Hong Kong Student Science Project Competition 2023

Template of Extended Abstract (Invention)

(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: SABC233

Project Title: Coral Nursery

Project Type: Invention

• Background

- Provide background information as to learn about the audience for whom the project is addressing
- Provide highlights of **literature review** and/or related technologies or devices, with the support of pertinent and reliable references
- Provide an overview of work, create a point of view as to define the needs and insights of the audience and mention the **research or technology gap the project is trying to fill**

As the ever-increasing emission of carbon dioxide into the environment, the effect of global warming is becoming increasingly critical with every passing day. As a result, the temperature of the seawater is affected, causing large amounts of coral reefs to die due to coral bleaching, consequently causing harm to the ecosystem.

• Objectives

- State the **aim(s)** of project

The aim of the project is to speed up the growth rate of coral reefs by setting up a bilayer structure, which produces calcium carbonate to promote the growth of coral reefs, maintaining a healthy ecosystem and biodiversity.

• Methodology

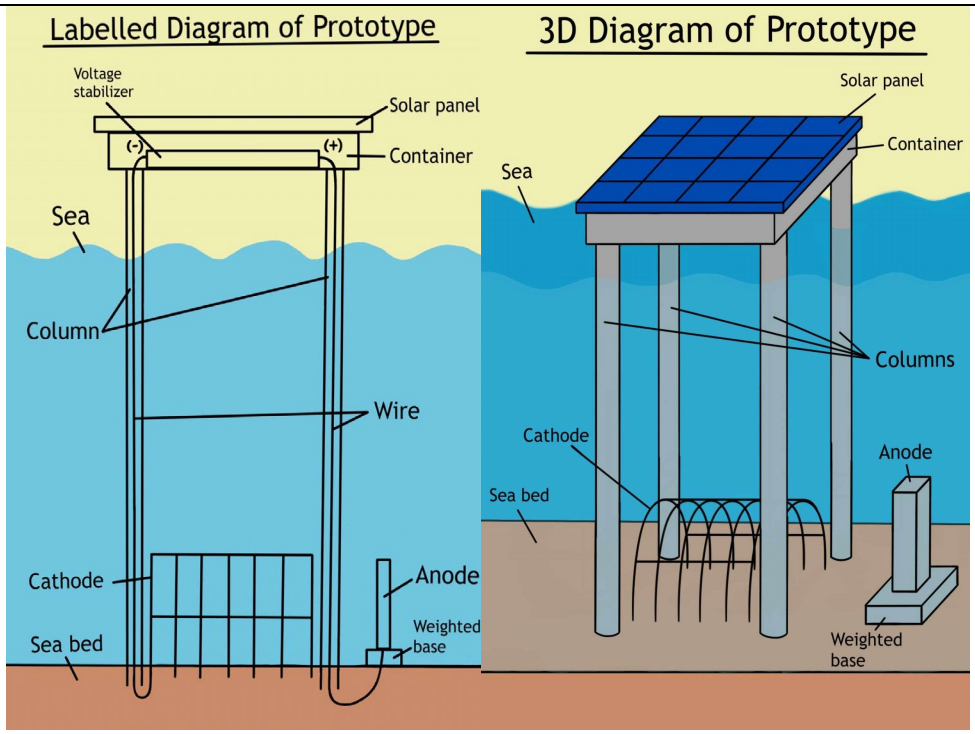
- Briefly describe the **approaches** used e.g., use of equipment, materials, tests and experiments
- Explain the selected implementation strategies with the **scientific theory**

To form calcium carbonate, electrolysis of seawater is the main method. A titanium mesh of anode and an iron-made cathode is placed underwater. Through electrolysis of seawater, the titanium mesh (anode) will form oxygen and cathode will form hydrogen. The two different poles will then attract cation and anion respectively. As the cathode attracts anions such as sodium, magnesium and calcium. On the surface of cathode, magnesium hydroxide and calcium carbonate will be formed at a slightly alkaline pH. Calcium carbonate produced is used to facilitate the growth of coral reefs.

To support the energy requirement of electrolysis, on the upper layer of our invention, a solar panel connected with voltage stabilizer is installed to give out a 6-8V power supply. The circuit will connect from the upper layer to the anode and cathode through the columns.

• Design of Invention

- Describe the **design** and the **principle** of invention (e.g. The ideation of the projects, the prototypes or creative solution as far as applicable)
- Provide sketches / drawings / photos of the invention



The structure of our invention is simple and practical. The design is inspired by the structure of an oil rig, the upper part of the invention consists of a solar panel which stays above sea water to prevent it from getting wet.

