

Initial Project Proposal

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Project Name: Garbage Collecting Boat
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1.0 Description of Problem:

One of the most critical environmental problems exists in the world in recent years is water pollution. Water pollution is the contamination of water bodies, usually as a result of human activities. Water pollution results when contaminants are introduced into the natural environment. 15 million children under the age of five die each year because of diseases caused by drinking water [1]. One type of water pollution is surface water pollution, including pollution of rivers, lakes, and oceans. The causes of water pollution include a wide range of chemicals and pathogens as well as physical parameters. Plastic waste, being a significant water pollutant, is causing massive destruction of marine life and is believed to be responsible for deaths of more than 100,000 sea mammals, seabirds and various types of fishes. The existing methods for collecting the garbage on surface water are mostly filtering water in a fixed position or hiring a person to clean up surface garbage manually. Therefore, a more effective approach to garbage collecting is needed.

2.0 Proposed Solution:

The team proposes a garbage collecting boat that collects floating garbage on the water surface. For the scope of this project, we do not consider water flow. The mechanism used to collect garbage is to use an upsloping conveyor belt to filter out the trash and send to the compression chamber on the boat. When the compression chamber is full, the garbage would be compressed and sent to the storage space. Electricity stored in storage batteries would power the whole boat. Solar panels would be installed on the boat so that the solar power can be converted to electric energy and stored in the storage batteries. The boat would be controlled by a computer through wifi, and the Global Positioning System (GPS) would be available on the boat. When the garbage storage space inside the boat is full or the boat is about to running out the power, the boat would send a warning signal to the computer and return to the starting point or a preset location.

The boat would have two operation modes: fixed route mode, and manual mode. In the fixed route mode, the boat would follow a route set was defined in advance with the assistant of GPS system. In the manual mode, the heading would be manipulated by a person remotely from the computer in real time. There would be a camera on the boat that sends the real-time image to the computer. A concept sketch of the garbage collecting boat is included in appendix 1.

3.0 ECE477 Course Requirements Satisfaction

3.1 Expected Microcontroller Responsibilities

ECE477 is an embedded systems course which requires the use of a student-programmed microcontroller. For the project proposed, a microcontroller will be used for the purposes of interfacing to various sensor inputs, GPS inputs processing, motor control, battery control, and camera control. Other functionality may be included as the ECE477 design semester progresses.

3.2 Expected Printed Circuit Responsibilities

ECE477 is an embedded systems course which requires the use of a student-designed and built printed circuit board (PCB). For the proposed project, the PCB is expected to incorporate a microcontroller, storage batteries, solar panels, regulation circuitry, and motor control circuitry. Other functionality may be included as the ECE477 design semester progresses.

4.0 Market Analysis:

A potential usage case for the garbage collecting boat would be for the lakes in parks. Visitors may leave trash that goes into the lake, and there also might be many fallen leaves floating on the surface. The traditional garbage collecting boats are all huge and lack of aesthetic resulting improper for tourist attractions. The garbage in lakes at scenic spots is usually scattered around the surface of the water, and thus the labor cost for hiring people to collect surface garbage manually is high. In this case, our garbage collecting boat proposed would be a perfect suit for this situation. It can collect the garbage at a low cost and keep the overall aesthetic of the scenic spot. Solar and electric power is used which is not only good for the environment but also save the cost of operation.

5.0 Competitive Analysis:

5.1 Preliminary Patent Analysis:

Advantageous to the project proposed, there appears to be some existing prior art in the field to help protect the project against patent infringement claims. This prior art is described in further detail in sections 5.2 and 5.3. There is, however, some relevant intellectual property in the field, and this is described in the subsections below.

5.1.1 Patent #1: US Patent Application US20180049615 A1:

Patent Title: "APPARATUS FOR COLLECTING GARBAGE AND DEBRIS FOR A MOTOR-SWEEPER"

Patent Holder: VETRUCCI; Giancarlo; (Fiorenzuola D'Arda, IT) ; COLLETTI; Alfonso; (Rottofreno, IT)

Patent Filing Date: February 22nd , 2018

The present [2] invention relates to a motor-sweeper for cleaning large surfaces such as streets or industrial facilities. In particular it refers to an apparatus for collecting garbage and debris from the ground to apply to a motor-sweeper, wherein the broom for collecting garbage always remains adherent to the ground and the space between the garbage conveyor assembly toward the collecting container and the broom, and between the broom and the container remains uniform

despite the wear of the brooms. Thus, the cleaning capability is not lost and the machine efficiency is improved.

