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DESIGN AND FABRICATION OF ELECTRIC SCOOTER

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Abstract – The volatile marketplace fees and prospect of diminishing materials of fuel Electric motors have been attracting unheard of attention in mild. Advances in battery technology and tremendous enhancements in electrical motor efficiency have made electric powered vehicles an appealing alternative, especially for quick distance commuting. Motors are being encountered extra frequently in electric cars because of their excessive efficiency and robustness. Motor scooter manufacturer worldwide grapple with the brand new layout demanding situations posed with the aid of electric motor scooters. The competition international is wherein the maximum modern-day design answers are first off examined. The present take a look at examined the preliminary design and consequent iterative system of improvement and development of a Electric Scooter. All elements are designed to be fabricated in Mild Steel.

Keywords: Electric Vehicle, Battery, Motor

I. INTRODUCTION

The concept of the battery electric vehicle is essentially easy. The car consists of an electric powered battery for electricity garage, an electric powered motor, and a controller. The battery is commonly recharged from mains strength thru a plug and a battery charging unit which can both be carried onboard or outfitted at the charging factor. The controller will typically control the power provided to the motor, and therefore the automobile speed, in ahead and reverse. This is usually referred to as a 2-quadrant controller, backwards and forwards. It is usually applicable to use regenerative braking each to recoup electricity and as a convenient form of frictionless braking. When in addition the controller lets in regenerative breaking in forward and reverse directions it's miles known as a four-quadrant controller.

Scooters are categorized as subclass of motorbike. Nowadays, there are range sort of scooters we can locate on town streets and park. The major parts of electrical scooters are predominant frame, wheel, tire, brake machine, battery and charger, motor, on/off switch, pace manage, and one way bearing. This type of scooter is simple to perform and smooth to carry everywhere in view that it's miles small and light. It can be use both for indoor or outside, but maximum humans used it for outdoor / exercise activities.

Generally, there are numerous styles of scooter operation. It is depends on how people need to use it. It can be operated via engine electricity, electric powered strength or foot strength. Each kind of them incorporates their personal benefit and downside. However, the electric scooters are the commonplace choice on account that it is light, cheaper, and clean to manufacture. It captures many eyes out there and an increasing number of growing incomes daily. Over past few years, the creations and improvement of electric vehicles, which include scooters, bicycles, bikes, and motors are gaining extra attention and the sales is forecast to be boom 12 months with the aid of 12 months inside the marketplace. For this challenge, the scope is minimized to the improvement of electric scooters. The use of electrical scooter turns into a new mode of transportation with a purpose to facilitate the human movement especially in massive or urban regions. Instead of that, it's miles such an opportunity shipping as an answer for an extremely low

stamina man or woman to transport quickly and the maximum crucial aspect is, it's miles environmental pleasant.

The electric scooter is not a fully motorized car, it's simply semi motorized scooter, which remains have brake and frame design and so on. This electric scooter use NiMH that's a commonplace strength supply used on the electrical scooter. This type of the battery is rechargeable and a lighter and denser ability batteries which is make it the designing of an electric scooter greater handful and less complicated. The electric scooter isn't like a motorcycle in many concepts, both it design or it energy deliver. Besides that, the electrical motor is also used lower energy as compared to bike that's the scooter. There is a few sort of electric scooter that generally used by all of the people in time period of weight and frame fabric kind. Weight of this scooter also plays an important position in the velocity of the scooter. The weight of the scooter depends at the purpose of the scooter been used, it is to either for competition so there is few of not unusual weight that been used for the scooter.

Figure 1: 3D Model of Electric Scooter

Problem Statement

Nowadays, small scooter turns into famous mainly at some point of exercise time, relaxing and for human exercising after they had confronted their workplace job. There is lots of scooter type round us like have seated or stand while driving the scooter. Most of this is operation by way of motor electric powered or just using our leg to move scooter like gambling skate board. The hassle is, most of that scooter is not bendy even though it is already small. Even although a few producer make it is able to be flip, but there may be just only a few part to be that like seat, cope with, and sometime arm bar. Most of flip small scooter are operate by swinging rider leg to transport it. Some of the scooter appeared now not so ergonomic and cannot be use for a long term. Even for an electric powered scooter, most of that may be turn. Usually simply their seat and take care of can be up and right down to flip. Sometime this may motive a number of areas for storage and difficult to bring a ways from residence like to place it into the automobile.

Objectives

•To reduce time and fasten the movement

•To reduce the use of non-renewable energy assets

• To manage the pollutants

•To be used for transportation on airports, colleges and at places of tourists interests.

II. LITERATURE REVIEW

For this study and observation are focused on existing system. The literature survey has been pioneered effort in this regard. Various machine design concepts and CAD/CAE concepts from literatures help to establish comparative study between existing and new experimentation. The terminologies referred from literatures for designing are discussed as follows:

Mahesh S. Khand et al [1] (2020) compares the different parts of the components in electric scooter and studies about the design and the development. It focuses on the main components battery, battery charger, motor, dc-dc converter, brushless dc hub motor, and also focuses on the rolling resistance of the tires of the vehicle.

Pradeep Daingade et al [2] (2020) focus on the initial design and the development of an electric scooter. The researchers here use mild steel for the fabrication.

PAndrada et al [3](2013) Compare the two different types of drives analytically & Experimentally. Both are permanent magnet synchronous motor drives, but one motor is fixed inside the rear wheels of the electric scooter and the other is connected to the wheel by the mechanical transmission system

Julio A. Sanguesa et al [4] 2021, this paper discusses the different types of electric vehicles, the technologies used in them, the advantages of electric vehicles over traditional vehicles such as zero-emission, reliability, simplicity, cost efficiency, and accessibility. This paper represents an expansive survey on charging modes, analyzing the different kinds of batteries.

Sanket Kakde et al [5] (2020), this paper identified that the market for e-bikes, the scooter is increasing day by day. The work in this paper is focusing on the long charging hours of the battery, very less life span of battery 3 or 4 years, less efficiency.

Satyendra Pratap Singh et al [6] (2021) in this paper the author gives a brief about the role of electric vehicles to reduce pollution in India. As 27 % air pollution caused by transport sector which leads to the premature death of 2 million Indian every year.

B Sreelakshmi et al [8] (2019The researcher here also uses a BLDC hub motor which is24V and a lithium-ion battery, and a speed controller which controls the speed and also acts as a dynamic brake in the electric scooter.

III. MATERIAL METHOD

For the complete construction of the chassis on electric powered scooters, simplest one type of the materials for all of the parts inside the chassis is chosen. This is due to the fact the materials which might be for use for all the components in the chassis are precisely the equal. The materials should be the best in residences of power, value, green product and formability. From the comparison of each of those properties, the chosen cloth for fabricating the body is slight steel.

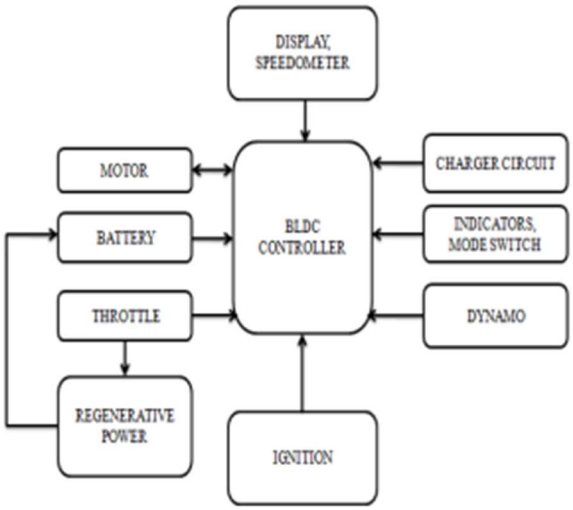

Figure 2: Block Diagram of Electric Scooter

Battery

Li-ion batteries might be characterized as energy storage systems that think insertion reactions from each electrode anywhere metal ions act due to the fact o the charge provider. Given this wide definition, there rectangular degree many completely one of a kind cellular chemistries that compose the Li-ion battery family. Most Li-ion batteries use a negative electrode mainly crafted from carbon (e.g., graphite) or lithium titanate (Li4Ti5O12), with some novel substances underneath development, namely, Li steel and Li(Si) alloys. The electrolyte used varies based totally on the selection of electrode materials, but is typically composed of a combination of lithium salts (e.g., LiPF6) and an natural solvent (e.g., diethyl carbonate) to permit for ion switch—those additives might be mentioned in more detail beneath. A keeping apart membrane is employed to permit steel detail ions to skip between the electrodes while stopping an indoors tangency. Advantage of this battery is Environmentally Friendly, Long Cycle existence, No reminiscence impact and Low Self-Discharge. A lithium-ion battery or Li-ion battery is a kind of rechargeable battery composed of cells in which lithium ions move from the terrible electrode thru an electrolyte to the wonderful electrode in the course of discharge and lower back whilst charging. Li-ion cells use an intercalated lithium compound as the fabric at the tremendous electrode and commonly graphite on the poor electrode.

Figure 3: Lithium Battery

Hub Motor

Motor Controller Circuitry is used to control all the operating cycle. The controller inside the electric powered scooter is the glue between acceleration and brake manipulate the battery and motor.

Hub motor electromagnetic fields are provided to the stationary windings of the motor. The outer a part of the motor follows, or attempts to comply with, those fields, turning the attached wheel. In a brushed motor, strength is transferred through brushes contacting the rotating shaft of the motor. Energy is transferred in a brushless motor electronically, doing away with bodily contact between desk bound and shifting elements. Although brushless motor era is pricier, maximum are greater efficient and longer-lasting than brushed motor systems.

A hub motor generally is designed in considered one of three configurations. Considered least sensible is an axial flux motor, in which the stator windings are generally sandwiched among units of magnets. The other two configurations are each radial designs with the motor magnets bonded to the rotor; in a single, the internal rotation motor, the rotor sits inside the stator, as in a conventional motor.

Figure 4: Hub motor

Electric motor

Conventionally, there are, in general, three types of motors used in elevator systems: AC, DC and a hybrid between the two. The AC-2 motor is a primitive motor drive popular at least half a century ago for low-speed elevators. It is usually coupled with a worm gear to reduce speed and increase driving torque.

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. Electric motors can be powered by direct current (DC) sources, such as from batteries, or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. An electric generator is mechanically identical to an electric motor, but operates with a reversed flow of power, converting mechanical energy into electrical energy.

Electric motors may be classified by considerations such as power source type, internal construction, application and type of motion output. In addition to AC versus DC types, motors may be brushed or brushless, may be of various phase (see single-phase, two-phase, or three-phase), and may be either air-cooled or liquid-cooled. General-purpose motors with standard dimensions and characteristics provide convenient mechanical power for industrial use. The largest electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors are found in industrial fans, blowers and pumps, machine tools, household appliances, power tools and disk drives. Small motors may be found in electric watches. In certain applications, such as in regenerative braking with traction motors, electric motors can be used in reverse as generators to recover energy that might otherwise be lost as heat and friction.

Electric motors produce linear or rotary force (torque) intended to propel some external mechanism, such as a fan or an elevator. An electric motor is generally designed for continuous rotation or for linear movement over a significant distance compared to its size. Magnetic solenoids are also transducers that

convert electrical power to mechanical motion, but can produce motion over only a limited distance.

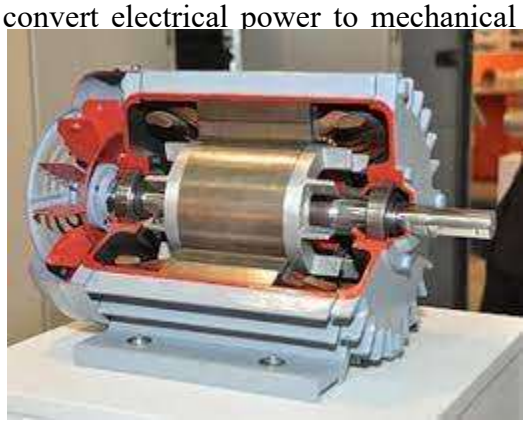

Figure 5: Electric Motor

The electric motor should have sufficient power to accelerate and carry the load. Two parts are considered separately

i. The torque required during accelerating the system

ii. The torque required during uniform velocity

For the deceleration, the braking system is responsible.

Rated Power	15 kW
Speed	360 rpm
Rated voltage	380 V

Table1: Electric motor properties

Charge/Motor Controller

Motor Controller Circuitry is used to control all the working cycle .The controller within the electric powered scooter is the glue between acceleration and brake manipulate the battery and motor.

A motor controller is a device or organization of gadgets that can coordinate in a predetermined way the overall performance of an electric powered motor. A motor controller might encompass a manual or automated way for beginning and stopping the motor, choosing forward or opposite rotation, selecting and regulating the speed, regulating or restricting the torque, and protective in opposition to overloads and electrical faults. Motor controllers may additionally use electromechanical switching, or may use energy electronics devices to alter the rate and path of a motor. Motor controllers are used with each direct cutting-edge and alternating contemporary cars.

Figure 6: Motor Controller

A controller includes way to attach the motor to the electric electricity deliver, and might additionally consist of overload safety for the motor, and over-current protection for the motor and wiring. A motor controller may also supervise the motor's discipline circuit, or stumble on conditions along with low deliver voltage, incorrect polarity or wrong phase series, or high motor temperature. Some motor controllers restrict the inrush starting modern-day, allowing the motor to accelerate itself and linked mechanical load extra slowly than a direct connection. Motor controllers may be manual, requiring an operator to series a starting switch thru steps to accelerate the load, or can be fully automatic, the use of inner timers or modern-day sensors to accelerate the motor.

Throttle

The throttle is used to boost up the scooter. When the rider presses the throttle, electric powered Signals go from the throttle via wire to the controller, which instructs the battery to launch electric energy to the motor and as a result scooter movement ahead. Throttle is located at the take care of bar. Red: Input, Green: Output, Black: Ground

Figure 7: Throttle

An engine's power can be increased or decreased by the restriction of inlet gases by the use of a throttle, but usually decreased. The term throttle has come to refer, informally, to any mechanism by which the power or speed of an engine is regulated, such as a car's accelerator pedal. What is often termed a throttle in an aviation context is also called a thrust lever, particularly for jet engine powered aircraft. For a steam locomotive, the valve which controls the steam is known as the regulator.

IV. WORKING

The electric Scooter works on batteries. These are rechargeable batteries made up of 48v/40ah lithium-ion type. The BLDC motor of the e-scooter is mounted on the frame. Once the Ignition is given, the battery establishes a connection with the BLDC controller then electricity that is produced in the battery is transmitted back to the motor via the controller, and motor starts to rotate. While providing throttle, depending upon the switch modes used in the controller, the motor will increase/decrease the distance traveled per hour (kmph). Then the motor will drive the belt connected with the pulley system e-scooter starts to move. In this system controller, motor, throttle, and battery play a vital role. The LCD display gives information about the battery, it displays speed, battery voltage, temperature, front light, right and left turns. This system uses Regenerative braking using dynamo.

V. RESULT

CALCULATION

1. Battery

Li-ion Battery- 1 battery = 12V

Pack of 4 batteries= 12 * 4=48V

Current carrying from each battery (I) = 7.4 Amp

Therefore, Power = V * I

= 48V * 7.4 Amp

= 355W

2. Motor

BLDC Hub Motor = 48V

Current consumption at full load 10 Amp (steady condition)

Current consumption at moving state = 2 Amp

Motor Power = 48V * 2Amp

= 96 W/hr

3. Battery backup given

= 370W / 96W/hr

= 3.7 hrs

Wheel Diameter = 14 inches

Assuming the speed of electric scooter will be 25km/hr,

Therefore, Distance covered = Speed * Time

= 25km/hr * 3.7hrs

= 92.5km

Hence, this scooter can travel up to 92 km (ideally in single charge)

4. Power consumed in 1km travel

We have total power = 355W

And total distance travelled = 92km

= 355W / 92km

= 3.85 W (for 1km travel)

5. Battery power consumed for 1km travel

P = V * I

3.85W = V * 2amp

V = 3.85 / 2

= 1.925 V

Hence, only 1.925V of voltage will consumed from total 48V.

No Load speed calculation

No of tooth on the Motor (T1) = 9No of tooth on wheel (T2)=36

Speed of N1=3300 rpm

Speed of N2=?

Using Gear ratio formulaN1T1=N2T2

N2=N1T1/T2

Hence, N2=825 under no load condition.

Calculation for motor rating

The overall performance of the motor varies with load given to the motor, it is important to pick the motor score in step with the load given to the motor. We assumed that the weight being located at the motor to be 110kg.

The next steps describe the calculations for deciding on the motor score.

Assuming that a mass of 110 kg is loaded.

m = 110 kg

Speed changes from 0 → 15 km/hr in 10 sec.

Acceleration

a = (15-0)*(5/18)/10 = .416 m/sec2

Force is given by

F = m x a =110 x .416 = 45.83 N

d = Wheel Diameter in metre Wheel Diameter (d) is 8 inch

1 inch = 0.0254 m, So, d = 8 inch = .204 m Torque developed = force x radius of the wheel

= F x r

= 45.83 x .102 m

= 4.675 Nm

Selection of motor

When deciding on force motor for the electric car, a number of things ought to be taken below consideration to look the maximum torque wished. The factors are:

- Rolling resistance

- Gradient resistance
- Aerodynamic drag

Ftotal= Frolling + Fgradient + Faerodynamic drag

Where Ftotal = Total force

Frolling= Force due to Rolling Resistance Fgradient =Force due to Gradient Resistance

Faerodynamic drag =Force due to Aerodynamic Drag

Ftotal is the total tractive force that the output of the motor must overcome, to propel vehicle.

1) Rolling Resistance

Rolling resistance is the force which resists the motion of the automobile because of the touch of the tire with the street.

The formulation for calculating force due to rolling resistance is given with the aid of the equation:

Frolling= Crr × M × g

Where M = mass in kg

g = acceleration due to gravity = 9.81 m/s2

For application, puropose consider, Crr= 0.004

Then, Frolling = Crr×M×g

=0.004×110×9.81

= 4.3164 N

2) Gradient Resistance

The gradient resistance of the automobile is the resistance supplied to the vehicle whilst mountain climbing a hill or an inclined floor. The angle among the floor and slope of the route is represented as "θ"

The method for calculating the gradient resistance is given by way of equation under

Fgradient = ±M × g × sin θ

Where, + (positive) sign is for moving up the gradient -(negative) sign is for moving down the gradient.

For application, in this illustration, let us consider electric scooter moves at an angle of θ (inclined angle) = 2.5°

Fgradient = ±M × g × sin θ =110×9.81×sin 2.5° = 47.0696 N

3) Aerodynamic Resistance

Aerodynamic drag is the resistive force presented due to viscous force appearing on a car. It is determined with the aid of the shape and size of the automobile.

The components for calculating aerodynamic drag is given by way of the under equation.

Faerodynamic drag = 0.5 × CD × Af × ρ × v^2

Where, CD =Drag coefficient, Af=Frontal area

ρ = Air density in kg/m3

v = velocity in m/s

For application assume, maximum speed of our scooter is 15 kmph that is four.166 m/s and air density is 1.1644 kg/m3 at 30° temperature and drag coefficient is zero.5 , frontal location is 0.7

Then,

Faerodynamic drag = 0.5 × CD × Af× ρ ×v^2

= 0.5×0.5×0.7×1.1644×(4.166)2

=3.5376 N

Then, The force required for driving a vehicle is,Ftotal = Frolling+ Fgradient+ Faerodynamic drag

= 6.2894 N + 47.0696 N + 3.5376 N

= 56.8966 N

Then, the power required for driving a vehicle is, Power = Force × Velocity × (1000 ÷ 3600)

= 56.8966 × 15 × (1000 ÷ 3600)

= 237.06 watt.

