

# Hong Kong Student Science Project Competition 2023

Template of Extended Abstract (Invention)

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

**Team Number: JABC232**

**Project Title: Marine Medic**

**Project Type: Invention**

## I. Background

Hong Kong is a hectic and vibrant city that is renowned for its iconic skyline, bustling streets, and rich cultural heritage. However, like many other modern cities around the world, it also faces several environmental challenges.

The issue of waste and rubbish is one of the most significant environmental challenges in Hong Kong. As reported by Lau et al. (2017), plastic debris accounts for up to 70% of beach litter in some areas of Hong Kong, highlighting the urgent need for proactive measures to reduce waste pollution and promote beach cleaning. There are several initiatives and organizations in Hong Kong that are actively working to address environmental challenges. For example, Hong Kong Clean up has been conducting beach clean-up activities for over twenty years, involving more than 550,000 participants in beach cleaning. These initiatives provide significant support in keeping the beaches clean. However, beach cleaning requires a significant amount of manual labour to clean up. Thus, there is an urge to design a device to reduce the labour cost needed for beach cleaning.

## II. Objectives

This project is designed with the intention of addressing the issue of labour shortages while also improving the environment. Our invention has the potential to significantly reduce the amount of garbage that accumulates on the beach, making it cleaner and more habitable for everyone, not only us, the Hong Kong residents, but also the species in Hong Kong. If our project is implemented in the future, we anticipate that it will have a positive impact on both the environment and the community.

## III. Methodology

Technology is advancing rapidly, and innovations are emerging continuously, with significant impacts on various industries and processes, including manufacturing and healthcare. Among the most notable technologies are the Google USB Accelerator and 3D printing, which have practical applications. The Google USB Accelerator is designed to enhance the performance of machine learning models on edge devices, allowing faster and more efficient operation. On the other hand, 3D printing is a cost-effective and sustainable method for prototyping that minimizes material waste and transportation emissions.

Machine learning and auto filtering are also applied in the construction of debris removal

systems for beaches. Machine learning is a powerful technology for processing and analyzing data, enabling businesses and organizations to handle large volumes of data quickly and accurately. Auto filters are effective tools for collecting and removing debris from beaches, capturing items of various sizes and types and significantly reducing waste on the beach to prevent it from entering the ocean.

Overall, these technologies have practical applications that enhance performance, reduce waste, and provide more sustainable solutions, making them essential tools in various industries and processes.

#### **IV. Design of Invention**

Our device is equipped with several components that work together to remove human garbage from beaches effectively.

First of all, there is a singulator on top of the device, which helps to filter out tiny substances, such as sand, and prevent them from entering, clogging and damaging the device. This ensures that the device can operate efficiently and effectively. Besides, there are barriers on both sides in order to avoid the things collected from running out. Furthermore, the barriers are narrowing so that the filtered matter can pass the intermediate part one by one, letting the separator recognise and analyse which of the two groups it belongs to accurately and effectively. The matter collected will be delivered to the hole of the intermediate part of the machine by the singulator which will shake by itself.

In the intermediate part of the device, a high-frame-rate camera is installed. This camera is connected to a Raspberry Pi, which runs a program to differentiate between human garbage and natural matter. This distinction is important in ensuring that the waste is disposed of properly, in accordance with environmental regulations.

In addition, there is a tippy thing located inside the sorter which delivers the object to the appropriate location based on its type. This ensures that they are disposed of properly and that those natural resources are separated from man-made garbage.

#### **V. Application / Market Need**

This device, which can effectively separate human garbage from natural matter on Earth, can be utilized during beach cleanup efforts to streamline and enhance the process of beach cleaning. According to the survey conducted by the Beach Patrol (2019), cleaning the foreshore areas requires a total of 800-1700 hours of operation, making it clear that beach cleaning is a time-consuming task. Since its founding in 2000, Hong Kong Cleanup has organized a diverse array of clean-up activities, involving over 550,000 participants in beach clean-ups. However, two decades of data and volunteers' feedback indicate a need for greater community engagement and action, as many individuals participate in beach clean-ups only once before becoming reluctant to engage in further voluntary activities. The aforementioned facts demonstrate that the number of volunteers is insufficient. Additionally, a volunteer noted that the most challenging and distressing aspect of the cleanup process was separating sand from plastic products, as the latter were extremely "vulnerable" and could be easily shattered. Therefore, our invention is critical in tackling this problem mentioned by the volunteer.

**VI. 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)**

This sustainable development initiative not only benefits humans but also promotes the well-being of species, making it highly deserving of an award. It helps to mitigate the harmful effects of human activity on wildlife, which is a well-known problem. Animals often suffer from habitat loss caused by human encroachment and are also threatened by pollution, including waste left behind by humans. With the removal of such waste, animals are no longer at risk of suffocation and the ecosystem can begin to recover. Additionally, this initiative creates more habitat for many species, promoting biodiversity.

**VII. If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. (Word limit: 300 words)**

Our invention is expected to benefit a diverse range of stakeholders, including beachgoers, tourists, local communities, and conservationists. By creating a cleaner and more enjoyable beach environment, our project can enhance the experience of people who visit the beach while also addressing pressing issues such as littering, pollution, and environmental degradation.

For tourists, our invention offers the opportunity to enjoy a cleaner environment, which can help to address issues such as declining tourism revenues, unemployment, and economic inequality. Local communities can benefit from the project as well, with access to safer and healthier beaches that can address public health, environmental justice, and community well-being concerns.

In addition, our invention helps to protect marine life and ecosystems from pollution and other environmental threats, which is of particular interest to conservationists. By promoting biodiversity and preventing habitat destruction and climate change, our project can help to address some of the most pressing environmental challenges of our time.

**VIII. Conclusion**

In summary, we have observed a significant pollution problem not only in Hong Kong's marine environment but also on its beaches. To address this issue, we propose inventing a device that can distinguish between garbage and usable materials found on the beach, thereby reducing the burden on beach cleaners. Given the large size of the beach and the limited number of workers available to manage it, we believe that this solution can promote sustainable development, improve waste management efficiency, reduce costs, and minimize the need for additional manpower. By freeing up these resources, we can allocate them to other areas with greater potential benefits.

Our project is developed based on previous project and the enhancement is below: