Beach Roomba

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Introduction

Most people that have attended a beach before know of the growing problem that is trash on our beaches and there has been many study's done to show the harm that it does to this earth and the things on it. That being said may people still leave there trash lying around on the beach. This trash and debris is usually picked up by hand by volunteers or beach maintenance crews, but what if it could be done faster, easier, and with less man power? It has been done, there are companies that create machines that can be driven or dragged around to pick up the trash, but the can be very expensive.

Design Requirements

1. Able to clean a beach that is 750 square feet
2. Should be able to clean the beach in 6 hours
3. Should be no bigger than 8 feet wide, 12 feet tall, & 10 feet long
4. Should be able to pick up trash from the dirty dozen list below

Item	Amount
Cigarette Butts	68,273
Plastic Pieces	47,903
Food Wrappers (Candy, Chips, etc.)	32,154
Bottle Caps (Plastic)	28,506
Foam Pieces	19,036
Glass Pieces	17,652
Straws, Stirrers	15,957
Beverage Bottles (Plastic)	13,349
Bottle Caps (Metal)	11,019
Grocery Bags (Plastic)	8,134
Beverage Cans	8,041
Other Plastic Bags	7,341

Figure 1: Dirty Dozen (Reference 1)

Criteria & Constraints Table

Must	Should	Want
1. Must be able to pick up debris	1. Should be able to dump debris at the proper location	1. Should be able to clean a 750 sq ft Area in 6 hrs
2. Must be able to move through the sand	2. Should be able to pick up 80% of trash in it first pass	2. Should be able to leave the ground groomed after every
3. Must be able to separate sand and debris	3. Should be able to dig down 3” to pick up sand	3. Should be easily repairable and maintainable
4. Must be able to carry trash to the proper disposal location	4. Should be a tow behind device	
	5. Should be able to withstand corrosion from sand and water	
	6. Should be able to withstand temperatures well above 0 deg	

Testing

Wheels

While starting the design we looked at three different types of wheels, Vex Robot Wheels, RC Wheels, & RC Paddle Tires. After testing how wheel they turned the axles and how much force it takes to pull them we came up with this chart:

Wheels ->	Vex	RC	Paddle
Avg. Drag	0.75 lbf	1.00 lbf	1.50 lbf
Avg. Resistance	0.52 lbf	0.67 lbf	2.18 lbf

Belt

To move the sand into the Storage System the device uses a belt. This belt is made of a mesh that needs to be turned by the wheel. Using a MATLAB script to calculate the size of the gear the final gear was:

Mesh

When testing the mesh we took into account how fine the mesh was, how well it bent around the belt hub, and how fine the openings are in the mesh. When doing this we gathered this data:

Mesh Size	1/4 in	1/8 in	1/16 in
Sand Stopped	0 g	2 g	6 g

Collection System

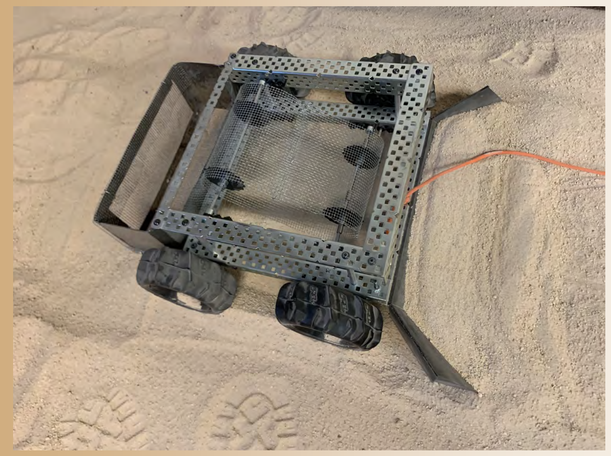
To get the trash, a plow was mounted on the front of the device to move sand and trash up and onto the belt that will take it to the storage system.

Storage System

To carry the trash, a collection system was designed to hold trash and not sand. The collection system uses some of the same mesh from the belt, this is to help filter the sand out of the trash even more.

Design

The design for the device is a scaled down trailer for a tractor or truck. The design focused on functionality of the belt, scoops, and plow while still being a accurate small scale model. To simulate being towed a string was tied to the front of the device while the other side was attached to a motor that was capable of pulling it at a constant speed. The final design has the wheels, belt, mesh, collection system, and storage system found during the testing.



Conclusion

As this device is just a prototype there are may things to do with it in the future. One of those could be to scale it to the actual size of a trailer and use it for a real beach. That being said many more tests would have to be done to correctly identify what the best approach would be when it comes to cleaning the beach.

References

Reference 1 - www.nysbeachcleanup.org

Reference 2 - http://www.hbarber.com/

Reference 3 - https://www.freethink.com/environment/beach-cleaning