NEW HORIZON
COLLEGE OF ENGINEERING
New Horizon Knowledge Park, Ring Road, Marathalli
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

Outer Ring Road, Bellandur, Bengaluru – 560103

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

20EEE78A Project - Phase I

Report on

A REVIEW ON ELECTRIC SCOOTER BASED ON SPACE COMPATIBLE CONVENTIONAL SCOOTER

Submitted in the partial fulfilment of the Final Year Project - Phase I

Submitted by

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2021-22

Outer Ring Road, Bellandur, Bengaluru – 560103

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CERTIFICATE

Certified that the Project work entitled **"ELECTRIC SCOOTER BASED ON SPACE COMPATIBLE CONVENTIONAL SCOOTER"** carried out by **SRIDHARSHINI SARAVANAN(1NH18EE741),VARUN SHAM KUMAR KS(1NH18EE753),ATEEQ UR RAHMAN(1NH18EE704), S.V PAVAN KUMAR(1NH18EE744),** bonafide Student(s) of New Horizon College of Engineering submitted the report in the partial fulfillment for the award of Bachelor of Engineering in **Department of Electrical and Electronics Engineering, New Horizon College of Engineering** of Visveswaraiah Technological University, Belgaum during the Year 2020-21.

It is certified that all the corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the department library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for said Degree.

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Internal Examiner **External Examiner**

DECLARATION

We **SRIDHARSHINI SARAVANAN(1NH18EE741),VARUN SHAM KUMAR KS(1NH18EE753),ATEEQ UR RAHMAN(1NH18EE704), S.V PAVAN KUMAR (1NH18EE744),** students of New Horizon College of Engineeringhereby declare that this project work entitled **"ELECTRIC SCOOTER BASED ON SPACE COMPATIBLE CONVENTIONAL SCOOTER"** is an original and bonafide work carried out by me at New Horizon College of Engineering in partial fulfillment of Bachelor of Engineering in Electrical and Electronics Engineering of Visvesvaraya Technological University, Belgaum.

We also declare that, to the best of our knowledge and belief, the work reported herein does not form part of any other thesis or dissertation based on which a degree or award was conferred on an earlier occasion by any student.

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ABSTRACT

In today's modernized world travelling is very essential for human being in order to travel around world. Among the world's manufacturers and producers of two-wheelers, India ranks second. It stands after Japan and China with regards to the number of two-wheelers that are produced and also with respect to the sales. The Indian vehicle industry has seen extraordinary progress in the past decades. The reality of the vehicle industry that was completely changed by the advent of fuel-efficient technology is about to be revealed as the dawn of a new era in two completely different industries. Rather than petroleum or other fuel, electricity has begun a revolution for the two-wheeler industry.

The Indian market welcomed the idea of Electric vehicles which have become a famous means of transportation in countries that are developed. Thus electric vehicles have a great future. An e-bike is an electrically-assisted machine that is designed to deliver the electromagnetic momentums to a bicycle, therefore relieving the user of generating the energy necessary to pedal and move the bicycle. It contains a powerful motor and enough battery power that needs charging to help in hill climbing, generate faster motoring speeds and provide completely efficient transportation, free of cost. The single biggest advantage of an electric bicycle is that it is cost operative as it mainly only entails building cost as running cost would only require the charging of the battery.

The electric bicycle has been popular since last two decades and now its demand is rapidly increasing in India. Bicycle being the greenest and cheapest mode of transportation comes with a drawback that cannot be ignored in this fast paced world. Transportation is considered as a time saving process, and with regular bicycles, it is slow and energy consuming. The e-bike comes into picture here. People need a green, health preserving, fast mode of transportation and electric bicycle gave it all.

The e-bikes are slowly becoming the best way of transport in urban environments. Bicycles are more agile and faster than cars in city conditions because they are more maneuverable and can easily bypass obstacles that would greatly slow down cars. The portability of bicycles also makes parking them easy. It is possible to park them almost anywhere. . Furthermore, most electric bikes have enough range to handle the daily routine in a big city.

Our objective is to develop an electric bicycle having low cost, greater range, an ideal motor. The bicycle experiences 4 resistive forces which oppose the forward moment of the cycle. To overcome these forces, we are using a BLDC motor. With integration of this motor with our design we will achieve the highest range for a cycle while keeping the cost low for any electric cycle in the same domain.

