

## **Innovative Design for Enhanced Street Sweeping: Introducing a New Gutter Broom**

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The City College of New York

ENGL 21007: Writing for Engineering

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April 26, 2023

This product serves not as an entirely new truck but as an item that can be purchased and added to existing street sweepers. This product makes it a more cost-effective, alternative way to buying brand new street sweepers. This coupled with that fact that street sweepers have a lifespan of 5 years can save money to any company or state organization like NY sanitation. The new product also has a 75 percent more effective street cleaning process. The product comes with different mechanisms the first of which is a new sweeping mechanic where instead of flaking out dirt and trash that the truck could be cleaning up but just pushes to the side with its old brushes, it vacuums it all up until it reaches the back of the truck in its original compartment or an additional compartment that will come with the product as well. The company or group that buys the product will have the option to either install it themselves with their own technicians or pay an upgraded fee to have our own technicians come and install it themselves.

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## Introduction

Carol Lee

Sweeper Trucks are cleaning vehicles that are designed to clean and maintain streets and roads. Historically, it was common for workers to manually clean the streets by hand or by using brooms. It was only during the early 20<sup>th</sup> century in the United States that the first motorized street sweeper was invented. In 1849, C.S. Bishop, patented the first motorized street sweeper. His early model was a mechanical street-sweeper, equipped with a broom and two conveyor belts that deposit the trash into a container ([The history of the broom and the Brooks Sweeper], n.d.). Based on Bishop's design, Charles B. Brooks, an American inventor, developed a platform on wheels with two revolving brushes that could be interchanged with a flat scraper for use during winter. Brooks's design resembles the modern-day street-sweeper machines we commonly see ([Charles B. Brooks Patented One of the First Self-Propelled Street Sweepers], n.d.).

With the development of vacuum sweepers, in the early 1970s, new street sweepers were made, equipped with a high-powered fan and a vacuum chamber that creates a suction to extract dirt and deposit it into a container for disposal. With additional features, such as spray nozzles and water tanks, they can clean the streets more thoroughly. The issue with vacuum sweepers is that not only does it struggle to pick up large debris, but it also releases large amounts of dust into the atmosphere. ([Brief History of the Vacuum Sweeper], n.d.).

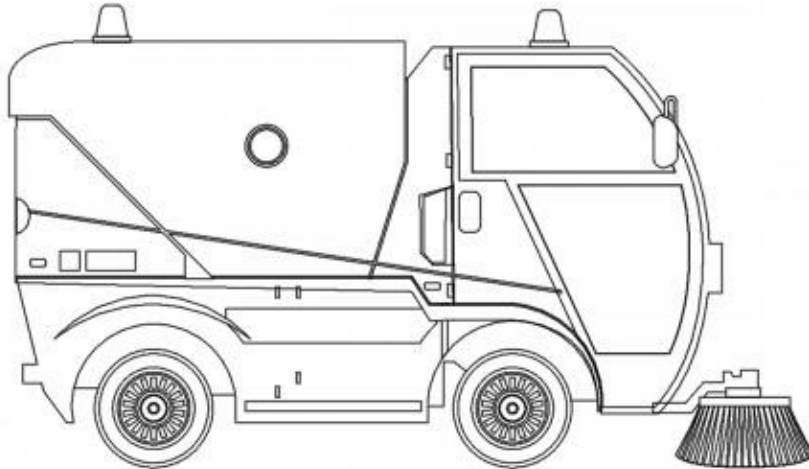
The effectiveness of street sweepers, regenerative air or mechanical, heavily relies on the type of debris being picked up. On one hand, vacuum sweepers are only effective when it comes to picking up small debris. On the other hand, mechanical sweepers are only effective at picking up larger debris. Additionally, they all share the similar flaw of potentially causing respiratory problems, as well as contributing to air pollution.

