IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Design And Development Of An Efficient System For Affordable Retrofitting Of Internal Combustion Engine Vehicle To Hybrid Electric Vehicle

[1]Aditya Khotte, [2]Shravani Gaikwad, [3]Sanat Deodhar, [4]Mohit Valsangkar
[1,2,3,4] Academic Scholar
[1]Department of Mechanical Engineering,
[1]Progressive Education Society's Modern college of engineering, Pune, India

Abstract: The future of the automotive sector is electric automobiles. The focus of all well-known industries was on electrification as opposed to sticking with the traditional form of power for propulsion. Future electrical-powered vehicles completely outperformed IC vehicles in terms of performance. If a country's expenditures are taken into account, the payment of import bills for petroleum products accounts for 80–90% of the total. The end outcome is a rise in the price of petrol, which in turn leads to growing inflation. India is currently the world's fourth-largest emitter of greenhouse gases. It would be necessary to expand the use of electric vehicles and reach their full potential. 80% of the vehicle market is dominated by two wheelers. According to the Motor Vehicle Act, Transport Department, Government of India, a two-wheeler has a 15-year lifespan. One current option for this problem is to convert existing scooters to hybrid electric scooters. This can be used to create hybrid electric automobiles rather than scrapping current gasoline vehicles.

Index Terms - Hybrid Electric Vehicle, Retrofitting, Tractive forces, Drive Cycle.

I. INTRODUCTION

Bikes that run on petrol need regular maintenance, including engine oil and gear oil changes and replacement of other parts. As a result, the annual cost will be high, and the cost of gasoline refills will only increase the total. It helps a country save money on oil imports and has less of an impact on the environment. Maintenance costs for e-scooters are at least 60% lower than those for ICE scooters. Taking everything into account, moving to electric scooters can cut annual carbon emissions by 766 kilograms, reduce CO2 emissions by more than a tone and save 45 thousand gallons of gas. Rapid growth in the use of internal combustion engines has led to an increase in the number of pollutants released into the atmosphere. Seven percent of all global emissions come from India. You can help reduce our global warming impact by making the switch from a gas scooter to an electric one. The price of the latest generation of electric scooters has increased. More than half of your monthly fuel bills can be eliminated when you switch from a gas scooter to an electric one. The government of India has committed to a major reduction in carbon emissions from diesel and petrol engines by the year 2030, and has also set an ambitious goal for electric vehicles (EV). As a result, the nation is making preparations to make the transition to electric automobiles. The primary benefit of electric vehicles is their lower environmental impact. Large, expensive battery packs are the source of energy for electric vehicles. Two-wheelers account for the vast majority of vehicles on Indian roads (79 percent), while cars (including tiny good vehicles) account for 4 percent and economy cars (costing less than 1 million rupees) account for 12 percent. Getting rid of conventional cars immediately and replacing them with electric ones would be difficult in the Indian context. The transition to electric vehicles is underway across the country. To achieve its goal of decreasing carbon footprint, the country must prioritize transforming the existing ICE vehicles into electric ones, but the rate of this shift can't be extreme. Vehicles that have been retrofitted can remain on the road for an additional 5-7 years, making them exempt from the new scrappage regulation. Therefore, one option is to think about making an ICE vehicle into a hybrid electric vehicle. challenges encountered and the critical necessity to transition to electric vehicles immediately. The suggested architecture is an electric hybrid with a BLDC motor powering the rear wheel. The electric scooter's brushless DC (BLDC) motor is embedded in the wheel hub. Because of its small size and quiet operation, the BLDC motor was selected.

1.1. Problem Definition:

The goal of this system is to create a transitional mode of transportation between conventional gasoline-powered scooter and battery-operated Scooter.

1.2. Objectives:

a) To make universal kit to convert a non-geared 2-wheeler from ICEV to HEV.
b) To facilitate battery swapping & range extender batteries.
c) To revive redundant 2 wheelers.

1.3. Scope:

To reduce consumption of petrol and emissions from IC engine and develop an ecofriendly vehicle to cruise through city’s traffic.

a. Independent Electric and Petrol Drive
b. No changes required in vehicle for Installation.
c. Easy to Install
d. 60 km of top speed in pure Electric Drive
e. Compatible with 48v & 60v battery pack
f. Easily Detachable Battery Pack

II. MATHEMATICAL MODELLING

2.1. Drive Cycle:

A driving cycle is a numerical representation of a vehicle's time-to-speed relationship. Vehicle efficiency is measured in terms of fuel economy, electric vehicle autonomy, and pollution emissions using driving cycles created by a wide range of countries and groups. Another use for driving cycles is in vehicle simulations. They are used in simulations of propulsion systems to get an idea of how things like transmissions, electric drive systems, batteries, and fuel cells will perform.