CHAPTER I

1.0 INTRODUCTION

Lately, environmental issues caused because of the fuel vehicles and fuel economy are very serious. Vehicles of new era that are green, environment friendly, and economically viable are a critical goal towards economic and the social development as a result of the widespread development of many countries. The concept of an EV is an electric vehicle that has zero emissions in comparison to fuel vehicles and mileage vehicles. Processes that do not require physical human assistance will be fully automated by the future. Every second becomes important to accomplish the targetted automation task. In order for this to happen, an electrical drive system needs to facilitate with accurate performance characteristics and speedy recovery from any damage. An electrical motor is required to improve the performance and speed characteristics of the vehicle. Electric systems consist of motor, motor controller, battery, and other components.

The major role of the electricity driven vehicle is that it provides power and energy to the motor to benefit a scooter in running. This energy which is in the form of chemical or electric energy which has been stored in the battery that is used by a hub motor, hence the electric or chemical energy is converted into mechanical energy. An efficient electric system is necessary to make sure the driver as well as the vehicles safety in incidents of crash. To hub of the rearwheel of the e-scooter, a BLDC motor has been fixed. We have

chosen a BLDC motor because of the advantages it has such as noiseless operation and compactness.

Our objectives are as following:-

i. To cut down the running cost per kilometre of the two wheeler

ii. To cut down the harmful emissions released.

iii. To overcome the draw backs of the existing electric vehicle

iv. To increase the life period as well as the working efficiency of existing e-scooters.

Currently, the transportation system is an essential part of human activities. In the past few years, the number of persons using the transportation system has improved. Presently, around 40 percent of the world's population spends a minimum of 1 hour on the road every day. The depedency of people using transortation systems is increasing, these systems face many challenges currently. Our study helps come up with ideas that would help to overcome a few of the same.

1.1 LITERATURE SURVEY

1 ***Simulation and Implementation of Electric Bicycle employing BLDC Drive, International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST), October 2016*** - *K.Deepak , R.Gowtham , T.Hariharan , S.Manimaran & Dr.R.Seyezhai, UG Scholars, Department of EEE, SSN College of Engineering, Chennai.*

The purpose of this article is to describe the design and implementation of a hybrid powered electric bicycle that uses a dc-dc power converter. A battery and super capacitor are used as DC sources. A battery and super capacitor are used as DC sources.

Outcome- SIMULINK is used to generate a voltage and current waveform for the lead acid battery and super capacitor. This dc-dc converter prototype is built along with a controller and tested. A real-time working model of the electric bicycle is constructed, and all results are verified, in order to fully analyze the performance of the sources and power converter.

2 ***Electric Bicycle,*** **IJSDR, April 2017 -** *Sanjeeb Kumar Pattanayak, Milan Tirkey, Pramod Lakra, Vivek Ranjan, Soumya Ranjan Panda, Manas Ranjan Panda, B.Tech Mechanical Gandhi Institute of Engineering and Technology, Gunupur*

A rider's range can be extended by using an electric assisted bicycle, which is the focus of this report. Despite the fact that the electric bike is a concept that has been viable for years, but has not yet been developed to its full potential, technological advances are accelerating exponentially. Human electric bicycles are powered by electric propulsion, enabling a cyclist to move a bicycle without producing any energy required to operate it.

Outcome- In order to drive the bicycle, a dc motor is mechanically coupled to a dc rechargeable battery and electrically wired with the motor, ensuring efficient power transfer from the source to the motor.

3 ***Design and Implementation of Smart Electric Bike Eco-Friendly, International Journal of Innovative Technology and Exploring Engineering (IJITEE), April 2019 -*** *Sunikshita Katoch, Rahul, Ranjit Kumar Bindal*

This paper is concerned about the growing demand of energy all over the world, which motivate us to switch over renewable resource of energy. We can save energy in a variety of ways in different sectors. With the conversion of old petroleum bikes to electric ones, the paper focuses on the automobile sector. We use BLDC motors for these electric bikes, which are cleaner, less expensive to maintain, less noisy and emit less pollution. We use rechargeable battery packs to store chemical energy.

Outcome- This paper deals with the design and development of electric bike which make use of electric energy as primary source. Battery charging is distributed from the main system through a distribution system.

4 ***Electric Bicycle, International Journal of Scientific Development and Research (IJSDR*), *April 2017 -*** *Sanjeeb Kumar Pattanayak, Milan Tirkey, Pramod Lakra, Vivek Ranjan, Soumya Ranjan Panda, Manas Ranjan Panda, B.Tech Mechanical Final year student, Assistant Professor Gandhi Institute of Engineering and Technology Gunupur*

This paper focuses on on a building design of an electric assisted bicycle that will extend the range of a typical rider. The electric bicycle is designed to provide electromagnetic propositions to a bicycle therefore relieving the user of having to produce the energy required to run the bicycle.

Outcome- The system design is based on mechanically coupling a DC motor as the primary power source to drive the bicycle and electrically wiring the motor together with a DC rechargeable battery and efficient transmission from the source to the motor.

CHAPTER II

2.0 FEASIBILITY STUDY

2.1 PROPOSED PROTOTYPE:

The following study, component selection and calculation is going to be based on the model proposed by Matheen Aaquib, Jaimon and Harish for their project, which is a model similar to the one in the figure provided below.

FIGURE 1: EXPECTED PROTOTYPE

2.1.1 EXPECTED PROTOTYPE RATINGS:

- **Motor** - 250W brushless gearless electric hub motor
- **Battery** - Li ion 36V, 7.8 Ah

2.2 COMPONENTS:

The following are the main components in the electric scooter:

1. Battery storage

2. Battery

3. Lithium ion battery

2.2.1 BATTERY STORAGE

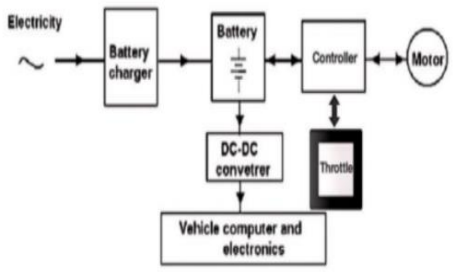


FIGURE 2: BATTERY STORAGE

Scooter batteries are built to last for a specific number of charging cycles. However, if they are stored improperly, the number of cycles you get out of them may be greatly reduced. If you have a new scooter battery in your mobility device, it is in your best interest to make sure it is stored properly when not in use. Here, we'll outline the best practices for scooter battery storage throughout the year. Scooter batteries are built to last for a specific number of charging cycles. However, if they are stored improperly, the number of cycles you get out of them may be greatly reduced. If you have a new scooter battery in your mobility device, it is in your best interest to make sure it is stored properly when not in use. In this post, we'll outline the best practices for scooter battery storage throughout the year.

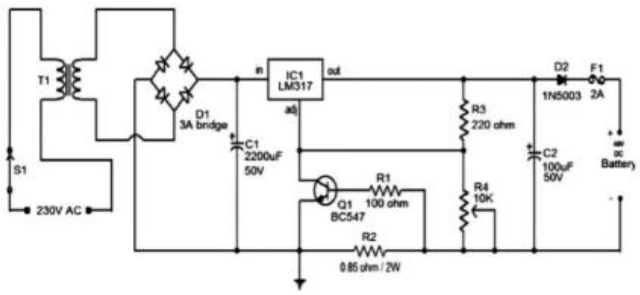


FIGURE 3: WORKING OF A LITHIUM ION BATTERY

In mobility scooters, there is a special type of battery called a deep cycle battery. These batteries last the longest when they are consistently charged. Letting one of these batteries discharge for an extended period of time will damage its internal components, and it will

not be able to hold a charge when taken out of storage. Be sure your battery is fully charged before you store it.

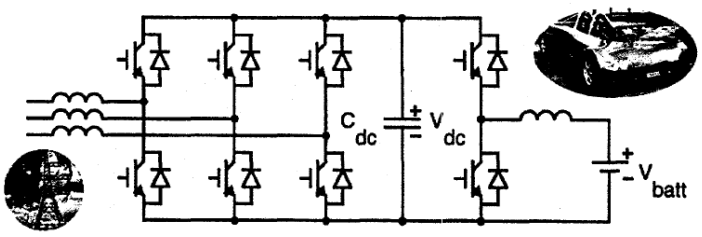


FIGURE 4. Basis of design of charger

2.2.2 BATTERY

The design of battery management systems is according to that model. Measuring parameters provides the desired parameter for the control and performance of an Affordable and Reliable Battery Management System. It is any system that monitors, calculates, reports and controls secondary data, such as determining if a battery is operating outside its safe operating area, controlling its environment, and authenticating it. An effective BMS not only indicates the health of a battery, but also protects it while in use. Voltage, temperature, and current ranges are established for each battery chemistry and cell. Cell balancing is another important safety feature of a BMS.

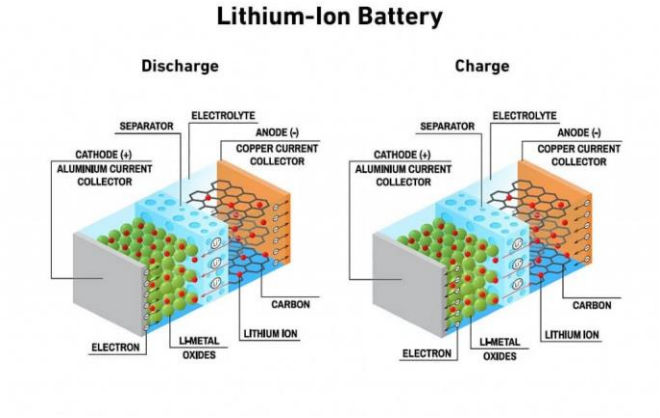


FIGURE 5: CHARGING OF A LI ION BATTERY

TABLE 1: TABULATION OF THE BATTERY SPECIFICATIONS OF THE EELCTRIC VEHICLE

Type	Parameters	Correponding value of the parameters
Lithium-Ion Battery	Nominal Voltage (V)	50
	Rated Capacity (Ah)	50
	Initial State-Of-Charge	100
	Battery Response Time (s)	30

2.2.3 BATTERY BRAND:

An e-scooter's battery is made up of individual Li-ion cells that are manufactured by several companies. The best batteries are made by companies such as LG and Panasonic but these batteries are usually only used in high end e-scooters. Budget-friendly are made from generic cells manufactured in China but lack in the field of quality. Scooters with branded cells and generic Chinese ones differ mainly in terms of quality control. Few companies such as Xiaomi provide budget friendly battery packs with good quality control.

2.2.4 INDIAN STANDARDS FOR AC CHARGING

IS-17017 is India's primary EV charging standard, consisting of three parts and six sections. IS-17017-Part-1 specifies the essential characteristics of all electric vehicle charging systems. This standard, as well as particular AC connection specifications in the IS-17017-Part-2, must be followed by an AC EVSE. The technical standards IS-17017-Parts 21 & 22 apply to both AC and DC EVSE.Additional Indian requirements for AC EVSEs have been certified for usage in parking areas by light EVs and e-cars (in the form of low-cost charging stations).

2.2.5 INDIAN STANDARDS FOR DC CHARGING

The criteria for IS-17017-Part-23 are as follows:

DC charging stations with a power output ranging from 50 kW to 100 kW 200kW. High-power charging requirements are also required. Buses and other big vehicles must be accommodated.

The IS-17017-Part-25 was just completed by the BIS. This is designed to provide light EVs with low DC power of less than 7kW. As a result of the need for digital communications, Data connection protocols between the DC EVSE and the EV are described in IS-17017-Part 24. Communications will follow the IS-15118 series when the Combined Charging System (CCS) standard is implemented, which can support both AC and DC charging.

CHAPTER III

3.0 WORKING

3.1 PROPOSED METHOD

Working of the Electric Vehicle can be explained by using a simple block diagram given below which is divided into 3 parts. The vehicle body consists of 3 parts namely Gear-box, Differential and tires. Second partof the system consists of the motor and controller. Third part of the system consists of Drive Input where we create input and reference signal with the help of inbuilt drive cycle by using a signal builder block. The last and the most important part is battery where the motor will provide mechanical energy to gear-box for the operation, motor will take power from the battery. If we directly connect motor to the battery then the speed control of the motor will not be possible therefore, we are going to connect controller between the battery and the motor.

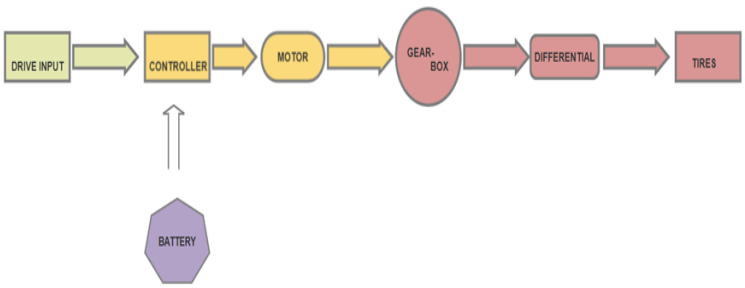


FIGURE 6: BLOCK DIAGRAM OF THE ELECTRIC VEHICLE

3.2 CHARGING PROCESS:

In order to charge a battery, a DC current is supplied. Through an electrochemical process, the current produces electrical charge that is stored in the battery. The amount of energy supplied to the battery pack while charging depends on the magnitude DC current supply and time elapsed. Since the current supplied from generator to consumer is in AC, it has to be rectified to DC.

