VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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A PROJECT REPORT ON

"DESIGN AND FABRICATION OF AN ELECTRIC CAFÉ RACER"

(SPONSORED BY KSCST)

Project report submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF ENGINEERINGIN

MECHANICAL ENGINEERING

Submitted by

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CERTIFICATE

It is certified that the Project work entitled **" Design and fabrication of an electric café racer"** carried out by **Abhijith Balamurali(1NH17ME701),Haseeb Fayaz Khan(1NH17ME721),Ashish Jose Varghese(1NH17ME713),Amit Kishor Vernekar(1NH17ME711),** the bonafide students of **New Horizon College of Engineering, Bengaluru**, in partial fulfillment for the award of **Bachelor of Engineering in Mechanical Engineering** of the **Visvesvaraya Technological University, Belagavi** during the year **2020-2021**. It is further certified that all corrections/suggestions indicated for internal assessment has been incorporated in the report deposited in the department library. The Project has been approved as it satisfies the academic requirements in respect of Project Work prescribed for the **Bachelor of Engineering** degree.

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DECLARATION

I hereby declare that the entire work embodied in this dissertation has been carried out by us and no part of it has been submitted for any degree of any institution previously.

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This is to certify that the above declaration made by the candidates is correct to the best of my knowledge and belief.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The fundamental substance of this report is to give the specific view by harnessing the different wellsprings of energy accessible to humankind. In the present modernized world voyaging is extremely fundamental for people to lengthen in this world. Also, to do as such voyaging ought to be done in least conceivable manner and in jiffy. This report insights concerning the Electric Bike which runs on the battery subsequently giving voltage to the engine. This report compromises manufacture of Electric Bike which utilizes Electric energy as the essential source and solar energy if conceivable by connecting sun-based boards. It likewise features on the plan parts of the bicycle. There is an arrangement for a charging the battery by launching it from the primary framework. The electrical force generated issued to run the bicycle which can give better mileage contrasted with customary vehicle, better execution and furthermore causes less contamination.

Chapter-1

INTRODUCTION

Electric bikes as many folks have seen have non heritable an excellent significance as a result ofit'san alternate future approach for transmission due their features. In spite of that, there are 3 difficulties that face the analysis of the electrical bikes: long time of charging, price of batteries, and restricted driving ranges .the nice developments in power electronic inverters that are used as a main controller within the electric bikes have given a step forward. additionally, to that, the electric machine motors appreciate DC motors, induction motors, and three-phase synchronous motors have witnessed effective method in material and electromagnets assisted to extend their potency. The traction motors wantpowerfully2necessary parameters to acknowledge their performance: high beginning force and acceleration. Furthermore, the traction motor ought to have the initial force to beat the resistance force induced at the starting movement. the electrical automobile was 1stfanciedwithin the USA and European country in 1834. when that, slow progress began to prove its importance till3 eras of development to the present day. These three boom eras were dominated by factors such as the presence of oil, prices, and crises, and the second issue is that the pollution of the setting and the rise in temperature of the earth. the primary boom era began in 1850 and continued to 1900 within the USA wherever the DC motors were the fundamental part of the drag with the presence of batteries. The second boom era started from 1950 to 2000, where the 1973 oil crisis, pollution of the environment, and heating contributed to the present development. The third boom started since the start of 2000 to the present day, wherever the Japanese corporations, Toyota and Nissan, and the

German company, Mercedes or BMW, and Chinese companies additionally as U.S.A. companies entered during a fierce competition to management the world markets.

The following table gives the electric vehicle history.

Name	Year and country	Type of traction	Notes
Thomas Davenport	1834, USA	DC motor	
Robert Anderson	1832–1839, Scotland	First prototype electric-powered carriage	
Andreas Flocken	1888, Germany	The first four-wheeled electric car	
Pope Manufacturing Co.	1897, USA	The first commercial electric vehicle	
La Jamais Contente	1899, France	The first electric vehicle to travel over 100 km per hour	
	1900, USA	Electricity-powered cars	Capturing 28% of the market
The petrol-powered Ford Model	1908, USA	Electric car Model T	
A Baker Electric	1909, USA	Automobile	
Charles Kettering	1912, USA	The electric starter was invented instead of hand-crank	
Global EV stock	1912, USA		Market, 30,000
Carmaker Tama	1947, Japan	Electric car with a 40 V lead acid battery	
General Motors	1996, USA	EV1 electric car	
Toyota	1997, Japan	The Prius, the world's first commercial hybrid car	
BEV Nissan	2010, Japan	The world's largest electric car sharing service	
Nissan LEAF	2011, Japan	New car models	
PHEV Chevrolet Volt	2012, USA	New car models	

Table 1.

1.1 Electric traction motors

1.1.1 Traction engine types

There are three kinds of electric engines which are designated to utilize: DC engine, AC single- or three-stage enlistment engine (IM), and three-stage simultaneous engine (SM). These engine highlights are picked relying upon the idea of voltage-provided source, execution, and technique for development.

1.1.1.1 DC engines

DC engines are described as follows: claimed turn speeds, the equivalent wide scope of changing velocity with the chance of simple control, the chance of switching the rotational development, and the likelihood to begin a suitable force.

1.1.1.2 Induction engines

There are two kinds of enlistment engines: the primary sort has a rotor shape-like squirrel confine plan. It is described by straightforward establishment, minimal expense, and hardness. This sort is reasonable for applications requiring steady turn speed. The subsequent kind is known as the slip-ring engine which has an injury rotor with a three-phase winding. The initial three terminals of the windings are shorted, while the second three consummation terminals of the windings are associated with the three slip rings. Slip-ring enlistment engine is appropriate for applications that need incredible beginning force for a couple of moments with a diminishing in the worth of the beginning current. This sort is described by the principal type with its extraordinary capacity to control the speed and force what's more, the beginning current by utilizing extra factor three-stage obstruction associated through the three slip rings of the engine.

1.1.1.3 Synchronous engine

This sort of engine is reasonable for applications that need a consistent revolution speed worth and extraordinary force notwithstanding the chance intended to work at moderate speeds by a powerful factor and high working proficiency.

1.2 Advantages and disadvantages of electric traction

The main benefits of utilizing the electric engines in foothold are anticontamination that goes with the utilization of electric engines. The electric engine gives an extraordinary beginning force, which permits high speed increase esteem at the beginning of the vehicle.

Along these lines, they permit conveying twice as numerous individuals on the same way on account of the great progression of vehicle speed. The electric engine gives a delicate change in the ultrafast speed. The electric engine gives the chance of utilizing the electric brake, which empowers the return capacity to the electric network when utilizing the brake recovery while strolling down the slants. The utilization of electric brakes prompts investment funds in the utilization of the mechanical brakes which drags out life and decreases erosion in the roller haggles iron bars. The time needed for the support and fix of an electric vehicle is lesser than the need by others. The support and fix of the electric vehicle cost about portion of those expense in different vehicles. They didn't require electric vehicles to the time to become functional. At long last, disposing of the exhaust vapor, which may contain poisonous components, is viewed as perhaps the main benefits of electric footing, particularly in deception and streets under the ground. The disservices of electric footing are as per the following: The expense of development is high, any breakdown in the electrical matrix in any event, for a concise period will prompt complete loss of motion in rush hour gridlock and might expand extended periods of time, and furthermore a cross-over happens between the electric footing organization and correspondence signals.

1.3 Feeding electric traction system networks

There are three distinct kinds of feed electric foothold frameworks:

a. DC voltage framework (DC power framework)
b. Single-stage AC voltage framework

c. Three-stage AC voltage framework

(a) DC power framework: DC voltage of 600 to 700 V is utilized universally for cable cars in the urban areas, while the continuous exertion of the 1500–3000 V is utilized external the urban communities. The iron bars address the impartial line. The particular expresses that the voltage drop ought not be in excess of 7 volts between any two focuses on the unbiased line

(iron bars). 4 Applied Electromechanical Devices and Machines for Electric Mobility SolutionsAs for the electric transport (trolleybus), the two electric lines ought to be two overhanged, the taking care of line and unbiased line. The voltage should not surpass 10% give or take. The DC network is taken care of into electric force stations 3–5 kilometers away from one another inside the urban communities and 40–50 kilometers outside the urban communities. Electric force stations are likewise provided with power from the AC voltage organizations of 110–122 kV, where it is changed over into a DC voltage required.

(b) Single-stage AC framework: This framework utilizes a voltage of 11–15 kV (2/3 16) or 25 Hz. In the event that force plants are utilized to take care of footing stations, there will be no trouble in creating the necessary voltage and recurrence. On account of high-voltage organizations at 50 or 60 Hz recurrence, as far as possible ought to be decreased to as far as possible (a three-stage simultaneous engine is utilized to work a solitary stage generator to create the necessary voltage and recurrence). For this situation, the foothold network comprises of a solitary overhanged line, and the rails address the impartial. The footing line conveys the transformer to decrease the voltage to 300 or 400 volts to take care of the overall series engine, and the engine speed can be constrained by changing the voltage of the transformer. Low recurrence (16.667) or 25 Hz is utilized to work on the proficiency and force factor of the engine. It likewise assists with diminishing the electrical flash between the brushes also, the commutator, as well as lessening the acceptance impedance of the traction network transmission lines and consequently diminishing the lost voltage. This increments the distance between taking care of stations to 50–80 kilometers. Low-recurrence use too lessens impedance with phone and correspondence organizations.

(c) Three-stage AC framework: Three-stage acceptance engines are utilized as drive engines for this situation with a voltage of 3.3 kV and a recurrence of 16.667 Hz. The force stations get power from high-voltage organizations, and the voltage and recurrence are decreased to as far as possible. The footing network comprises of two transmission lines; the line bar is the third line. The benefits referenced, because of the utilization of low recurrence, can likewise be referenced in this framework.

Following table shows specification of Electric bikes in various countries:

Country	Type of bike	Speed limit in km/hr	Watt	Weight in kgs	Age required in yrs
Australia	Pedal	25	250	None	None
Canada	Hand	32	500	None	Various
China	P/H	30	200	20	None
Norway	Pedal	25	250	None	None
Israel	Pedal	25	250	30	14
UK	Hand	27	250	40	14
Taiwan	Hand	25	200	None	None
US	Hand	25	750	None	None
China	P/H	30	500	None	None

Table: 1.1

1.4 Factors to be considered while choosing an electric motor

Decidingon an electric motor depends at the occasions so that it will work beneathandthe sort of load. There are several elements to recall whilst selecting an electricmotorto healthy commercial program s, and one of the maximum crucial are as follows:

1.electrical homes:

a. The residences of the begin of the motion, in phrases of the value ofeach of the torque andthe-drawn current

b.The properties of the motor all through operation, the relationship amongthe torqueand speed,and the relationship between velocity and energy,modern, losses, and performance.

c. The volume of manage the rate of rotation during operation.

d. How to turn off the motor and smash it.

2.Mechanical issues:

a. the kind of outdoor cowl of the motor, the sort of cooling of the motor.

b. The form of rotary bearings used. FiveMechanical and electrical layout Calculations of Hybrid motors what's the transmission manner between the motor and the weight.

d. The noise level, which is produced with the aid of the motor.

3.The motor size and the design strength:

a. Loading requirements in phrases of non-stop or quick term or intermittent.

b. capacity of the motor to address immoderate loads

4.The value of the motor:

a. In phrases of the primary and working feein addition tothe preceding factors, it ought to be saved in thoughts the contemporary personkind,in terms of being a DC consistent, AC unmarried-phase, or 3-section modern.From the above it's far clear that there are numerous elements ought to be taken into consideration whilechoosing a motor to drive agiven load, and regardless of the truth that the value of thesystem got here insidethe last preceding mechanical concerns, however the very last choicein the selection ofthe gadget, relying upon considerably.

The preferred andselected system ought to meet all of the technical necessities of the load and at theequal time ought to now not beso excessive till it succeeds economically. In fact, the selection ofthe motor callsfor careful examine and evaluation of its traits and cargo collectively. In addition to thefull understanding of the entire gadget of stirring and controlgadgets, it's far required to haveswitching gadgets and alternate the frequency.

The modern-day factors andtheir impact on extraordinary styles of vehicles can be discussedin detail separately insidethe subsequent phase, to demonstrate the effect of each of them:

1. electric houses:

The properties of the one of a kind vehicles in phrases of working houses and the properties of the begin of the motion and pace manage have been studied within the

decisions of the DC machines and AC small electricity automobiles.

2.Mechanical issues:

A. cowl person kind: the principle objective of the outer frame of the gadget is not handiest to provide safety for the humans and the workers however additionally to offer protection for the system itself, against moisture, dust, dirt,and undesirable objects and what would possibly leak out of the motor fumes andflammable substances. Thereare exceptional sorts of the cars in step withtheir protection ways:

i. Open type

ii. Mesh cover-blanketed type

iii. kind protected in opposition to scattering of beverages and dust

iv. Water- and rain-blanketed type

v. Self-air cooling

vi.applied Electromechanical devices and Machines for electric powered Mobility Solutions. Separated cooling

vii. Tubed cooling

B. Bearings used kind:

There are two sorts of bearings utilized in electric powered cars, particularly, ball bearings and curler bearings.

i. Ball bearings: utilized in cars as much as a hundred horsepower.

They'refavored through different types because of its many benefits. The maximumvital of those are little friction losses, less maintenance, andlonger sturdiness than thealternative wheels. among stator androtor. but its most important dangers are its excessive price and noise,mainly at high speeds.

ii. roller bearings:

utilized in cars that paintings in quiet places inclusiveofhospitals,workplaces and school rooms.

C. formsof transmission: switch the generated mechanical electricity to thesystem to power the mechanical load axis; there are numerous approaches to guidetheburden, and the most crucial are:

i. Direct transmission: the weight and the motor are directlyconnected by using a mechanical

coupling that is strong or bendy.Coupling is used while the burden pace is same to thespeed of themotor.

ii. riding by way of timing belts to transfer energy of up to two hundredand fiftykilowatts, preferably when the usage of this technique to be lessdistance among the axis ofrollers equal to 4 to 5 instances thediameter of the biggest pulley, and so that the most ratioamong the diagonal rollers are 1: 6, as there's in this examplesliding among the bordersof three to four percent. Thedrawback of this method is that it requires a massive area, sothe belts make anxiety sideways on the bearings, causingincreased friction missing out and fatigue.

iii. riding with the aid of the usage of V-kind belts: This form of V-type conveyor isused between rollers with the identical shape. This method isused to move massive valvesthat exceed the capacity of the belt,and it operates with a small slip that can be omitted.iv. through driving chains: This method is greater green and is used athigh speeds, howeverthe fee is the

mostimportant. however they want muchless areathanthe previous , wherein the

desired distance between theaxis of rollers is of one and ½ to twice the diameter of a larger pulley. it's far utilizedin moist and dust locations so that the chains mustbe blanketed by using its own cover, because it must have perfectly parallelaxes, to keep away from lateral tensile axis rollers.

v. By way of guidance with gearbox: This method is used whilst the motorused hasa high speed to force a load when its speed is gradual; the

D.The noise produced by way of the motor: noise produced inside the motor for the following reasons:

i. Alternating magnetic area within the motor caused by vibrationsin the iron body segments and the motor

ii. The motion of air inside the device

iii. Friction in the bearingsNoise stage need to be reduced to the bottom level feasible, in particular inautomobiles which can be used in hospitals, places of work, theaters, and classrooms. To lessen thetransitional noise from the motor to the alternative places, it should be established withrubber or helical springs to soak up vibrations.three. size of the

motor and its electricity:

The elements that manage the size and capacity of the motor is the mosttemperature

reached by means of the motor for the durationof the service run under load situations, in that it constantly or intermittently, or quick-term and the maximum. it's beendiscovered that the motor that achieves the primary circumstance of temperature also achievesthe secondone situation of the torque required. it is really worth citing here that themaximum temperature of the motor is designed on the basis of the kind of theinsulating material used. Motor insulations are categorised to kinds depending on the maximum temperature allowed.

Loading necessities in phrases of-that continuous or brief term or-intermittent:typically, electric cars are designed primarilybased on the quantity of time wherein theyperform the gadget required load in addition to the quantity of time wherein thesystem is desk bound for paintings or runs at no load. in this basis, the guidelines that complywithto select electric automobiles indicate the possibility of rating motor in terms of timeplan. right here are a few running kinds of motor:

A.non-stop operation: the system running needs to doits activity in this case tobegin the motor complete score and on continuous whichwill attain the temperature inall components of the motor to the most amount at which the motor has beendesigned-on the basis of not beyond it with the operating continuation of anyduration after that.

B. quick-time period operating: The machine operating in this kind of operation runs sporadic periods, each of which extends over a particular time period, the measured temperature so as no longer to exceed in all components of the motor the most temperature.

Chapter-2

LITERATURESURVEY

1.DeepRPrajapti,KunjanShinde,AbhishekMhakshe,andAniketPrabhu"Design andFabricationofElectricBike"istheauthorsofthispapergivestheexactview by bridling the various sources of energy available to mankind. They have also mentioned about the electric bike which runs on the battery by providing voltage to the motor. This paper also compromises with fabrication and design of e-bike whichmakesuseofelectricenergyastheprimarysourceandalsosolarenergyby attachingsolarpanels,anditalsoaprovisionforchargingthebatterybyremoving batteryfromthemainsystem.Theelectricalpowergeneratedbythee-bikeisused torunthebikeandalsoforbetterperformancecomparedtoconventionalvehicles whichalsocauseslesspollution.Thesystemwhichtheyhaveinnovatedasvarious benefits both to the members of the team and also external benefits by making awarenessofusingalternativemodesoftransport,thee-bikewhichworksonthe battery powered motor is a general mode of transport for local trips. The solar panels can also use to be an alternative source for charging the battery when stationary they are using an AC motor which is powered by using DC battery and switching that electrical energy in the form of electric current to the AC converter circuit which is used to convert AC to DC but the obtained AC current is amplified again and fed to the stator winding of the AC motor. they have tried to make the bikemoreefficientandcheaperandalsotoaidshorterdistancesbypeopleofany age the solar panels are used to increase the energy production when not in use the main motive of this project is to not to use any kind of fossil fuels and also to decreasethenoisepollutionsincethise-bikeasfewercomponentsitcanbeeasily dismantled to small components which perfectively leads to lessermaintenance.

2.MiteshM,TrivediandManishK"DesignandDevelopmentofE-Bike"inthis project author's main reason is to identify the need to modifying e-bike to overcometheissueofpollutionbecauseofvehiclesinmetrotownsandurban zones is swelling

uninterruptedly considering, all the class of society it is not reasonable to purchase scooters or motorcycles. So, by combing both issues environmentalprogresssupportingandeconomicallyaffordablealternativewould be a best solution. There are two parts of the electric bicycle as per their working and functions: Power on Demand and Pedal Assist. The motor is activated by a throttlewithpower–on–demand,customarilyandbar–mountedaswellason general scooters and motorcycles. By pedalling electric motor can be controlled withpedalassist,thispedalassistaugmentstheeffectsoftheriderwhenpedalling the e-bikes are known as pedelec have a sensor to identify the force and speed of pedalling.Disablingthemotoristhebrakesensingaction,themainpurposeofthis projectistoreviewthecurrentsituationandeffectivenessofelectricbicyclewhich they have researched in order to approach the objective to maximize the speed and efficiency and to optimize the cost. The main objective of this paper was to explore the acceleration and speed of manually and electrically powered bicycle. The author has considered the importance of easy vehicle mobility and compactness and they have revealed that folding is a strategic feature of the e- bike. Which makes it mobile. The conclusion of this project is to ensure comfortable, compact, high speed and effective e-bike can be achieved. The resultsfromtheexperimentwhichasobtainedbydifferentauthor'sadvancement in current e-bike model includes pre discover results from literatures like the selection of materials of frame tubes and aerodynamicdesign.

3.C.Abagnale, M.Cardone, and P.Lodice "Design and Development of an InnovativeE-Bike"theyhavedesignedpower-assistedbicyclebyusingthenew mechanical transmission as installing the motor as the pedal axle. This present paper describes about the pedelec prototype which as a motor at the pedal axle as to increase the cost and to make the mechanism compact. This innovative solution is represented by the motion transmission from the motor to the pedal shaftwhichisachievedbyusingtwodifferentgearboxes,thefirsttypeisbyusing theplanetarygearboxandthesecondtypeisusingsimplebevelgear.Thispedelec as a new low-cost measurement system by using the driving torque based on a strain gauge load cell located on one side of the rear wheel which is between hub andtheframe.Thistestrigisabletoreproduceaforethoughtpartsacquiredduring the road tests, to

measure the e-bike performance in terms of instantaneous power and speed this test rig also can simulate the resistant torque of a predetermined track and it also aims to test and to optimize the control

strategy available on the electronic control unit. They have also conducted an environmental analysis of the developed pedelec prototype which is particularly compared with the e-bike with a thermal moped, in terms of environmental impact. The authors have tried to achieve a different form than the common approach by using electric motor which is located on one of the three hubs of the bicycle, they came up with the idea of pedelec prototype. This paper deals with the activity carried out on the pedelec prototype which is an innovative power-assisted bicycle which is designed at Department of Industrial Engineering of the University of Napeles Federico II: a pedelec characterized by a new low cost measurement system of the total driving torque of the e-bike (Rider torque + Electrical motor torque) and also by an innovative layout of electrical assistance. The pedelec motor system is characterized by a driving torque due to both rider torque and an electric motor one. As the large use of traveling vehicles as increasedproblemswhichareconnectedtotheairqualityandthepetroleum usage,thishuman-electricbicyclethatsupportstheriderwithelectricpoweronly whentheriderispedallingwhichcanbethefutureofsubstantialmodificationsin the mobility of the e-bike, particularly in urban areas which is also the alternative solutions for multiple-fuelling, hybridization andelectrification.

Chapter-3

EXPERIMENTALEQUIPMENTANDINSTRUMENT

3.1 Motor

A DC motor is an electrical machine which convert direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either an adjustable supply voltage or bychangingthestrengthofcurrentinitsfieldwindings.SmallDCmotorsareusedintools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drivesforsteelrollingmills.TheadventofpowerelectronicshasmadereplacementofDC motors with AC motors possible in many applications. A wire which is coiled and when current is passed through it an electromagnetic field adjustable. The direction and magnitude of the magnetic field produced by the coil can be changed with the direction and magnitude of the current flowing through it. A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallelcurrentpaths.Theendsofthewirewindingareconnectedtoacommentator.The commentatorallowseacharmaturecoiltobeenergizedinturnandconnectstherotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes.) Basically, there are two types ofmotors.

- Brushed DC electricmotor
- Brushless DC electricmotor

3.1.1 Brushed DC electricmotor

AbrushedDCelectricmotorisaninternallycommutatedelectricdesignedtoberunfrom a direct current power source. Brushed motors were the first commercially important application of electric power to driving mechanical energy, and DC distribution systems were used for more than 100 years to operate motors in commercial and industrial buildings.BrushedDCmotorscanbevariedinspeedbychangingtheoperatingvoltageor thestrengthofthemagneticfield.Dependingontheconnectionsofthefieldtothepower supply,thespeedandtorquecharacteristicsofabrushedmotorcanbealteredtoprovide steady speed or speed inversely proportional to the mechanical load. Generally, the rotational speed of a DC motor is proportional to the EMF in its coil (the voltage applied to it minus voltage lost on its resistance), and the torque is proportional to the current. Speed control can be achieved by variable battery tapings, variable supply voltage, resistorsorelectroniccontrols.Asimulationexamplecanbefoundhere.Thedirectionofa wound field DC motor can be changed by reversing either the field or armature connections but not both. This is commonly done with a special set ofcontactors (direction contactors). The effective voltage can be varied by inserting a series resistor or byanelectronicallycontrolledswitchingdevicemadeoftransistors,mercuryarcrectifiers. A permanent magnet DC motor is characterized by a linear relationship between stall torque when the torque is maximum with the shaft at standstill and no-load speed with no applied shaft torque and maximum output speed. There is a quadratic power relationship between these two speed-axispoints.

3.1.2Brushless DC electricmotor

AbrushlessDCelectricmotoralsoknownasECmotor,aremotorspoweredbyDCelectricity via an inverter or switching power supply which produces an AC electric current to drive eachphaseofthemotorviaaloopcontroller.Thecontrollerprovidespulsesofcurrentto the motor windings that control the speed and torque of the motor. The construction of abrushlessmotorsystemisatypicalpermanentmagnetmotor,butcanalsobeaswitched

reluctance motor, the advantages of a brushless motor over brushed motor are high speed,

highpowertoweightratioandelectroniccontrol.Applicationsofbrushlessmotor findsitwayindiskdrive,DVDplayers,handheldpowertools,andmodeltoautomobiles. The development of brushless motor allowed the commutator and brushes to be eliminatedinDCmotors.InbrushlessDCmotors,anelectronicservosystem replacesthe mechanicalcommutatorcontacts.Anelectronicsensordetectstheangleoftherotor,and controls semiconductor switches such as transistors which control current through the windings,eitherreversingthedirectionofthecurrent,orinsomemotorsturningitoff,at the correct time each 180° shaft rotation so the electromagnets create a torque in one direction. The elimination of the sliding contact allows brushless motors to have less friction and longer life; their working life is only limited by the lifetime of theirbearings.