Table 1. Indian Drive Cycle for Two wheelers

No. of operation		Acceleration (m^2/sec)	Speed (Km/h)	Duration of each operation (S)	Cumulativetime(s)
1	Idling	--	---	16	16
2	Acceleration	0.65	0-14	6	22
3	Acceleration	0.56	14-22	4	26
4	Deceleration	-0.63	22-13	4	30
5	Steady speed	--	13	2	32
6	Acceleration	0.56	13-23	5	37
7	Acceleration	0.44	23-31	5	42
8	Deceleration	-0.56	31-25	3	45
9	Steady speed	--	25	4	49
10	Deceleration	-0.56	25-21	2	51
11	Acceleration	0.45	21-34	8	59
12	Acceleration	0.32	34-42	7	66
13	Deceleration	-0.46	42-37	3	69
14	Steady speed	--	37	7	76
15	Deceleration	-0.42	37-34	2	78
16	Acceleration	0.32	34-42	7	85
17	Deceleration	-0.46	42-27	9	94
18	Deceleration	-0.52	27-14	7	101

<table>
<tr><td>19</td><td>Deceleration</td><td>-0.56</td><td>14-0</td><td>7</td><td>108</td></tr>
<tr><td colspan="4">BREAK DOWN OF TH E OPERATING CYCLE USED FOR THE
TYPE ITEST</td><td colspan="2" rowspan="8">B: AVERAGE SPEED DURING TEST: 21.93 Km/h

C: THEORETICAL DISTANCE COVERED PER CYCLE: 0.658 Km.

D: EQUIVALENT DISTANCE FOR THE TEST (6 cycles): 3.948 Km</td></tr>
<tr><td colspan="4">A: BREAK DOWN BY PHASES</td></tr>
<tr><td>Sr. No.</td><td>Particulars</td><td>Time(s)</td><td>Percentage</td></tr>
<tr><td>1</td><td>Idling</td><td>16</td><td>14.81</td></tr>
<tr><td>2</td><td>Steady speed periods</td><td>13</td><td>12.04</td></tr>
<tr><td>3</td><td>Accelerations</td><td>42</td><td>38.89</td></tr>
<tr><td>4</td><td>Deceleration’s</td><td>37</td><td>34.26</td></tr>
<tr><td></td><td></td><td>108</td><td>100</td></tr>
</table>

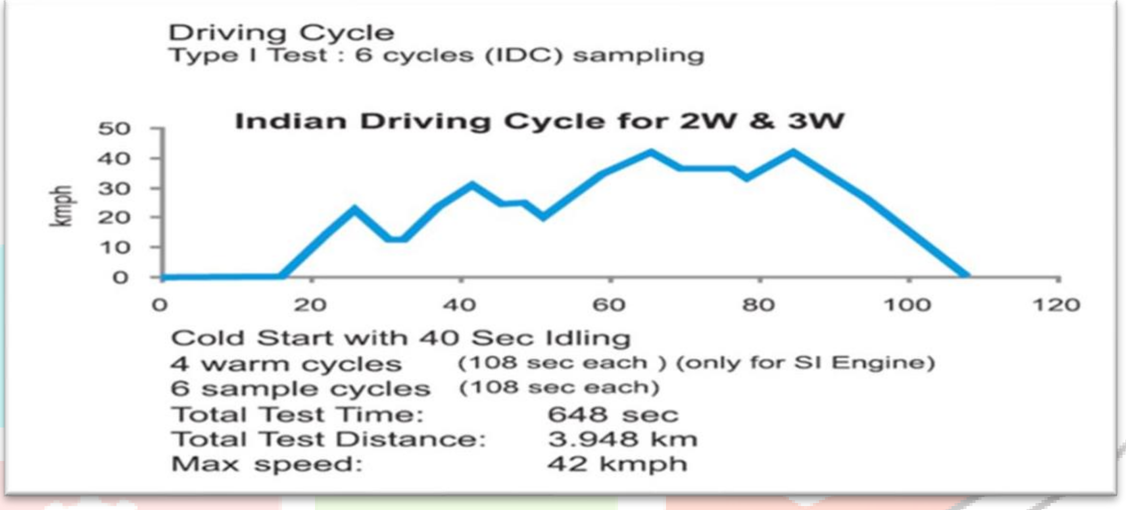


Figure 1. Indian Drive Cycle for Two wheelers

2.2. Scilab Model: Model of Vehicle Resistive Force in Scilab-Xcos to study the power requirement.

Table 2. Model Inputs

Sr. No.	**Parameter**	**Value**	**Units**
1	Coefficient of rolling resistance	0.013	
2	Gross Vehicle Mass	170	Kg
3	Gravity constant	9.81	m/s
4	Grade Angle	0	degree
5	Area	0.5	m^2
6	Air Density	1.2	Kg/m^3
7	Drag Coefficient	0.5	
8	Radius of wheel	0.28	m

Table 3. Program

A. To Import Track Data:	**B. To define all input parameters:**

//Importing Drive Cycle data = csvRead("track.csv")
Drive.time = data(3:106,1)
Drive.values = data (3:106,2)
 	
//Importing the grade data
value = csvRead("Grade Data.csv")Grade.time = value(3:106,1)
Grade.values = value(3:106,2)
	//Vehicle Dynamics
	//Radius of the wheel Rw = 0.28
	//m
	//Coefficient of rolling resistanceCrf=0.013
	//Gross Vehicle Mass
	GVM=170
	//Kg
	//Gross vehicle Weight
	GVW=GVM*9.81
	//N
	//Area
	A = 0.5
	//Coefficient of Drag
	Cd =0.5