3.3 MATLAB SIMULATION

Vehicle Body Subsystem

First, I've developed a vehicle body subsystem. I have included tires, differential, gearbox, and vehicle body blocks from the Simscape library in the vehicle body subsystem. We can change the block parameters as per our requirements. Connect tires, differential, gearbox, and vehicle body blocks to each other to make the first subsystem.

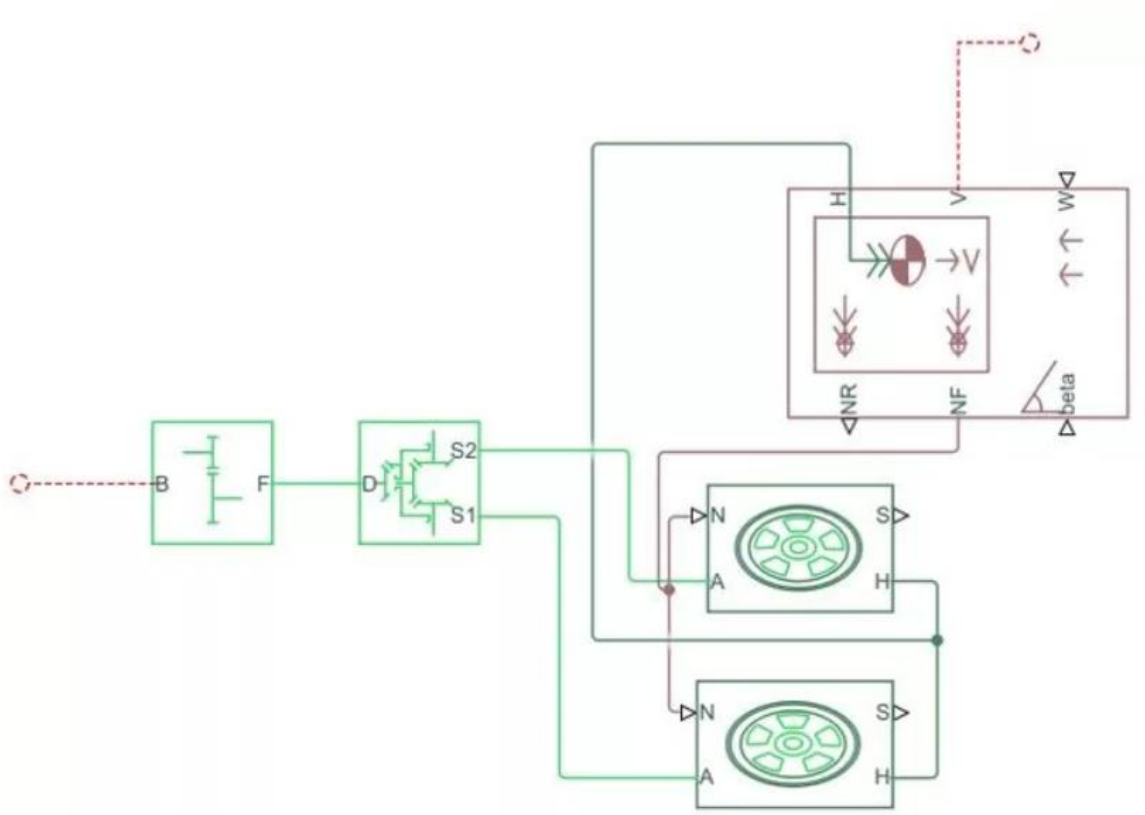


Figure 7: Vehicle Body Subsystem

Motor Circuit and Controller Subsystem

The motor will take controlled power from the battery and convert electrical energy to mechanical energy. The mechanical energy produced is supplied to the gearbox and mechanical rotational frame. To make the subsystem, I have added the motor circuit and controller block from the Simscape library. I have used a simple DC motor, and to control the DC motor, I have used an H-bridge controller. With the help of an H-bridge controller, I can apply acceleration, deceleration, and breaking. To control the PMW wave, I have

added a controlled PWM voltage block. We can change the block parameters as per our requirements.

The figure below shows connections between each block to make a subsystem.