Hence, the power required to propel the vehicle is 237.06 W, Which is just below our motor specification 250W.

VI. DISSCUSSION

Self charging Electric scooter is amendment of current electric powered scooter. It is appropriate for each city and Roads, which can be fabricated from cement, asphalt, or mud. This scooter is inexpensive; less complicated in creation & can be extensively used for short distance visiting especially via college kids, university college students, workplace goers, villagers, and postmen and so on. It is very a whole lot suitable for young, aged peoples. It can be operated free of cost. This scooter is that it does now not eat precious fossil fuels thereby saving cores of foreign currencies. It is green, within your means & pollutants free, because it does not have any emissions. Moreover it's far noiseless and can be recharged with the AC adapter in case of emergency or cloudy weather. The mission deals with the layout and fabrication of Electric Scooter that promotes within your budget and green approach of transport for absolutely everyone. As the initial step, a literature survey on associated systems and initiatives were performed. An appropriate layout became proposed but because of infeasibility incurred in making the version, we decided to make a scaled-down prototype converting the layout accordingly. The design dimensions and components were correctly calculated and analyzed. Materials and components for the fabrication of the mission have been as compared and selected. The car is used to reduce the manual effort i.e. In place of conventional cycle; and offers more displacement with lesser attempt. This scooter has simplest three wheels, seems strong and lets you take it for a experience in step with its design. Many structures can be stepped forward in the future to optimize the producing of the car. Solar panels and Dynamo turbines can be included with the automobile for charging whilst riding. Light weight carbon fiber can be used to reduce the overall weight of the automobile and improves energy. This gadget can be correctly used everywhere whether or not it's far outdoor or indoor. This utilizes exceedingly fuel-saving technology that's a primary requirement of this period. We evolved a branch and bound approach which is coupled with quick, powerful bounds to optimize the Electric Scooter which serves the motive of journeying and also use the non-renewable strength assets. On the complete, we're satisfied with our project.

VII. Advantages

• It is Eco-Friendly.
• It can without difficulty be used for quick-distance travels i.e. College tours, factory excursions etc.
• The Electric Scooter has a predictable surface this is a lot simpler to negotiate than sidewalks, curbs or trails and the risk of tripping is decreased.
• Multiple customers can use the equal device without adjusting the shape.
• It may be used at the locations in which are the dangers of infection due to emission.

VIII. Disadvantages

Electric Scooter has following hazards:

• On sudden software of brakes jerking and coincidence can arise.

• Main disadvantage of Electric Scooter is its discharging battery. Due to surprising discharge of battery in between of touring many problems are confronted.

• Not most useful for long distance.

IX. CONCLUSION

This paper offers the take a look at of the layout and Fabrication of Electric Motor. In end, comparing our task electric powered Bike with the commercial electric powered vehicle. Our motorcycle is green to run at double the space of an ordinary electric motorcycle. As a end result, electric powered bikes aren't simplest used for short-variety transportation, they also can be used for long-variety transportation's too. Though our electric powered motorbike is impartial of outside energy supply it is able to be used for charger free transportation's and it payees a higher course in the direction of pollutants free atmosphere for our kingdom. In the approaching destiny, it's far forethought that all the petrol bikes want to get replaced by the E-bikes as there may be a gasoline strength disaster and additionally to save our mom earth. And additionally it made a low fee of transportation for the individual. This vehicle also gives safety driving for people because of their confined speed. The "Regenerative Braking" is operating with satisfactory situations. We are capable of recognize the problems in preserving the tolerances and additionally quality. This challenge work has provided us an incredible opportunity and knowledge, to use our confined know-how. We received tons of realistic know-how regarding, making plans, purchasing, assembling, and machining even as doing this task paintings.

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