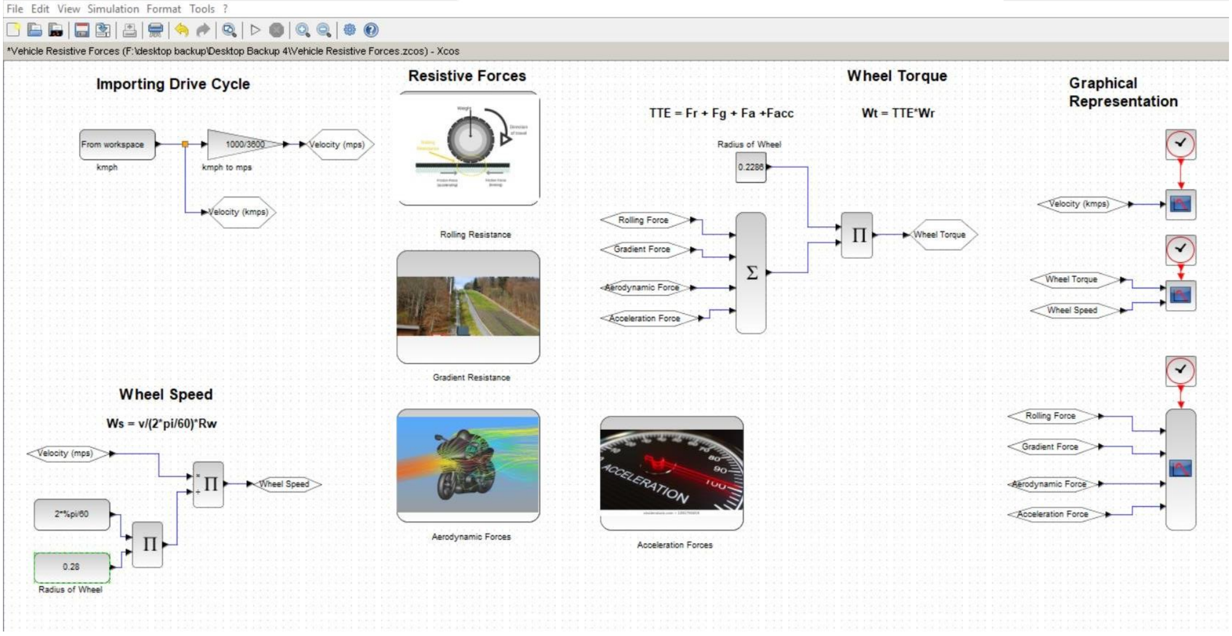


Figure 2. Scilab Xcos

2.3. MBD Results:

Table 4. Energy Requirement

Energy Consumed (Wh)	10.75
Distance travelled (m)	701.96
Wh/km	15.32

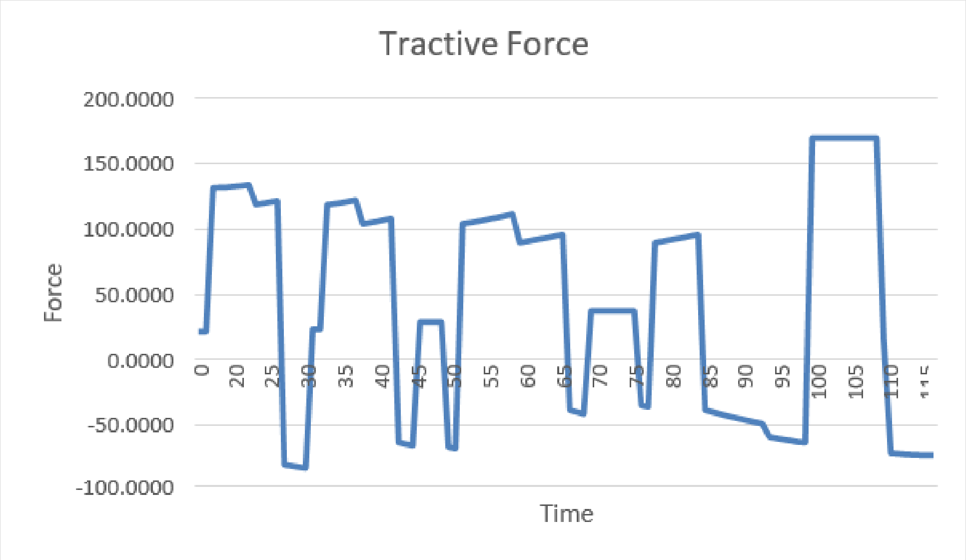


Figure 3. Tractive Force Vs Time Graph

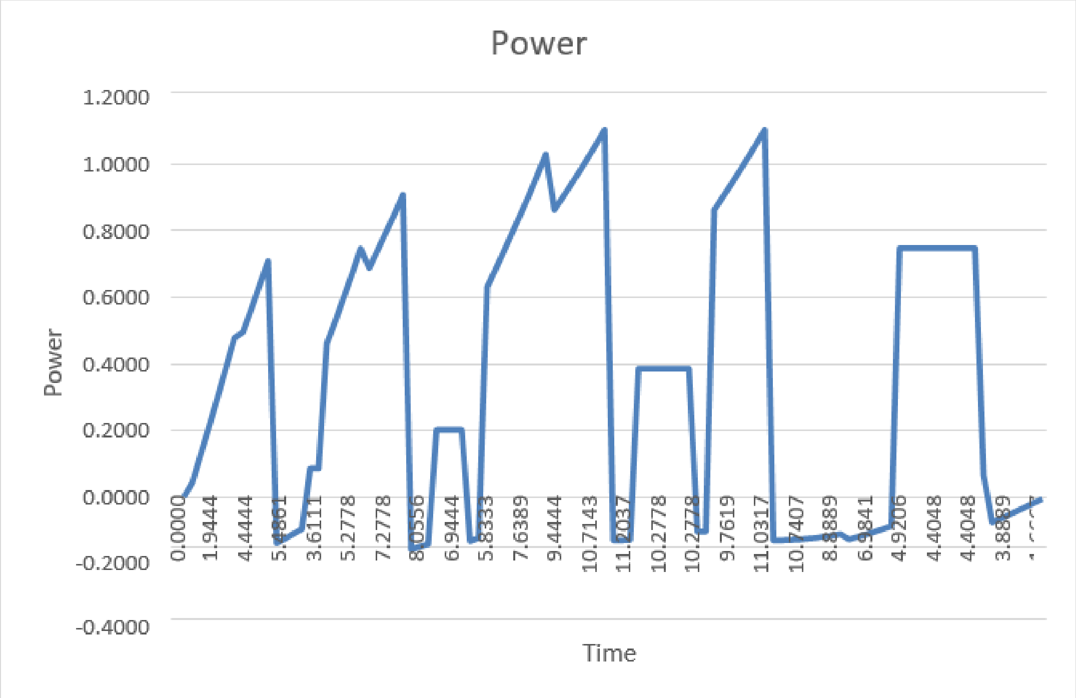


Figure 4. Power Vs Time Graph

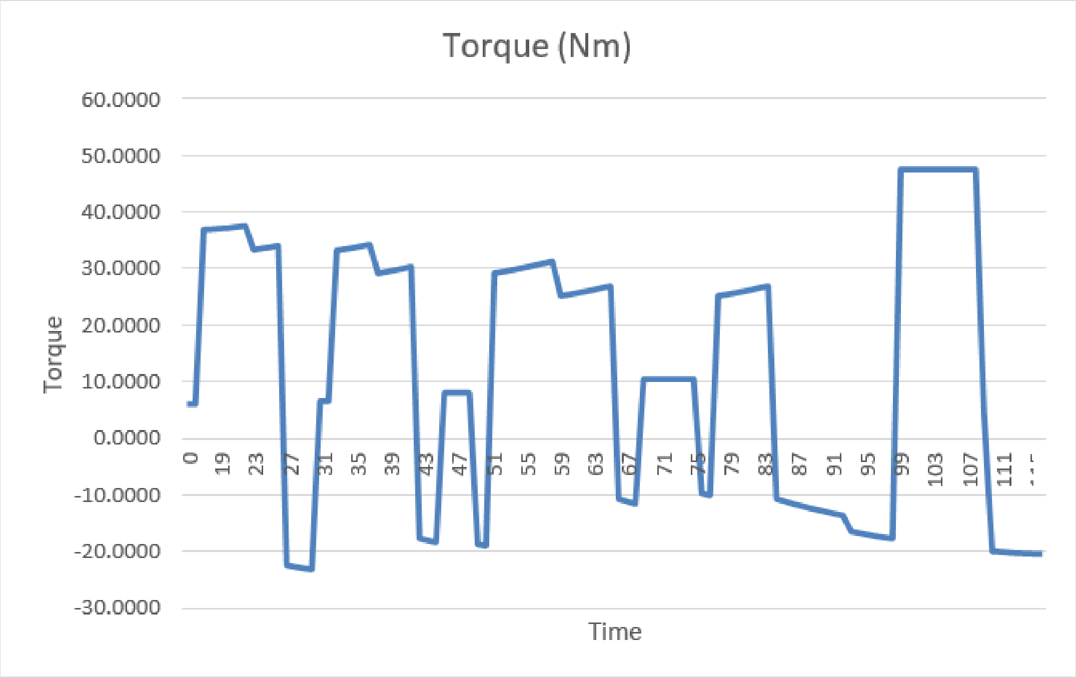


Figure 5. Torque Vs Time Figure

III. CALCULATIONS:

3.1. Selection of motor:

A vehicle has to power to overcome certain resistive forces. The force which overcomes the resistance is known as Tractive force. Tractive Force Overcomes Aerodynamic Drag, Gradient resistance and Rolling resistance considering vehicle is moving at constant velocity.