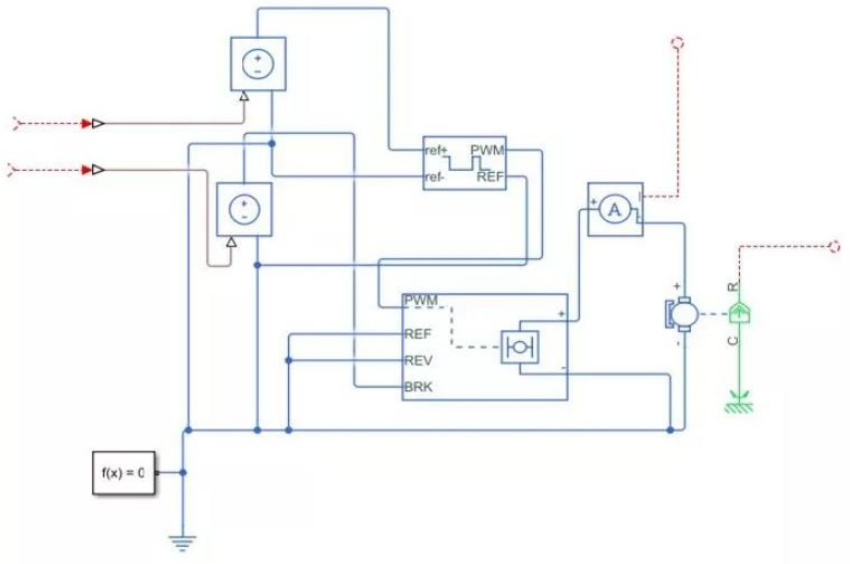


Figure 8: Motor Circuit and Controller Subsystem

Driver Input Subsystem

Longitudinal driver block from the powertrain block library produces normalized acceleration and braking commands based on reference and feedback speeds. Reference velocity will be given by the built-in drive cycle or we can generate our own signal by using the signal builder block. Feedback speed will be taken from actual vehicle speed. Based on the difference between the reference signal and the actual speed error will be generated.

The error produced will result in acceleration or deceleration so that the vehicle's actual speed will try to match the reference speed.

We have used the Longitudinal block and Signal Builder block to create the Drive Input Subsystem. The diagram below shows the connection between the blocks.

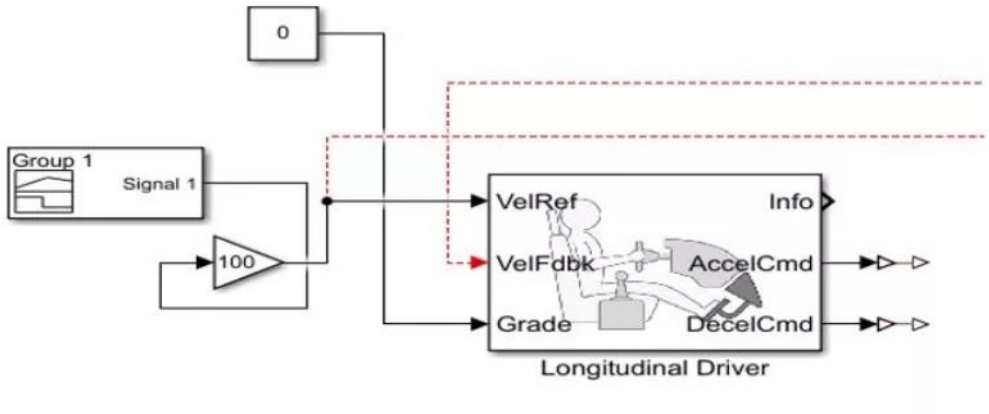


Figure 9: Driver Input Subsystem

Battery Pack subsystem

The battery pack will provide power to the motor. Calculation of State of Charge (SOC) would give us information about how much the model can be driven pre-recharge and how much time the existing battery can be used. I have used a Li-ion battery to check the SOC percentage directly. Battery charging and discharging we can examine with the help of SOC. The figure below shows connections between each block to make a subsystem.

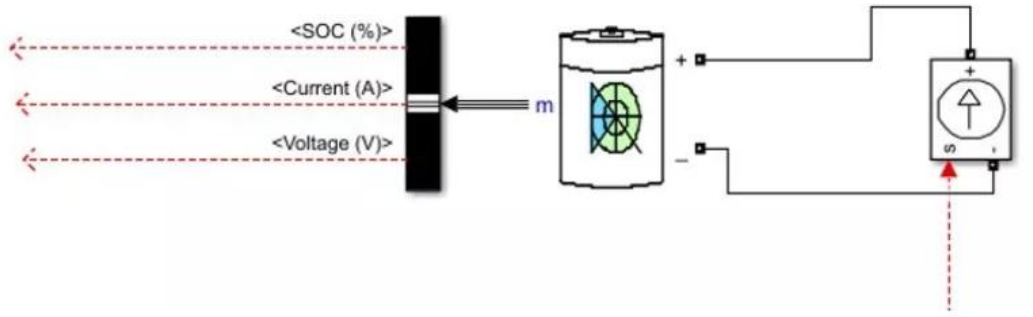


Figure 10: Battery Pack subsystem

Overall Model

Add powergui block to Simulation. Add scope and display block to examine outputs and behavior of the Electric Vehicle model. With the help of the signal builder block, I have created a reference signal. The reference signal and actual speed on the same graph will explain how the feedback loop is working. We can also calculate the average speed of the electric vehicle. With the SOC graph's help, we can analyze battery charging and discharge during deacceleration and acceleration command, respectively.

