

Electric Street Vacuum Cleaner (ESVC) and Litter Picker



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(Session 2020-2024)

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and Litter Picker**

**FINAL YEAR PROJECT REPORT
(SESSION 2020-2024)**



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We would begin by thanking Allah (S.W.T), without whose help we would not have been able to prepare the project report presented. Thanks to Allah Almighty, who showered us with the strength and mental fortitude to effectively achieve this goal. We also thank our supervisor and co-supervisor, **Dr. Atiq Ur Rehman**, and **Engr. Umer Farooq**, along with other faculty members, for their guidance and encouragement throughout the project. Their knowledge, experience, and professional expertise in Mechatronics will enable us to complete this project successfully.

ABSTRACT

The major problem of third world countries is the problem of littering and its management, so we have devised a plan to tackle this problem as a whole. The major portion of littering is because it is improperly managed and accumulated. Our project aims to use our engineering knowledge for the improve of the robotic field, so our final year project is focused on designing and implementing a system that would be able to pick up the litter with a powerful battery suction system on mobility that can move from one place to another with the help of motors. We would also use a 240 liters bin to store the litter picked up from streets and nearby areas. As for the clean air program, this all will be powered by the battery. So this project will help accumulate the litter in one place and then be put in storage.

NOMENCLATURE

ESVC	Electric Street Vacuum Cleaner
SDG	Sustainable Development Goals
EV	Electric vehicle
Ltr	Liters
gm	Grams
FYP	Final Year Project
GPS	Global positioning system
GSM	Global system for mobile communication
BMS	Battery management system
ESPs	Espressif module
IoT	Internet of things

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Introduction:

Keeping streets clean is important to maintaining a healthy and sustainable environment. Street litter picking is a common practice for cleaning streets, but it often requires much time and manual labor. A street vacuum cleaner can significantly improve the efficiency and effectiveness of street cleaning, reducing the time and effort required to keep streets clean. Products like these are very common in the world that maintain some standards of cleanliness for their people. Figure 1 shows the ESVC currently being used in Italy and produced by a company named TSM [1].



Figure 4 ESVC was built in Italy by a company TSM

We decided to create the same product, but better, more affordably, and with more parameters because other companies offer this service to the current world for the same or higher prices. Figure 2 shows the ESVC being used in Belgium and is produced by a company named Glutton [2].



Figure 5 ESVC Glutton by a company in Belgium

Background and Motivation:

In simple terms, when we look around us, the world, especially Pakistan, has become a place where we have litter and unwanted garbage around us, and yet there is no effective

mechanism to solve the problem. The world has devised a solution but it has yet to reach Pakistan. We would be the first to make such a system In Pakistan.

The main motivation behind this project is that we want to see a cleaner and greener Pakistan, as our Prophet MUHAMMAD (PBUH) has told us at various points in his life that cleanliness is half of your faith.

Sustainable Development Goals:

Out of the 17 goals defined by the Department of Economic and Social Affairs of the United Nations to achieve prosperity and a more sustainable future for all the people around the world, our product falls under the following categories:

Good Health and Well-being:

The product will follow this part of SDG in terms that litter in this world is a major concern for health problems. As it picks up litter, this machine causes the major portion of the health problems to disappear if time to time picking litter is executed.

Climate Action:

The major portion of the climate problems rises from basic 2 problems. One is air pollution, and the other is the litter problems that the litter does not properly degrade, which is one of the major reasons for climate change.

Life on Land

Life on land is a great initiative from the UN that we should live a healthy life and fewer people should die from health issues. To cater to this problem, the world has created these kinds of machines to pick up litter.

Literature Review:

Littering is a global issue worsening, and cleaning up waste from public areas may be difficult and time-consuming. A potential remedy for this issue has been the employment of litter-picking machines. In this study of the literature, we will look at the design, efficacy, and potential environmental effects of litter-picking devices. We will also look at any restrictions and potential future lines of inquiry.

Littering is a serious environmental issue that impacts the health and happiness of our planet's people. In addition to degrading the beauty of our natural surroundings, litter also hurts wildlife, contaminates waterways, and endangers people's health. As a result, picking up litter has emerged as a crucial activity to reduce the negative effects of littering. The paper on litter picking offers insightful information on the strategies, equipment, and processes involved. The significance of litter picking and its contribution to lowering litter pollution are emphasized in the paper. Also, it examines the different sorts of litter, where it comes from, and how it affects the environment [3].