The Allianz Johnston 4000, manufactured by the England-based company Johnston Sweepers Limited, is used by New York City for street sweeping purposes ([Johnston Sweepers, Ltd. Establishes a Foothold in the USA] n.d.). To remove debris from the surface of roads, the vehicle is equipped with three sweeping mechanisms—the side brushes, the rotary brush, and the vacuum. The two side brushes, otherwise known as the gutter brooms, move debris towards the rotary brush in a clockwise or counterclockwise direction. Then, with the help of a vacuum, the rotary brush then moves the debris up and onto the conveyor belt, where it is deposited into the hopper.

While gutter brooms are the most important component in this street sweeper, there are design limitations that affect their effectiveness. The major design limitation is the dust cloud it creates when it is in the process of sweeping. Since the brooms move in one continuous, circular direction, they can either miss debris, or push debris back onto the street because of this continuous motion. Additionally, the bristles of the gutter broom making constant contact with the road can cause them to damage and wear down over time, reducing its lifespan. With this in mind, we want to redesign and replace the gutter brooms with these limitations in mind. Our goal is to innovate a new broom that will be more effective at picking up debris, without it pushing back out onto the streets.

## Proposed Program

YiXuan Shi



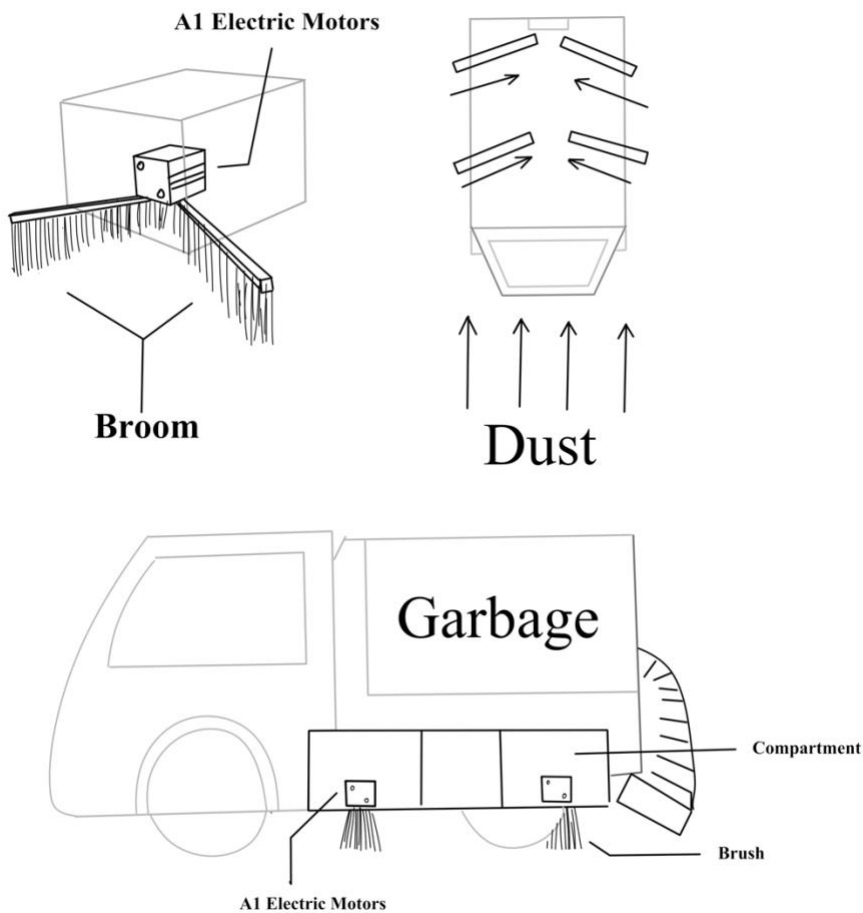
Mechanical brooms are the oldest and simplest type of street sweeper. It works like a classic broom and dustpan. The main broom runs along the bottom of the machine. This rotating, cylindrical brush moves debris onto a conveyor belt and into a hopper. However, the way a traditional broom collects the dust can cause a lot of problems. Firstly, it can be very noisy, especially when operating in residential areas. This might trouble the residents nearby and disrupt their daily activities. Secondly, it will cause air pollution. Since the broom will flake the dust out of the road and flow into the air and cannot collect it immediately, it can seriously hurt the air quality.