The figure below shows the overall Electric Model that I have used to examine the vehicle's SOC percentage and average velocity.

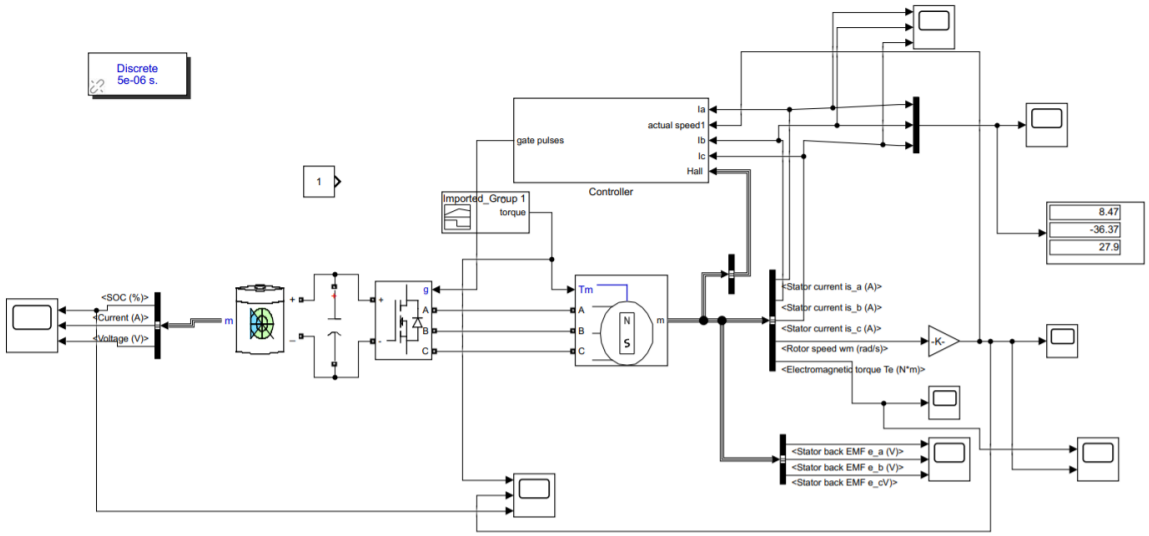
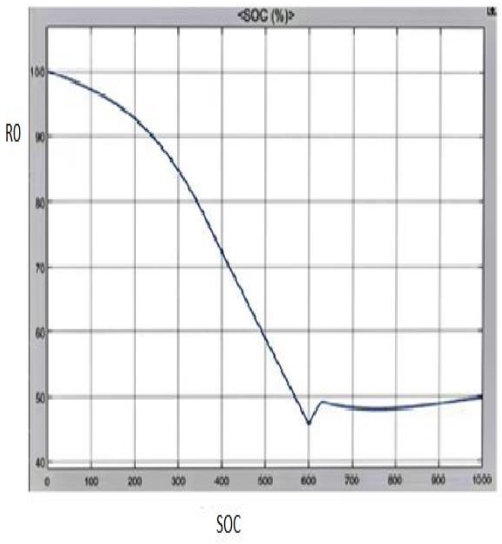