The paper on the litter pickup device offers a novel remedy for the litter pollution issue. The design and creation of a machine that can effectively and efficiently pick up trash from a variety of surfaces are described in the paper. Using a litter-picking machine has many benefits, including greater worker safety, labor cost savings, and increased productivity. The many parts of the device are also covered, including the collection system, sorting system, and a power source. The study offers insightful information on the difficulties encountered and solutions found for the litter pickup machine development. It also displays the outcomes of field tests and shows how well the equipment works to pick up litter [4].

Keeping our current circumstances perfect and liberated from litter is fundamental for the well-being and prosperity of the two people and untamed life. Litter makes an unattractive and unsanitary appearance, yet it can hurt creatures and harm environments. By appropriately discarding our waste and considering not litter, we can assist with safeguarding our planet and guarantee a solid future for a long time. How about we all do our part to keep our networks spotless and delightful by appropriately discarding our garbage and empowering others to do likewise. Together, we can have a constructive outcome on our current circumstances and make a more brilliant, better future for all [5].

The shift towards electric vehicles is a fundamental stage toward a more reasonable future. The EV powertrain is a basic part of this progress, and headways in this innovation are making EVs more open and reasonable than at any time in recent memory. With decreased discharges, commotion contamination, and a lower proprietorship cost, EVs are becoming an undeniably attractive choice for purchasers. The advancement of more proficient and solid EV powertrains holds much more important advantages for the climate and the economy. As we keep putting

resources into and working on this innovation, we can anticipate a cleaner, better planet and a more reasonable future for all [6].

The natural advantages of electric vehicles (EVs) are critical and wide-coming. By delivering zero tailpipe emanations, EVs help lessen air contamination and further develop air quality in our urban communities, which affects general well-being. Moreover, the diminished dependence on petroleum products and the shift towards environmentally friendly power sources imply that EVs have a lower carbon impression than customary gas-fueled vehicles. As the creation of EVs keeps on sloping up, we can hope to see much more significant advantages for the climate, remembering diminished ozone-depleting substance outflows and lessening the adverse consequences of environmental change. By and large, the ecological impacts of EVs are an important stage toward a more maintainable and better future for our planet [7].

Problem Statement:

In today's world of technology and superfast life, the main issue we all face is the environmental cleanliness that pollutes life here on Earth. One of the main reasons for this pollution in Pakistan is the litter that is not completely cleaned from roads and big dustbins. Hence they pollute the air and keep the environment polluted. This device will help us clean the roads and keep the environment clean.

Objectives of the Project:

This system aims to introduce a new and innovative solution for street cleaning, specifically a street vacuum cleaner. This machine will help reduce the manual labor involved in cleaning streets, increase efficiency, and improve the overall cleanliness of streets.

1. Design and fabrication of vacuum and mobility systems.
2. Online data acquisition and system monitoring using Internet of Things (IoT).

Scope:

1. Our product will be able to pick up 50g-60g of litter easily.
2. Our product will contain a filter to separate the dust so it does not leave the blower.
3. Our product will be completely battery-powered.
4. Our product will incorporate a standard 240L bin which is easily available everywhere.

- Our product will also have safety features like a mister to avoid fires.

Cost Analysis:

Table 1 mainly shows the group's cost at the initial stages to get a rough idea of how much the project will cost.

Table 4 Cost analysis for the Final Year Project (FYP)

SYSTEM PART	COST (in PKR)
Frame, Chassis, Tire, Drive train, handle	50000
Motor controller, Motor drive, ESPs, Batteries, Control movement	100000
Blower, Motor, Filter, Pipe	100000
Speed Controller	25000
GPS, GSM, BMS, Current and Voltage Sensor, Motor vibrations, Bin Volume	20000
BOX	25000
TOTAL=	320000 (20 percent extra)

Funding:

- We have a contract with hyper technologies private limited that they are willing to give 150000/- PKR for funding this project [8].
- We also have funding of 50000/- PKR from Patracon Engineering.
- We also have assistance in importing material for the project from Hara International [9].