To fix the problems, we decided to innovate a new kind of broom. With a compartment that holds it, we can apply it to every truck. Instead of rotating and rubbing the ground, the new brooms collect the garbage by gathering the garbage in the middle so it will not cause any noise problems. As the truck moves forward, most of the debris would be pushed to the middle. Since the broom stays stationary, instead of moving constantly at a clockwise direction and

pushing debris outward, it allows the debris to move in a linear direction for suction by the vacuum/

In the top left corner of the Figure below is our new broom. For the dust is too small that stuck in the crack, the motor helps keep pushing the broom down and can vibrate the brooms to makes the dirt out of the crakes.

Below the motor is the 7-8 feet width broom, it can efficiently collect the garbage into the middle of the truck and the vacuum system can collect it into the truck.



*Figure 1.- A drawing of our product*

**Table 1.-** Specifications sheet of our product

Spec Sheet of Our Product			
Type of Trucks	Height	Width	Size
Small street sweeper	2 feet	7-8 feet	0.6096* 2.1336 cm <sup>3</sup>
Large street sweeper	3 feet	10-13 feet	0.9144*3.048 cm <sup>3</sup>

## Innovation Process

Jerek Rodriguez

Our innovation is going to help any surface be a cleaner surface, with an improvement of 60-70% in cleaner surface away from trash, dirt, and debris. Street Sweepers have adjustable compartments and brooms that can be changed and replaced when they go bad or no longer work effectively, with our compartment you can expect a big improvement in cleaning the streets. Our brooms are made from materials like Polypropylene, Steel wire, Nylon, and natural fibers like Bassine and Coconut husk.

Our compartment brings a new motor and new brooms that make the work of cleaning the streets more effectively. Our compartment has A1 Electric Motors, which not only replaces the old hydraulic motors used in many street sweepers, but it also makes the cleaning more effective and better for the environment because it takes away the cause of emissions and noise pollution. Our A1 Electric Motors are sustained by the current voltage output of the battery in the street sweeper, so no extra batteries are necessary for this installation. We are aware that many



street sweepers trucks use 12-24 volts batteries and some even 48 volts batteries, this is why we made our product so that it works effectively with all types of battery voltages from 12 volts up to 48 volts. We do recommend at least 24 volts for our product to have more than enough voltage output so that not only the truck itself but also our electric motors receive more than enough volts to work efficiently, but even with 12 volts batteries and systems our product will work efficiently due to its A1 Chip which helps the distribution of voltage around our motors and make each volt more efficient.

The installation does require professional certified technicians to do the installation. The technicians will need to replace the old hydraulic motors that come mounted to the bracket in the vehicles frame with our electric motors. Our product is made so everything is plug and play, and that little wiring is required when installing our product. After the technician replaces the old motors and mounts our electric motors, he is then going to cut the old hydraulic wiring and do a reconnection with our motors wiring, which comes already cut and ready to be reconnected by the professional technician. Our electric motors A1 Chip do the rest of the work in monitoring the speed, torque, height, and feedback to the driver's console. After, the technician just has to install our brooms into the bracket by making sure the broom is positioned over the bolts holes and lined up with the corresponding holes on the bracket. The brooms should be at the correct height relative to the ground, which is about 1-3 inches. You will then need to use fasteners to secure the broom to the bracket, our fasteners are tightened to a specific torque of 25-100lbs, so they won't come loose during operations. Lastly, ensure that the broom is in good height relative to the ground and is making good contact with the road surface.

This product will not affect the way the street sweepers employees operate the vehicle, in fact, it will be easier for them to operate new and advanced technology that does the job faster

and more efficient. We are so confident in our product that we offer a full 1-year warranty to all our customers and businesses to ensure not only our product is being effective, but also our customers feel safe when buying our product.

