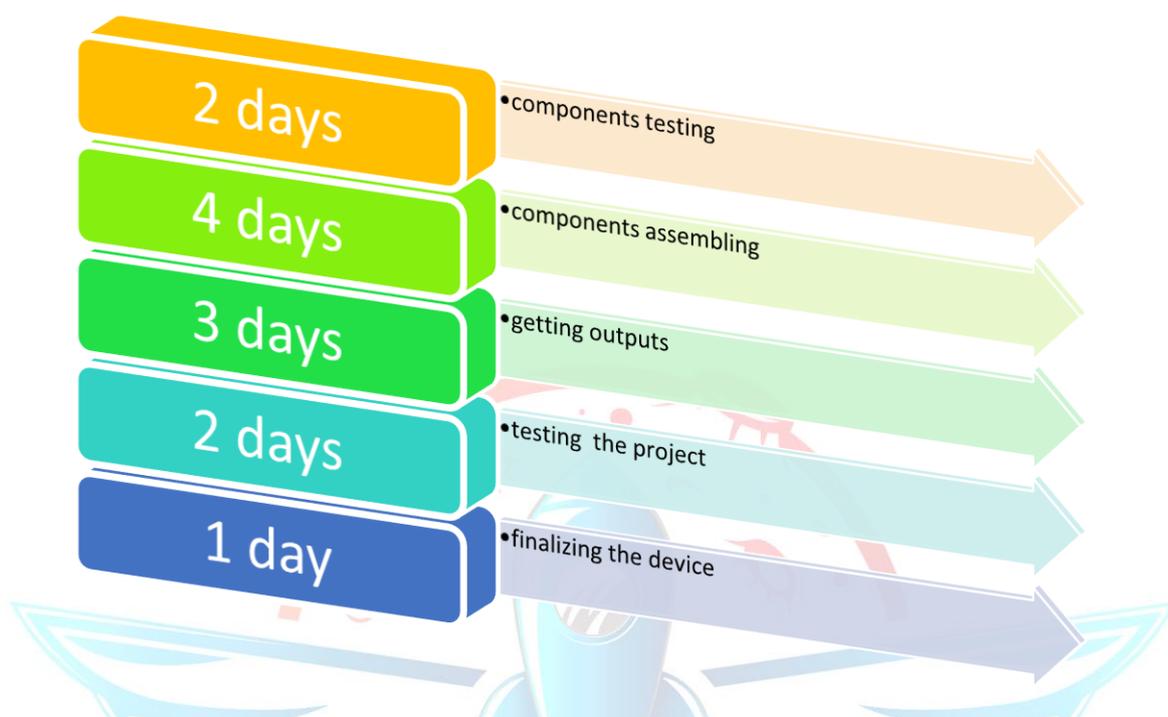
6. Applicability

It can be deployed in any water body, smaller or bigger, due its extensive hardware and functionality which makes it super compatible for any type of waters where it can swim with help of its paddle like legs and light weight body. Be it stationary water bodies such as lakes or moving waters such as canals, the Hydro Robo Bug is fit for all of them.

It can surely prove beneficial to waterkeepers while maintaining low cost and completing the task in shorter time. It is the best choice to get drinkable water easily because of its easy-to-operate and efficient mechanism which eats up the pollutants promptly.



7. Estimated cost and Project Scheduling



Name	Unit Prices	Detail / description
MFC microbial fuel cell	\$58.0	The main component (200 l system) of making hydro robo-bug
Bamboo(outer layer; Option 1)	\$22.0 per tone (only a few kg of bamboo needed to build)	The base of the project option 1
Stainless steel(outer layer; option 2)	\$2.43 per kg (less then kg needed)	The base of the project option 2 (alternative)
(rowing mechanism) Paddles	\$5.99	For the hydro robo-bug to move forward.
(rowing mechanism) Flaps	\$3.99	For the hydro robo-bug to move forward
Floats	\$1.75	To make the robo bug stay afloat
Total Cost (Approx.)	\$75	

8. Target Group of the Project Idea (Users):

The targeted group of audience are the developing nations which cannot afford the supply of clean water. For example Ethiopia, almost 60 percent of the population in Ethiopia lacks basic access to drinking water. Half of those without basic access are drinking water that is more than likely or certainly contaminated, like hand-dug wells, unprotected natural springs, and ponds. Papua New Guinea, The Republic of Chad, Uganda, Democratic Republic of Congo, Muzambique, United Republic of Tanzania, Somalia, Pakistan and Nigeria.

These are just a few nations which would be willing to use this project. As time goes on many advanced nations would be needing this as water is already a scarce resource and everyone needs it in order to survive. Like the basking shark the Hydro Robo-Bug will ensure the supply of clean water at a low price and in less time. Even the people who are worried about the planet/climate will approve of this project as it does its work without harming other life and our planet.

9. Risks

Just like limitations on every other project, limitations on this one also vary. (risks occurring globally according to each country)

- Some countries may not have the required products to build this successfully and it may not work properly with other replaced components.
- The price of certain products in making of this may increase or even decrease depending on resources of the country used in as time passes.
- It is necessary to keep the condition of parts in check other the wear and tear of mechanical parts of the Robo-Bug might just fall off into water body which will completely eradicate the actual purpose.
- Our robo-bug is a small machine which could be damaged by interaction with the aquatic life in the water body.
- Also due its small size, it might look like bait/food to the fish or other aquatic life and they might try to eat it, thus contributing to a risk factor.

10. Resource

The resources taken for this project are;

(Water boatman as it is harmless to humans and keeps the algal under control. Its also beneficial for fishes as a food resource.

Basking shark as it purifies water. (inspiring the creation of hydro robo-bug)

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5.D. Pant, G. Van Bogaert, L. Diels and K. Vanbroekhoven, "A review of the substrates used in microbial fuel cells (MFCs) for sustainable energy production", *Bioresource technology*, vol. 101, no. 6, pp. 1533-43, Mar. 2010.

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7.C. E. Reimers, H. A. S., J. C. Westall, Y. Alleau, K. A. Howell, L. Soule, et al., "Substrate Degradation Kinetics Microbial Diversity and Current Efficiency of Microbial Fuel Cells Supplied with Marine Plankton Substrate Degradation Kinetics Microbial Diversity and Current Efficiency of Microbial Fuel Cells Supplied with Marine", *Applied and Environmental Microbiology*, 2007.

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