Figure 11: Overall Matlab simulation circuit



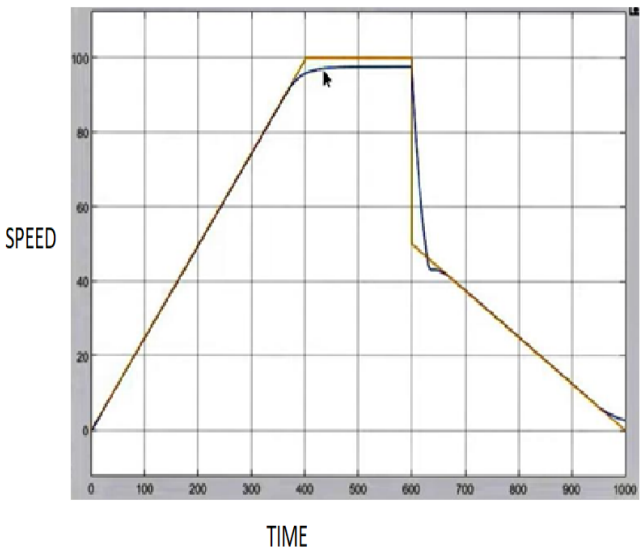


FIGURE 12.1 **FIGURE 12.2**

Speed v/s Time during one full cycle **SOC characterisics during 1000 cycle**

A brushless DC motor electrical system has a controller rated at 48V, which is connected by a battery VIA and 48V MSB (miniature sirsuit breakers). A specific controller control sequence is provided with the motor. In a BLDC motor there is a hall effect sensor that sends a signal to the control, which energizes the windings as a copy of the motor shaft. The throttle or speed adjustable handle bar is electrically connected to the control. This is accomplished by adjusting the handle bar. Also, the marriage system is electrically connected to the controller. When the marriages are completed, the circuit goes on, and the battery is disconnected from the motor. This results in a loss of speed, and after a short period of time, the motor will shut down.

Here we can see in figure 8.1 that the battery has discharged Non linearly for first 400 seconds. And for the And for the next 400 seconds the battery has discharged Linearly. And for the next 400 seconds the battery has charged and discharged according to the feedback that is given to the circuit. When we check the actual and reference graph We can conclude the following things, First thing is that actual speed is trying to follow the reference speed. And second thing is that we get approximate 50km/hr average speed from graph. To calculate average speed manually we divide distance by time. Where distance is approximately 13 km and time is 1000 seconds, which when converted to hours is 0.278

hours we will get approximately 50km/hr average speed.this particular circuit can be designed by adding solar panel as well which can be used as an additional advantage.

TABLE 2: TABULATION OF THE INPUT PARAMETERS OF THE ELECTRIC VEHCLE

Rated Parameters	Corresponding Main Settings	Corresponding values to the rated parameters
Vehicle Body	Mass	600kg
	Number of wheels per axis	2
	Horizontal Distance from CG to Front Axis	1.4
	Horizontal distance from CG to Rear Axis	1.6
	CG height from ground	0.5
	Drag	Corresponding block parameters
	Frontal Area	2 m^2
	Drag Coefficient	0.25

	Air Density	1.18kg/m^3
Simple Gear	Follower(F) to Base (B) teeth ratio(NF/NB)	2
	Output shaft rotates	In the same direction as Input shaft
Output Signal Unit	Km/hr	
Input Thresholds	Enable Threshold voltage	0.0001 V
	PWM signal amplitude	1V
	Reverse Threshold Voltage	0.0001V
	Braking Threshold Voltage	0.0001V
Bridge Parameters	Output Voltage Amplitude	50V
	Total Bridge On resistance	0.1 ohm
	Freewheeling Diode on Resistance	0.05 ohm
PWM	Switching Event Type	Averaged
Time	Maximum time	1000 seconds

Input Scaling	Input Voltage for 0% duty cycle	0V
	Input Voltage for 100% duty cycle	1V
Output Scaling	Output Voltage Amplitude	1V
Electrical Torque	Armature Inductance	12e-6 H
	No-load speed	14000 RPM
	Rated speed(at rated load)	12000 RPM
	Rated Load(Mechanical Power)	50kW
	Rated DC supply voltage	50 V
	Rotor Damping Parameterization	By damping value

CHAPTER IV

4.0 CONCLUSION

Nowadays, the use of vehicles that run on fuel has increased speedily, this has resulted in greater air pollution.. It is imperative that we employ EVs in order to control this issue due to their many advantages, including the fact that electric scooters are an environmentally-friendly product, and there are numerous other benefits, such as the fact that they are a cleaner and quieter product than gasoline-powered vehicles. With the frequent increase in gas prices, the electric vehicle has become one of the cheapest alternatives to traditional vehicles. The use of E-Scooters is additionally suitable for rural areas where the number of parking spaces are insufficient, so that rural residents are able to charge vehicles with the use of electricity. For a better understanding of EV technology, this review helps to offer an overview of the EV (Scooter) and the various components involved. Now a days, most of the cars for sale are electric.Hence, this have been resulting into greater air pollution which is harmful to human being. HENCE, this has resulted in greater air pollution, which harms human health.. Thus, the presented paper examined the design and development of EV two wheels. Thus the given EV contains a lithium ion battery of 48v, 25aH and has the capacity to charge within 3 hours with having a capacity of 48v, 5A . Therefore this EV can charge upto 1150 to 1200wH using this charger, which will run upto 50km with a sinle time charging with a suitable speed of 35 to 40kmph..

CHAPTER V

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