There are also 4 columns connected to the upper part of the invention, and are inserted into the sea bed to fix its position and prevent it from being washed away by sea water.

There is also a container attached to the underside of the solar panel, which contains a voltage stabilizer inside, used to receive the generated power from the solar panel to distribute it to parts which consume energy in the setup.

For the lower part of our invention, many iron wires are bent to form the structure of a rib cage, which provides a huge surface area for the growth of corals and attracts the sea animals such as clown fish,starfish and blue tang to promote the ecosystem. To carry out electrolysis, which makes the whole thing work, we put a vertical standing anode fixed to the ground by a weighted base on the side. Together with the cathode in the middle, coral growth can be promoted and a healthy ecosystem can be maintained.

- **Application / Market Need**

- Explain the area of **application** and function of invention
- Indicate the market need and impact of invention
- Discuss **limitation** and compare with existing related works (if any)

The device can be used to promote coral growth by providing necessary materials for coral growth through electrolysis, while giving them a habitable area to grow in with our ring cage-like structure which provides sizable surface area for the formation of the coral. We can apply this invention in areas where coral bleaching is most serious, such as the Great Barrier Reef, Hawaii, Jarvis Island etc. This can help compensate for the substantial amount of dead coral in such areas, which in turn contributes to maintaining a healthy ecosystem.

A healthy ecosystem is substantial in supporting commercial and subsistence fisheries, as well as jobs and businesses through tourism and recreation. It is estimated that half of all federally managed

fisheries are very much dependent on coral reefs and related habitats for a portion of their life cycles. Local economies also acquire billions of dollars from visitors through diving tours, recreational fishing trips, hotels, restaurants, and other businesses based around reef ecosystems. Therefore, the invention can help make an impact on maintaining a healthy ecosystem in areas of need, which directly results in meeting the market needs in relevant areas.

Although this invention can be very beneficial to not only the environment but also to related markets, there are some limitations in hand. The setup may be inconvenient to put in place correctly as it consists of two parts. In addition, it has to be done underwater and has to be anchored to the ground via embedding the four columns into the sea bed. However, We still firmly believe that the advantages far outweighs the disadvantages. With proper installation, the device will operate without much room for error with its simplistic structure and inflexible design.

- **If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award.** ***(Word limit: 300 words)***

Mentioned as part of the UN's 17 sustainable development goals, life below water is one of them. Coral reefs are considered as part of that category, and also will be our project's main focus. The project is mainly about an invention that can assist the growth and formation of coral reefs, which can bring about a healthy ecosystem supporting biodiversity and protect the endangered sea creatures. In addition, coral reefs act as natural barriers to storm surge and extreme weather events ,and can also support coastal areas in adapting to the impacts of climate change. Also, coral reef ecosystems support employment and nutrition for billions of people around the world, contributing to an estimated amount of 10 billion dollars annually in tourism income. This shows that our project's goal can boast development globally, but now for the "sustainable" part.

Our invention mainly consists of a solar panel on top, which provides the required energy to carry out electrolysis of seawater at the bottom part of the setup. Also, the entire setup is reasonably light on the consumption of materials when being constructed. This reflects that the full function of the invention can be utilized while maintaining a "sustainable" status. Therefore, it can be seen that our project not only focuses on the promotion of coral growth, but also to achieve sustainable development with the same invention at the same time.

- **Conclusion**

- Make a **<u>data-driven</u>** conclusion of the project and the way forward of the invention process
- Justify if the proposed project meets the objective(s)

All in all, the prototype we have designed is created through choices we have made after an extensive amount of research was done. Obviously, due to not everything being perfect, we will utilize the rest of our time to further improve every part of our invention. In the future, we will be doing some experiments to realize the true potential that our prototype has. As of now, we have created a prototype that will meet the objectives.

The main method we will be using to promote coral growth, electrolysis, done by passing electricity through the anode and the cathode, which ultimately releases calcium carbonate, an essential material to the growth and development of corals. This growth and development of corals can lead to a healthy ecosystem, attracting marine species to go around and around the created coral reefs, they can use the coral reefs for many different reasons, ultimately creating a significant natural habitat that was once lost to environmental reasons. This can create a new home for a diverse amount of marine species, as tremendous amounts of marine species depend on coral reefs for survival. As these species will find their place in these new corals, biodiversity will maintain.

As we have mentioned, the objective of this project was to promote coral growth with calcium carbonate, to maintain a healthy ecosystem and biodiversity. Therefore, I believe that the proposed project indeed meets the objectives listed above.