5.1.2 Patent #2: 20180171571 A1

Patent Title: "SYSTEM FOR AERATION AND SEPARATION OF CONTAMINANTS FROM FLOWING WATER "

Patent Holder: LADKAT; Rajendra Vithal; (Pune, IN)

Patent Filing Date: June 21st , 2018

A system [3] for aeration and separation of contaminant from flowing water is disclose wherein a contaminated water travel through up and down flooring and diverted its path frequently by the means of baffle to aerate and increase travel distance in particular channel. The sink between last baffle and partition wall collect contaminant and sliding mesh above wall collect the plastic, metallic, paper and weed. Water plants in H block baffle groove with pebbles & soil removes toxic gases in flowing water.

5.1.3 Patent #3: 20100185342 A1

Patent Title: "Autonomous Water Craft "

Patent Holder: Wubker, Jr.; Roy H;

Patent Filing Date: July 22nd , 2010

The present invention [4] is a control module which can communicate with an autopilot control system of a marine vessel and enable an individual or other device to remotely control the marine vessel. The control module can communicate wirelessly with a laptop computer, a PDA, a computer connected to the Internet or other types of control devices which are capable of controlling a marine vessel. The control module can also be in communication with preprogrammed navigation software which communicates with and operates an onboard marine autopilot system. A satellite phone can also transmit navigation commands to the control module via a sat com communication modem connected to the control module.

5.2 Commercial Product Analysis:

A number of commercial products focusing on ocean garbage cleaning have been made and putted into use. Despite the difference in the target surface water, all these products described below have some similar structures to our project.

5.2.1 Mr. Trash Wheel:

Mr. Trash Wheel [5], officially called the Inner Harbor Water Wheel, is a trash interceptor, a water-wheel vessel that removes trash from the Inner Harbor in Baltimore, Maryland. It is powered by water power and solar power, and the machine places trash from the harbor onto an onboard conveyor belt which routes it into dumpsters on the vessel. Mr. Trash Wheel was invented by John Kellett in 2008. The Mr. Trash Wheel vessel is part of the Waterfront Partnership of the City of Baltimore's "Healthy Harbor Plan." Data shows that Mr. Trash Wheel is effective and has collected much garbage so far.

5.2.2 The Ocean Cleanup:

The system [6] consists of a 600-meter-long floater that sits at the surface of the water and a tapered 3-meter-deep skirt attached below. The floater provides buoyancy to the system and prevents plastic from flowing over it, while the skirt stops debris from escaping underneath. Both the plastic and system are being carried by the current. However, wind and waves propel only the system, as the floater sits just above the water surface, while the plastic is primarily just beneath it. The system thus moves faster than the plastic, allowing the plastic to be captured.

5.2.3 HENGCHUAN Trash Skimmer for Lake Cleaning:

The Trash Skimmer Boat [7] uses high performance marine diesel engine to achieve Euro II standard. It meets the requirements of environmental protection, and thus can prevent secondary pollution. The Front collection includes the Rotary arm, the Cutting and Collecting Scissors, the Side Collection Chains, the Front collection belt and so on. The Front collection can automatically adjust the depth by using hydraulic cylinders. When sailing, it can extend the water surface to reduce drag and increase navigation speed. When fishing, it can also adjust the collection depth according to the thickness of water grass.

5.2.4 JuLong Aquatic Weed Harvester:

Multifunctional Algae Gathering Ship [8] is suitable for work in rivers and lakes. The gathering work for lake algae, floating rubbish, weeds and water hyacinth can be easily controlled through buttons in operation cabin. The ship is adopted horizontal-cabin style drive. The stern shaft has high precision water lubrication sealing device, thus it will not produce any oil leakage during operation process, the engine is used high-performance marine diesel engine with low noise, and fully comply with the requirement of environmental protection. During work, it will not increase any other pollution.

5.3 Open Source Project Analysis:

Thorough targeted web searches were conducted on Google. Although search efforts revealed commercial products (discussed in 5.2), no open source projects similar to the described project could be found.

6.0 Sources Cited:

[1] "40 Interesting Facts About Water Pollution," *Conserve Energy Future*, 06-Jul-2017. [Online]. Available: <https://www.conserve-energy-future.com/various-water-pollution-facts.php>. [Accessed: 30-Jul-2018].

[2] "APPARATUS FOR COLLECTING GARBAGE AND DEBRIS FOR A MOTOR-SWEEPER," *US Patent and Trademark Office*, [Online]. Available: <http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnethtml%2FPTO%2Fsearch-adv.html&r=18&f=G&l=50&d=PG01&s1=%22garbage+collecting%22&p=1&OS=%22omni+cat%22&RS=%22garbage+collecting%22#top>. [Accessed: 04-Aug-2018].