Block Diagram

The block diagram in Figure 3 shows the main components used and how they will be integrated with the main microcontroller.

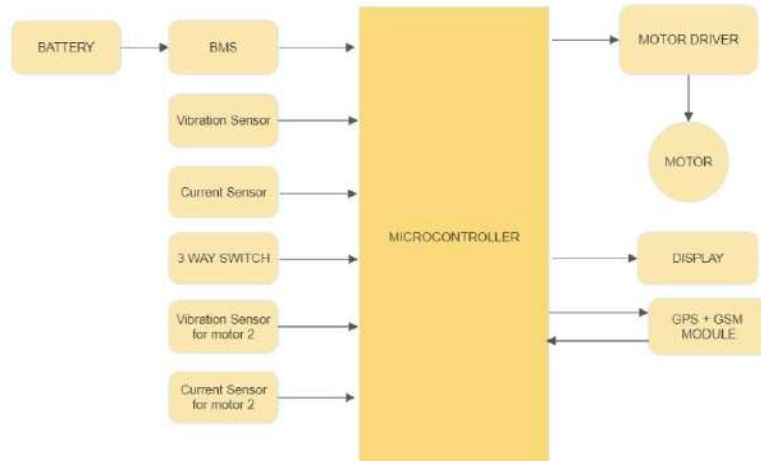


Figure 6 ESVC working block diagram with components and integration with microcontroller

Timeline of the Project:

The Gantt chart in Table 2 shows the timeline followed by the group until the project's completion, including FYP 1,2 and 3.

Table 5 (Timeline for the completion of FYP 1,2 and 3)

Process	6th Semester Spring-23				Summers-23				7th Semester Fall-23				8th Semester Spring-24			
	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Modeling & Simulation	[Task bar from FEB to DEC]															
Vacuum Electronics	[Task bar from MAR to SEP]															
Vacuum Hardware			[Task bar from MAY to SEP]													
Drive system- Hardware					[Task bar from JUN to OCT]											
Drive system- Software			[Task bar from MAY to DEC]													
IoT			[Task bar from MAY to FEB]													
Finishing											[Task bar from DEC to MAY]					

Work Division:

Table 3 shows how the main work is divided among the three group fellows and who will lead among the different categories for the project as the project moves forward.

Table 6 Work division among project group members

Roll no	Name	Work
190944	HUZAIFA	He would lead the documentation area of the presentation literature review and make reports. His secondary role was to help both others in their respective lead task, such as modelling and simulation, and troubleshooting
201122	RAFFAY	He would lead in modelling and simulation. He had all the tasks for SolidWorks and Matlab. Other than that, he has to help everyone in their respective task
201179	IBRAHIM	He was the overall lead for the project and had the coding assigned to him as the task. He had to manage all the main resources and the work timeline to help.