$F_{Tractive} = F_{rolling} + F_{gradient} + F_{aerodynamic}$

Where, Ftotal = Total force

Frolling = Force due to Rolling Resistance

Fgradient=Force due to Gradient Resistance

Faerodynamic drag=Force due to aerodynamic Drag

The motor must provide an output which will overcome the tractive force in order to move the vehicle. Tractive force needs to overcome these resistive forces first to accelerate later.

a) Rolling Resistance:

Rolling resistance is the resistance offered to the vehicle due to the contact of tire with road. The formula for calculating force due to rolling resistance is given by equation. Tires is the part of vehicle which is in constant touch with the ground and leads to rolling resistance. The rolling resistance coefficient, μ, is a function of road and tire characteristics viz temperature, material, temperature, etc.

Table 5. Coefficient of rolling resistance for different vehicles

0.001-0.002	Railroad steel wheels on steel rail
0.002	Bicycle tire on concrete
0.002 - 0.004	**Bicycle tire on asphalt road**
0.006-0.01	Truck tire on asphalt
0.01-0.015	Car tire on concrete, new asphalt, cobbles small new

$F_{rolling}$ = Force due to Rolling Resistance

$F_{rolling} = \mu \times M \times g$

Where, μ = Coefficient of Rolling Resistance,

M = mass in kg,

g = acceleration due to gravity = $9.81\ m/s^2$

For given application,
$\mu = 0.04$; $M = 170$Kg

$F_{rolling} = 0.004 \times 170 \times 9.81$

$F_{rolling} = 6.6078$N

b) Gradient Resistance:

A vehicle has to travel through different terrains all the time. The resistance offered by the inclination while traversing uphill is called gradient resistance. The angle made between slope and ground level is represented by θ. The gravitational force acts on the vehicle, and the sine component of the force acts as a resistance to the vehicle.

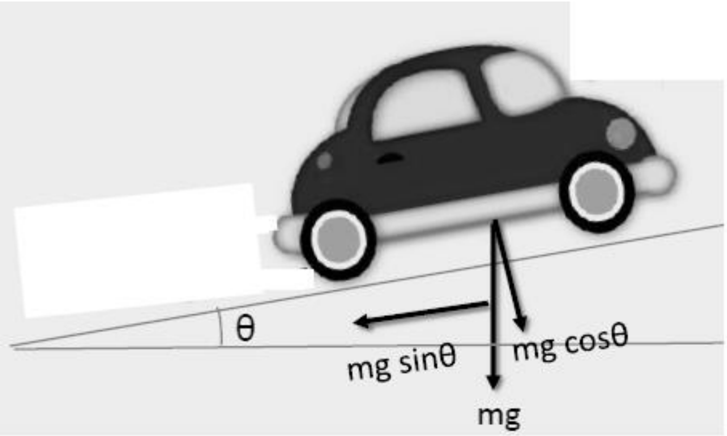


Figure 6. Vehicle along a slope

$F_{gradient}$ = Force due to Gradient Resistance
$F_{gradient} = M \times g \times \sin\theta$
Where, θ = Angle of inclination
M = mass in kg
g = acceleration due to gravity = 9.81 m/s^2
For given application,
$\Theta = 3.5^{0;}$ $M = 170$Kg
$F_{gradient} = 170\times9.81\times\sin3.5^0$
$F_{gradient} = 101.8106$ N

c) Aerodynamic Resistance

Aerodynamic drag is the resistive force offered due to viscous force acting on avehicle. It is linearly determined by the shape of vehicle. The formula for calculating aerodynamic drag is given by below equation. Air exerts a force on moving vehicle. The air particles impart drag force on vehicle while moving at a certain velocity known as aerodynamic drag. This force depends on air density at given temperature "ρ", and frontal area of the vehicle Af.

Table 6. Drag coefficient and frontal area of vehicle

Vehicle	**CD**	**Af**
Motorcycle	0.5-0.7	0.7-0.9
Car	0.5-0.7	1.7-0.9
Truck	0.45-0.8	6.0-10.0

$F_{aerodynamic}$ drag = $0.5 \times \rho \times Af \times C_D \times v^2$
Where, ρ = Air density in kg/m^3,
Af = Frontal area
ρ = Air density in kg/m^3,
C_D = Drag Coefficient,
v = velocity in m/s
For given application,
v = 35 kmph = 9.722 m/s
$\rho = 1.1644\ kg/m^3$ at 30^0 temperatures
Af = 0.9
$F_{aerodynamic}$ drag = $0.5 \times 0.7 \times 0.9 \times 1.1644 \times (9.72222)^2$
$F_{aerodynamic}$ drag = 34.6676 N

As discussed above,
$F_{Tractive} = F_{rolling} + F_{gradient} + F_{aerodynamic}$
$F_{Tractive} = 6.6708 + 101.8106 + 34.6676$
$F_{Tractive} = 143.1544$ N

d) Power Calculation
The power to overcome this tractive force is given by
Power = Force × Velocity
For given application,
v = 35 kmph = 9.722 m/s
Power = 143.1544 × 35 × (1000 ÷ 3600)
Power = 1391.7790 watt.
This gives required motor specification of 1500 W

e) Speed of motor (RPM)
$V = rpm \times 2 \times \pi \times R_{wheel} / 60$
Where V = velocity,
RPM = Revolution per minute (Motor)
R_{wheel} = 12.7 cm = 0.127m