- [3] "SYSTEM FOR AERATION AND SEPERATION OF CONTAMINANTS FROM FLOWING WATER," *US Patent and Trademark Office*, [Online]. Available: <http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahhtml%2FPTO%2Fsearch-adv.html&r=1&f=G&l=50&d=PG01&p=1&S1=%22river+cleaning%22&OS=%22river+cleaning%22&RS=%22river+cleaning%22>. [Accessed: 04-Aug-2018].
- [4] "Autonomous Water Craft," *US Patent and Trademark Office*, [Online]. Available: <http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahhtml%2FPTO%2Fsearch-adv.html&r=7&f=G&l=50&d=PG01&p=1&S1=%22remote+boat%22&OS=%22remote+boat%22&RS=%22remote+boat%22>. [Accessed: 04-Aug-2018].
- [5] "Trash Wheel Project," *Waterfront Partnership*. [Online]. Available: <http://baltimorewaterfront.com/healthy-harbor/water-wheel/>. [Accessed: 04-Aug-2018].
- [6] "Ocean Cleanup", *The Ocean Cleanup*. [Online]. Available: <https://www.theoceancleanup.com/>. [Accessed: 04-Aug-2018].
- [7] "High Quality River Garbage Collection Boat/trash Skimmer For Lake Cleaning - Buy Collecting River Boat For Sale,High Quality River Garbage Collection Boat,Trash Skimmer For Lake Cleaning Product on Alibaba.com," *www.alibaba.com*. [Online]. Available: https://www.alibaba.com/product-detail/High-quality-river-garbage-collection-boat_60760094026.html?s=p. [Accessed: 04-Aug-2018].
- [8] "Julong Aquatic Weed Harvester/ River Cleaning Boat /garbage Collecting Ship For Sale - Buy Julong Aquatic Weed Harvester,High Efficiency River Algae Cleaning Boat,Low Price Lake Plants Harvester Product on Alibaba.com," *www.alibaba.com*. [Online]. Available: https://www.alibaba.com/product-detail/JuLong-Aquatic-Weed-harvester-River-Cleaning_60744874257.html. [Accessed: 04-Aug-2018].