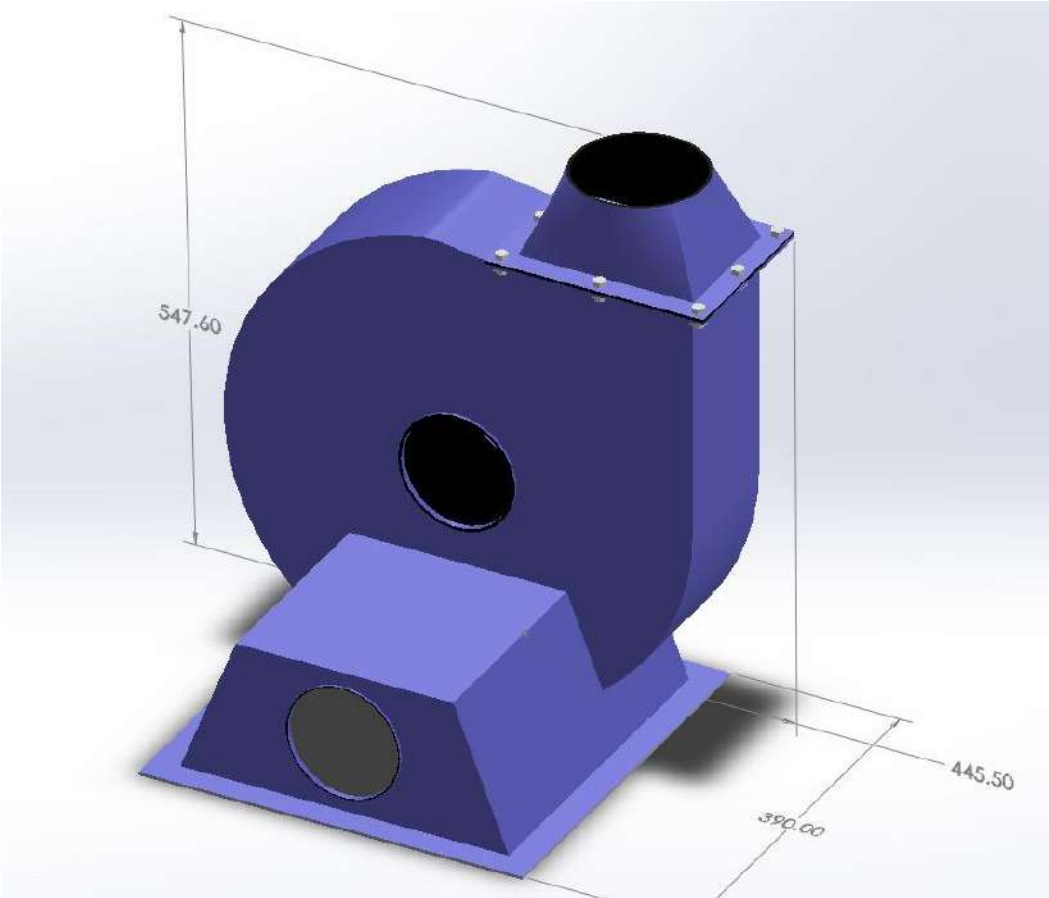
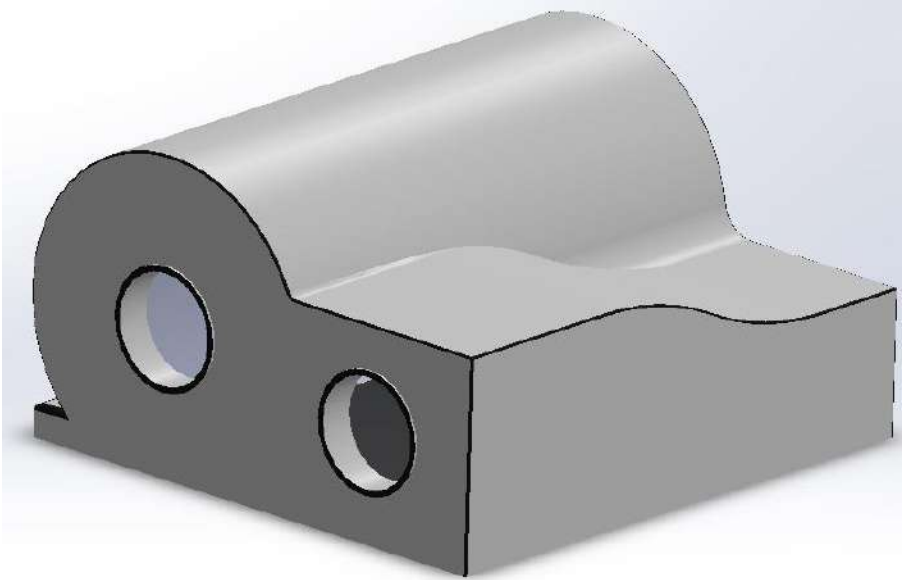
Organization of Report:

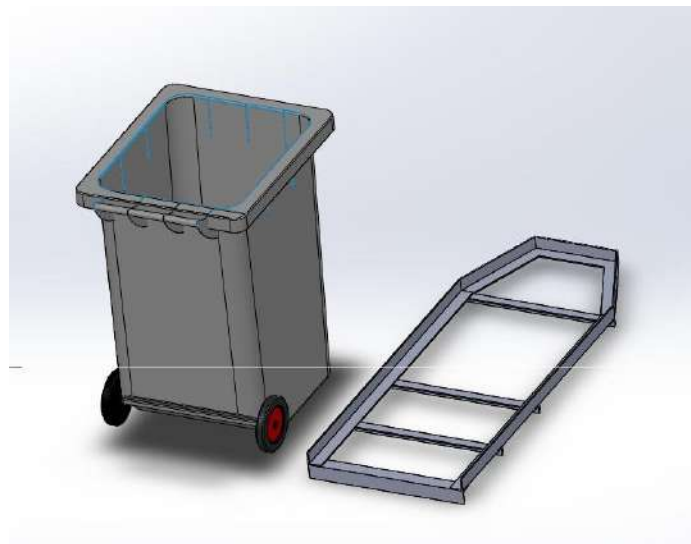
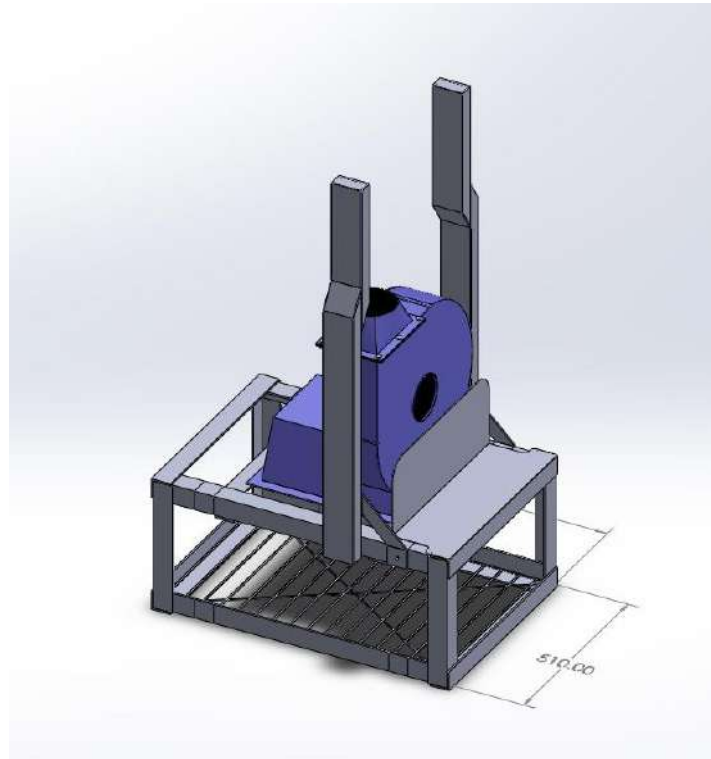
The organization of the report was done in the following manner:

Chapter 1: The first chapter of the report consisted of an introduction to the project we will make. The motivation behind choosing this project was discussed. We discussed the sustainable development goals and our project meeting the criteria of Goal 3, which was related to “good health and well-being”. Then the objectives and problem statement were discussed, and later on, we discussed the expected cost, the timeline, and the work division of the project

CHAPTER 2:

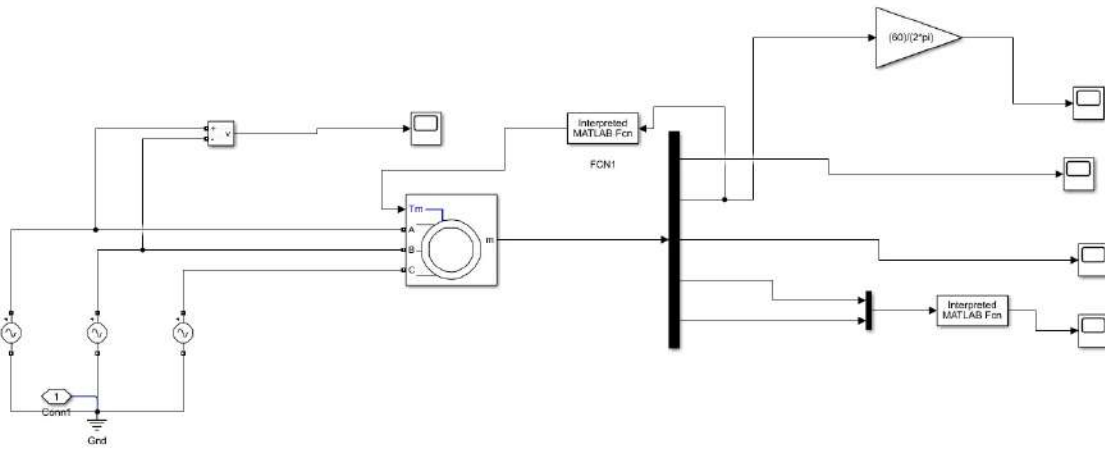
Solidworks:



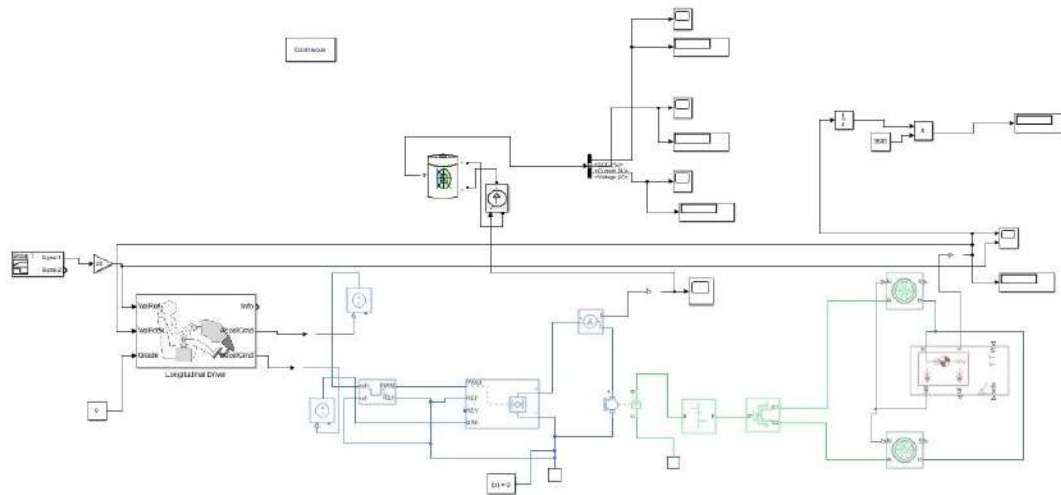


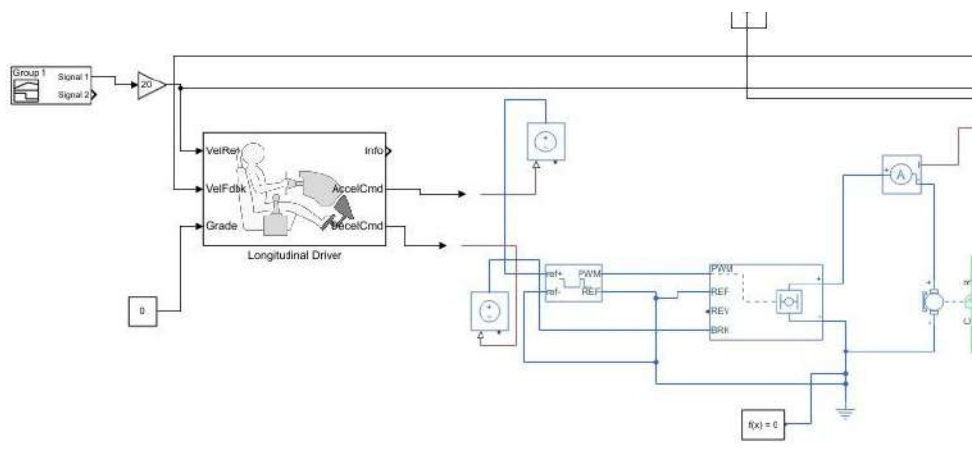
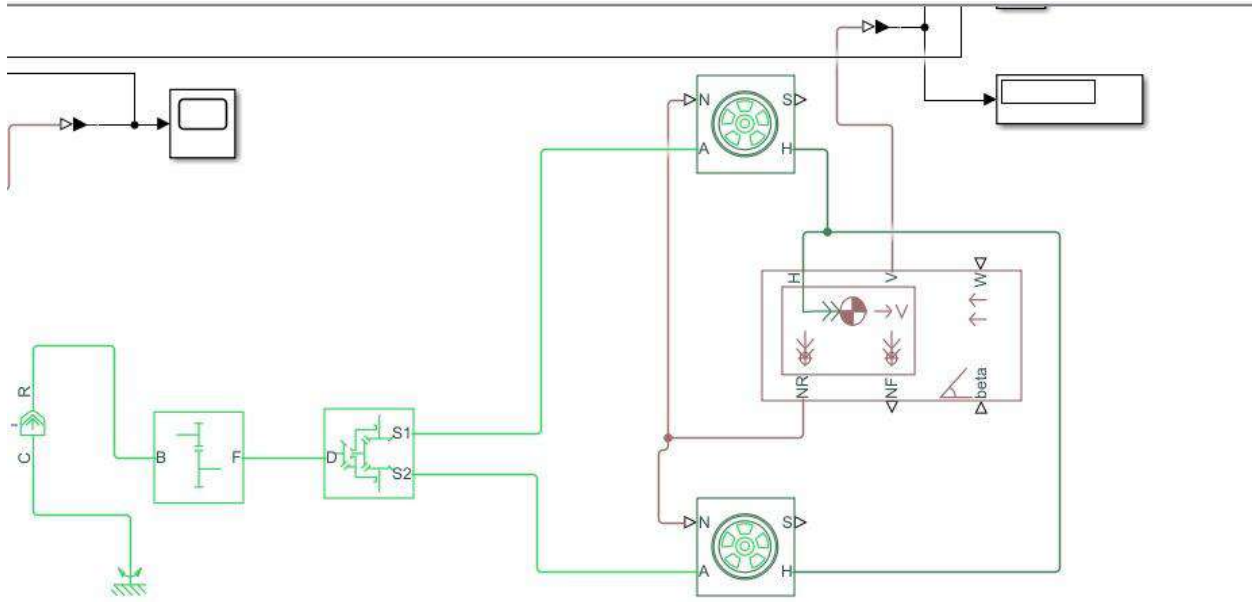
MATLAB:

Blower system:

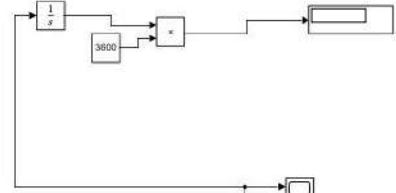
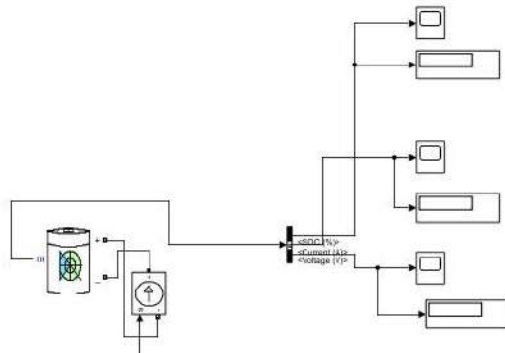


Electric vehicle system:





Continuous



Testing Pictures:







YOUTUBE QR CODE:



CONCLUSIONS:

In conclusion, the combination of a litter picker and a vacuum cleaner with two main parts - a mobility system powered by electricity and a blower system - offers a versatile and efficient solution for addressing different cleaning needs. The electric mobility system provides ease of movement and maneuverability, allowing the user to navigate various spaces with minimal effort. This feature enhances the overall user experience, making the cleaning process more convenient and accessible.

The blower system adds another dimension to the functionality of the device, enabling it to not only pick up litter but also to blow away debris or leaves from hard-to-reach areas. This dual functionality makes the device suitable for a wide range of cleaning tasks, both indoors and outdoors. The electric power source ensures sustainability and reduces environmental impact compared to traditional fuel-powered alternatives.

Additionally, the integration of these two essential components enhances the overall effectiveness of the device, providing a comprehensive cleaning solution. The combination of a litter picker and vacuum cleaner with both mobility and blower systems reflects a commitment to innovation and practicality in addressing diverse cleaning challenges. Overall, this dual-function device represents a step forward in creating efficient and environmentally friendly tools for maintaining cleanliness in various environments.

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