Considering Average velocity of 35Km/Hr
RPM = $(35 \times 60) / (3.6 \times 2 \times \pi \times 0.127)$
RPM_{Motor} = 731

f) Torque of motor (τ)
$\tau = (Power \times 60) \div (2 \times \pi \times RPM)$
$\tau = (1500 \times 60) \div (2 \times 3.14 \times 731)$
Torque(τ) =19.60Nm

3.2. Selection of battery:

As per given motor wattage of 1500 W,
We consider Voltage=60v
Watt.hr = 1500w × 1hr = 1500 w.hr
Taking into consideration battery's state of health, we will assume 20% as reserves.
In this case,
watt.hr = 1500w.hr × 1.20 = 1800w.hr
Current (Ah) in battery =1200w.hr ÷ 60v= 30Ah

3.3. Selection of battery charger:

Given wattage is 1800w.hr.
According to above condition,
Assuming to charge the battery in 5 hrs
Wattage of charger = 1500w.hr ÷ 5 hr = 300 w
Hence, current rating of charger = 300w ÷ 60v = 5A
Battery Charger specification should be 60V and 5A

3.4. Range Calculation:

As given Battery of 1.8kwh with a motor power rating of 1.5kw
Run Hour =1.8kwh/1.5kw
=1.2h
Considering the total efficiency of 75%
Run Hour =0.8 x 1.2h
=0.90h
Assuming top speed as 60 kmph
Range=60 5km/h x 0.90h
Range= 54km

IV. COMPONENT STUDY:

4.1. Battery:

The batteries in an automobile serve the purpose of storing electrical energy to facilitate the operation of the vehicle's motor as required. To take the chance of inquiring. The selection of the battery for a vehicle is contingent upon its operational specifications. Consequently, a comparative evaluation of various battery types is conducted, leading to the preference of the lithium ion battery. Compared to lead acid batteries, lithium ion batteries exhibit superior characteristics such as reduced weight, increased energy density, decreased self-discharge, and lower maintenance requirements. Thus, it is imperative to utilise a high-performance battery for the motor. The battery should possess the ability to undergo swift recharging, exhibit superior performance, and sustain prolonged lifespan. Two critical considerations are the mass of the battery and its power output in relation to the maximum velocity. One of the advantages of selecting this battery is its ability to rapidly recharge. The selection for the project's power source has been made in favour of lithium ion batteries. The battery employed in this system has a voltage of 60 volts and a current of 30 amperes, resulting in a power output of 1.8 kilowatts. It is classified as a Lithium-Ion battery. The rechargeable batteries have the capability to be charged through an alternating current power source. The power sources are equipped with a Protection Circuit Module (PCM) that serves to prevent instances of overcharging and discharging. The estimated range of the battery is 45 kilometres. The dimensions of the battery are 35 centimetres in length, 24 centimetres in width, and 7 centimetres in height. The mass of the battery is 8 kilogrammes.

4.2. Battery Management System:

The battery pack is comprised of several battery cells operating in conjunction with one another. The decision of whether to connect them in parallel or series is at the discretion of the designer. It is crucial to monitor and regulate each individual cell. The monitoring of conditioning involves the tracking of voltage, current, and temperature. The determination of the control and protection parameters for the system is based on the measured parameters.

4.3. Electric Hub Motor:

A hub motor refers to an electric motor that is connected to the wheels of a vehicle. The Brushless DC motor is widely utilized as a hub motor due to its superior torque to weight ratio. The hub motor is commonly linked to the wheels through speed controllers to modulate the velocity of the vehicle's motion.

4.4. Common Throttle:

The throttle valve in question is a frequently encountered component that is regulated by an electric motor and a petrol engine. Its operation is overseen by a sine wave controller, which adjusts the fuel energy or electrical energy as needed. The power transmission shifting is altered with ease, without significant modifications. The switch key is utilized for the transmission of power.

4.5. Controller:

The utilization of a BLDC motor in our vehicle results in the absence of brushes and commutators. Therefore, a mechanism was required to establish communication with the motor, leading to the implementation of a controller. The controller is a mechanism that regulates the velocity and transmits a command to the motor. The utilization of a controller holds significant importance in electric vehicles as it facilitates the management and regulation of the vehicle's speed, charging, and other operational controls. Although BLDC motors are mechanically uncomplicated, their operation necessitates advanced control electronics and regulated power supplies. Therefore, the selection of a drive controller is necessary to regulate the operation of the BLDC motor.

4.6. Battery Charger:

The battery charger is a critical component in maximising the capacity of a battery. Efficiency, reliability, weight, cost, charging time, and power density are among the notable characteristics of a battery charger. The attributes of the charger are contingent upon the constituent elements, switching methodologies, and regulatory algorithms. The digital implementation of this control algorithm can be achieved through the utilisation of a microcontroller. The charging device is comprised of a dual-phase system. The first component is an AC-DC converter equipped with power factor correction, designed to convert AC grid voltage into DC with a focus on achieving a high power factor. The subsequent phase governs the charging current and voltage of the battery in accordance with the utilised charging technique. The charger may possess a unidirectional functionality, solely capable of charging the electric vehicle's battery from the grid. Alternatively, it may possess a bidirectional capability, allowing for the charging of the battery from the grid during charging mode, as well as the ability to transfer excess power from the battery into the grid.