## Costs and Profits

Carol Lee

With the production of our product, we need to consider the costs of materials, labor, and the manufacturing process. The installation will cost between \$500 –\$1,000, depending on the specific size street sweeper. The location and additional tools needed for installation of our broom stay the same with both the small and larger trucks. The smaller trucks cost \$500 for installation since the broom needed is smaller. However, for the bigger trucks, the size will affect the installation cost, leading to around \$1,000 in installation costs alone. With installation, we need to hire individuals to put the product together. These individuals will be technicians who already have previous experience installing the current gutter brooms on the Allianz Johnston 4000. With this, a one-week intensive training session will cost \$1,000 –\$3,000 for two experienced technicians. The price is justified considering the value of training provided to ensure safe and efficient installation of our broom design. This intensive training will include hands-on practice, as well as an in-depth explanation of the design and function of our broom, as well as the safety procedures and installation techniques. Investing in intensive training can help prevent future costly mistakes, as well as ensure that there will be a smooth and linear transition from the current brooms to our new brooms. Then, the technicians will be paid around \$50 – \$100 per hour, depending on experience.

With our materials, we will be charging an estimate of \$2,000 per unit as a baseline since different materials will be tested to figure out which one will be used in the final design. The

maintenance fee is around \$1,000-\$2,000, but with the contract we have, we are not contractually obligated to pay any maintenance fees. The mechanic costs for 1-2 days will be \$800. Rent and utilities will be \$2,000, as well as \$1,000 for required tools and a \$500 installation fee. These costs come out to a total of \$6,300. We will be selling our product at \$10,000, resulting in a \$3,700 profit per unit. We estimate that we will sell around 150 units, totaling to \$555,000 in profit. With our selling price, our product is 50% cheaper than the current industry ones, with a 50-70% improvement of quality and efficiency.

## Marketing Strategies, Evaluation & Compensation

Our product has been tested throughout multiple different situations and received feedback by hundreds of NYC Street Sweeping Organizations, therefore, our product meets the requirements to be able to do its job efficiently. Throughout those test, we also gave those organizations a discount for testing our product and first serving installation of our product to them so they can enjoy our product as soon as possible. Contracts are currently being made and part of those contracts is keep receiving feedback on how to make our product even better after the test we have done, as well as long term goals that we both parties want to come down to. Long term goal is better than short term goal, we are going to do things right for the long term and implement that to go worldwide, but first we are going to get the respect and credit here in New York City, where our company is located.

## Task Schedule and Evaluation techniques

Dillon Romney

For our task schedule, we will first have the product made, depending on the size of the broom and truck. Then, we will find an installation crew who can make sure the brooms fit in

properly and are able to retract it in with enough space when not in use. As well as, allowing the brooms to easily pick up most of the dirt and grime left on the streets. Lastly, testing our latest product by using it on the dirtiest streets in NYC, showing how much the brooms can pick up trash and the area it can cover. This is one of many steps to keep the streets of New York City clean and with the public's approval; we can ensure that the roadways will be much clearer for smooth and easy traveling.

We will also test exactly how much noise pollution is reduced from our product. To test noise pollution, we will determine the sound level measurement in the absence of any sweeping activity. Then we will start the street sweeper, engage the gutter broom, and measure a sound level meter at a fixed distance and measure the readings. After multiple readings have been recorded, we will calculate the average sound level, and then compare our average sound level compared to the baseline noise level, as well as the sound level of the current brooms.

## References

North American Sweeper Magazine. (n.d.). Brief History of the Vacuum Sweeper. Retrieved from [https://www.nasweeper.com/2018/12/main\\_articles/brief-history-of-the-vacuum-sweeper/](https://www.nasweeper.com/2018/12/main_articles/brief-history-of-the-vacuum-sweeper/)

World Sweeper. (n.d.). Charles B. Brooks Patented One of the First Self-Propelled Street Sweepers. Retrieved from <https://www.worldsweeper.com/History/BrooksSweeper.html>

World Sweeper. (n.d.). Johnston Sweepers, Ltd. Establishes a Foothold in the USA. Retrieved from <https://www.worldsweeper.com/SweepingCoProfiles/JohnstonNA/index.html>

World Sweeper. (n.d.). The history of the broom and the Brooks Sweeper. Retrieved from <https://www.worldsweeper.com/History/BrooksSweeper.html>