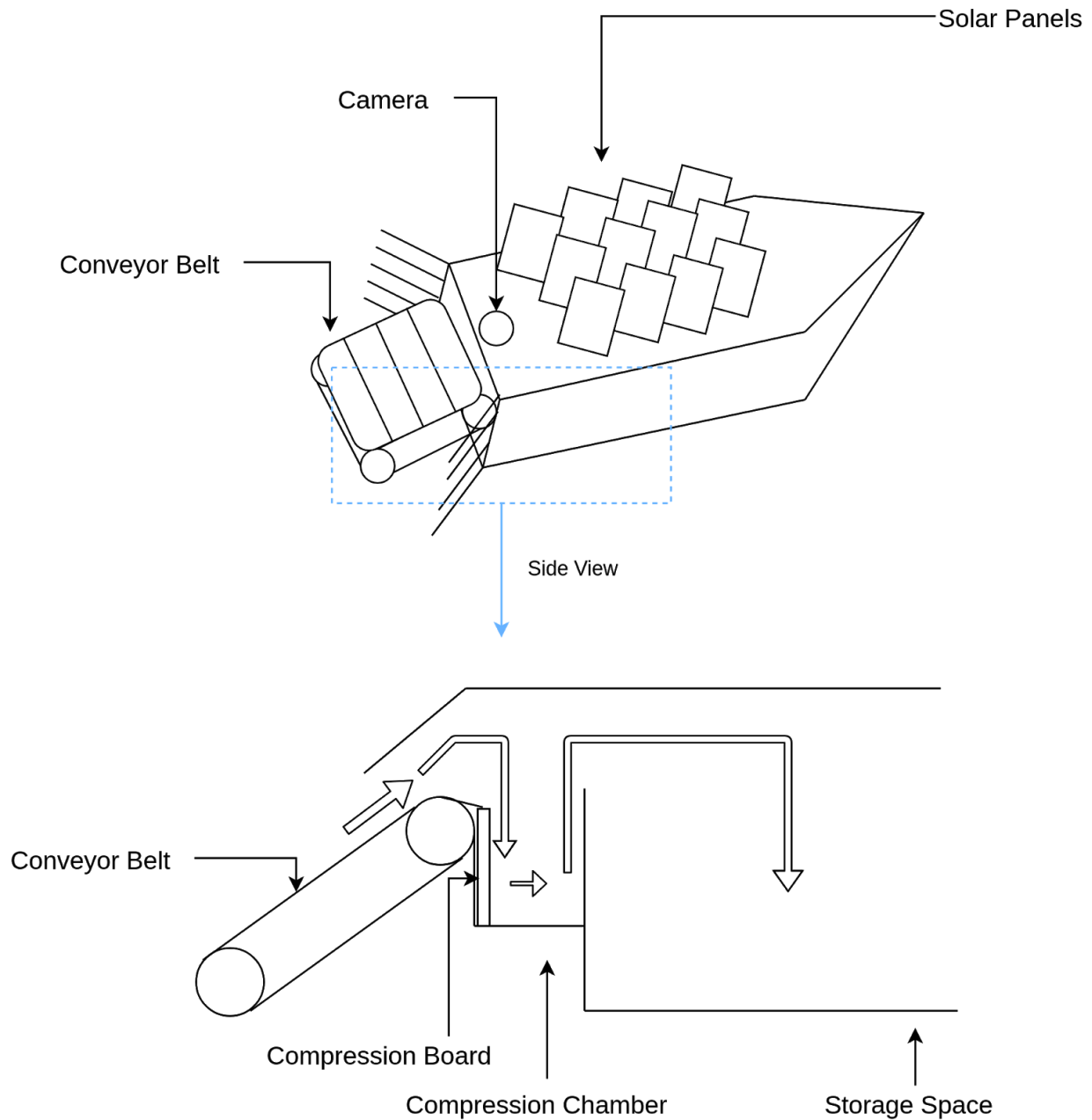
Appendix 1: Concept Sketch

Figure 1. Garbage Collecting Boat Sketch

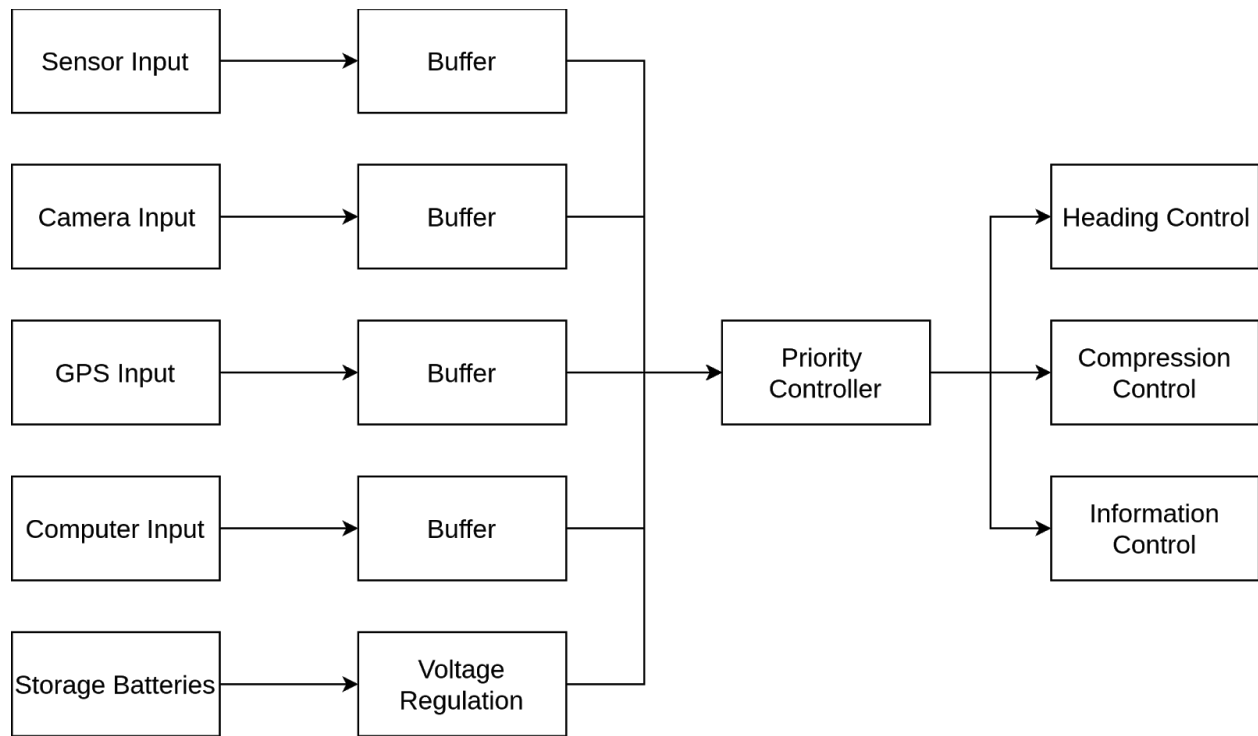


Figure 2. Functional Sketch