V. DESIGN STUDY:

5.1. Model Honda Activa:

Maximum Power: 7.79 Ps
Displacement: 109.51cc
MaximumTorque:8.79Nm@5250rpm
Number of gears: Automatic
Net Weight: 107 KG
Fuel Tank Capacity: 5.3 liters

5.2. Motor Rating:

Motor Type: Brushless DC motor
Power: 1.5 KW
Voltage: 48Volts
Rated Current: 20.83A(Doubt)
Wheel Motor diameter=10inches=10*2.54=25.4cm

5.3. Controller Rating:

Voltage: 48V
Rated Current: 35 Ampere
Peak Current: 65 Ampere
Type: Sine wave

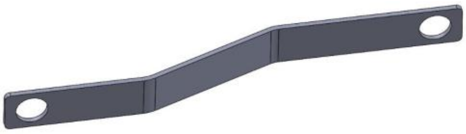
5.4. Battery Rating:

Battery Type: Lithium Ion Battery
Voltage: 51.2 V 30Ah
Capacity: 60V 24 Ah
Range: 45-55 Km
Max Discharge Current: 35Ah Max working temperature: 60°C

5.5. Battery Charger Rating:

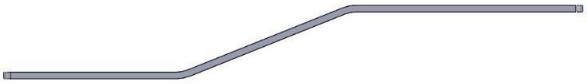
Capacity: 58.4v 6Amp & 73v 6Amp
Charging Time: 4-6 hours

VI. CAD OF TORQUE ARM:



Isometric View

Front View



Top View

Figure 7. Hub Motor Support Rod

VII. METHODOLOGY:

Assembly of retrofitting is as follows:

7.1. First the vehicle is completely dismantled, its body is removed

Figure 8. Scooter

7.2.Accelerator cable of conventional vehicle is removed & is replaced by throttlewire.

Figure 9. Throttle Cable connection

7.3.The rear wheel is dismantled & its drum is removed, the bolts on the removed are replaced with studs which have different nature of thread,a plate is added with drum, which is placed on the wheel & wheel is placed backon the vehicle.

7.4.It is helpful to change direction of air nozzle, to avoid further issues. Care shouldbe taken that nuts that are used on studs & wheel axle do not come ahead of theplate. It is advisable to grind the nut if it is exceeding the plate & make it face to face with the plate.

7.5.Hub motor is placed on the plate of the wheel, with the help of Allen key bolts with torque arm's direction being straight forward. Place the torque arm between silencer & engine.

Figure 10. Torque arm and Hub motor fitment

7.6.Controller is fitted below petrol tank by clipping it to the body.

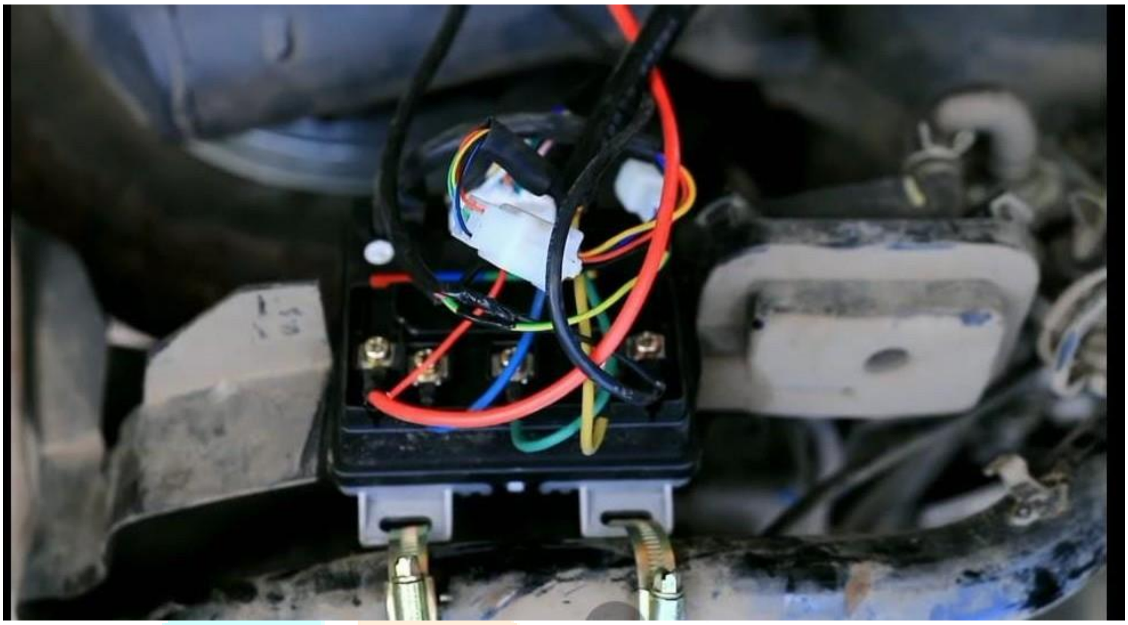


Figure 11. Controller fitment

7.7.Connect the hub motor wire to controller.
7.8.A cable from controller is passed in direction of accelerator cable towards key switch.
7.9.A hole is to be drilled in the fiber body near the key hole to place a button whichhas relay switch.
7.10. The relay has 3 wires, checked using multimeter that whichwire shows the reading of 12 volt.
7.11. The 12V relay wire is connected to the switch, the motor is tested and reassembled back.

VIII. RESULT AND VALIDATION:

8.1.In this project we converted Honda Activa to hybrid electric vehicle, with parts of following specifications

Table 7. Result Table

Component	Specification
Battery	a) Type: Li Ion Battery b) Capacity= 24 V 60AH c) Range= 52 Km per charge d) Max working Temp=600C
Hub Motor	a) Type: BLDC b) Power=1.5 KW c) Diameter=10 inch
Controller	a) Type: Sine wave b) Voltage=48 V

8.2.Vehicle retrofitted was less in emission hence an ecofriendly product.
8.3.The motor Vehicle was tested on all types of terrain & was found to be efficient & smooth even steep slope.

Table 8. Range per charge Table

Test	Range
1st Charge	49 km
2nd charge	45.9 km
3rd Charge	44.7 km
4th Charge	46.2 Km
5th Charge	48.2 Km

8.4. After rigorous testing at different terrains, an average range of 46.8 Km was achieved in a single charge.

8.5. The vehicle marked an acceleration of 0 – 35km/hr in 6.8 sec.

8.6. The top speed achieved is 50.3 km/hr

Figure 11: Operation Switches

Figure 12: Final Prototype.

IX. CONCLUSION:

The successful conversion of a conventional internal combustion engine vehicle into a hybrid electric vehicle was determined. The sales of two-wheelers in India during the 2017/18 period amounted to 20 million units, of which 40% were comprised of two-wheelers. Replacing the current vehicles with new electric two-wheelers may not be a financially viable option. Therefore, the process of transforming traditional automobiles into electric vehicles serves as a transitional mechanism. A hybrid electric bicycle is a more favourable alternative to a traditional motorbike in urban areas due to its potential to reduce pollution to some degree, as well as being one of the most cost-effective modes of transportation. The primary energy storage component utilised in electric vehicles is the battery. In order to ensure that the battery is not overcharged, a battery-assisted charging system is necessary for charging the battery. This mode of transportation is suitable for individuals of all ages and can be utilised for shorter distances. The primary characteristic of this product is its lack of pollution, environmentally conscious design, and quiet operational functionality. The operational cost per kilometre is minimal and the vehicle has a reduced number of components, allowing for effortless disassembly into smaller parts, resulting in decreased maintenance requirements. The goal of achieving a hybrid electric two-wheeler that is both comfortable, compact, high-speed, and efficient has been accomplished. The feasibility of battery swapping can be supported by its various advantages, which include: If there are sufficient battery swapping stations, the issue of range anxiety can be mitigated. Additionally, the ability to carry the battery home for recharging and the potential for lower costs may also be advantageous. Furthermore, the problem of battery capacity depreciation can be eliminated, and the adoption of newer battery technology can be facilitated once it becomes widely available. The implementation of regenerative braking in electric vehicles is a distinctive method that enables the capture of kinetic energy that would otherwise be dissipated during deceleration or braking. This technique is utilised to harness the energy that the vehicle possesses as a result of its motion. Therefore, in our particular scenario, the upgraded motor will serve as a means of regeneration. The implementation of regenerative braking in electric vehicles enables an extension of their range.

X. REFERENCES:

10.1. B.Ganapathi Reddy, G.Venkata Naga Bhaskar, et al, Fabrication of scooter, 1st ed, Rajahmundry, Andhra Pradesh, India, 2021

10.2. Najmuddin Jamadar, Suhani Jamadar, Abhilasha Kumbhar, Shital Tanvandkar, Manali Patil, Sourabh Zagde; Retrofitting of Existing Scooter into Hybrid Electric Scooter; Maharashtra, India

10.3. Deepanjan Majumdar, Archisman Majumder, Tushar Jash; Performance of Low Speed Electric Two-wheelers in the Urban Traffic Conditions; West Bengal India; 2015-2016

10.4. Ji-Young Lee, Byung-Chul Woo, Jong-Moo Kim and Hong-Seok Oh; In-wheel Motor Design for an Electric Scooter; Korea

10.5. Harish N, Amar Thakur, Alwin George, Mahmadali Babu Sab Nadel; Hybrid Two-Wheeler; Bengaluru, India,2018

10.6. Yimin Gao and Mehrdad Ehsani, „Hybrid electric vehicle:overview and state of the art, IEEE 2005, June 2023, croatia.

10.7. Massimo Ceraolo, Alessandro Caleo, Paolo Capozzella, Maurizio Marcacci, Luca Carmignani, Alberto Pallottini (2006), “A Parallel-Hybrid Drive- Train For Propulsion Of A Small Scooter”, IEEE