Brushed DC motors develop a maximum torque when still, linearly decreasing as velocity increases.Somelimitationsofbrushedmotorscanbeovercomebybrushlessmotors;they include higher efficiency and a lower susceptibility to mechanical wear. These benefits come at the cost of potentially less rugged, more complex, and more expensive control electronics.Ausualbrushlessmotorhaspermanentmagnetswhichrotatearoundafixed armature, eliminating problems related to connecting current to the moving armature. An electronic controller replaces the brush/commutator assembly of the brushed DC motor, which continually switches the phase to the windings to keep the motor turning.

The controller performs similar timed power distribution by using a solid-state circuit rather than the brush/commutator system. Brushless motors offer a number of advantages over brushed DC motors, including high torque to weight ratio, more torque per watt, increased reliability, reduced noise, longer lifetime, elimination of ionizing sparks from the commutator, and overall reduction of electromagnetic interference (EMI). With no windings on the rotor, they are not subjected to centrifugal forces, and because the windings are supported by the housing, they can be cooled by conduction, requiring no airflow inside the motor for cooling. This in turn means that the motor's internals can be entirely enclosed and protected from dirt or other foreign matter. The

maximumpowerthatcanbeappliedtoabrushlessmotorisonlylimitedtoexclusivelyby heat,toomuchofheatcanweakenthemagnitesandwilldamagetothecoilwindingand insulation.Whenconvertingelectricityinto

mechanicalpower,brushlessmotorsaremore efficientthanbrushedmotors.Thisimprovementislargelyduetothefrequencyatwhich the electricity is switched determined by the position sensor feedback. Additional gains are due to the absence of brushes, which reduces mechanical energy loss due to friction. The enhanced efficiency is greatest in the no-load and low-load region of the motor's performance curve. Under high mechanical loads, brushless motors and high-quality brushed motors are comparable in efficiency. Environment and requirements in which manufacturers use brushless-type DC motors include maintenance-free operation, high speeds,andoperationwheresparkingishazardous(i.e.Explosiveenvironments)orcould affect electronically sensitiveequipment.

3.1.3Variations inconstruction

In the usual configuration, the permanent magnets are part of the rotor. Three stator windingssurroundtherotor.Intheoutsurfaceorexternal-rotorconfiguration,theradial-relationship between the coils and magnets is reversed; the stator coils form the centre (core)ofthemotor,whilethepermanentmagnetsspinwithinanoverhangingrotorwhich surrounds the core. The flat or axial flux type, used where there are space or shape limitations, uses stator and rotor plates, mounted face to face. Out runners usually have morepoles,setupintripletstomaintainthethreegroupsofwindings,andhaveahigher torque at low rpms. In all brushless motors, the coils arestationary

3.2 DifferencebetweenaBrushlessMotorandaBrushMotor

Construction differences

Brushes inside electric motors are used to distribute current to the motor windings through commutator contacts. Brushless motors have none of these current carrying commutators. The field inside a brushless motor is switched via an amplifier triggered by a commutating device, such as an optical encoder.

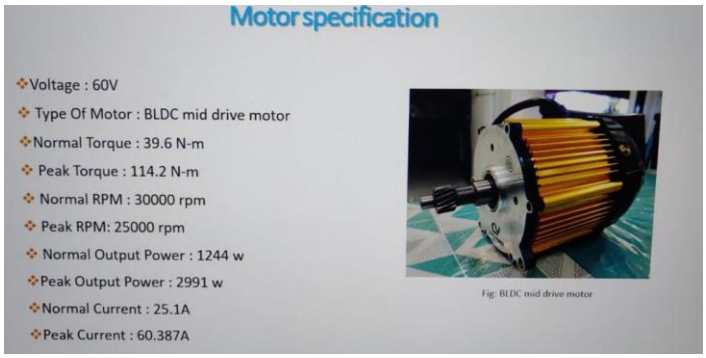
Table: DC motors

SL. No	Brushed dc motor	Brushless dc motor
1	Simplified wiring	Complex wiring
2	Has a higher full load torque	Has a higher no load or low-load torque
3	Low cost	High cost
4	Long lifespan: No brushes to wear out	Long lifespan: No brushes to wear out
5	Low maintenance: No brushes to replace	Low maintenance: No brushes to replace
6	75-80% efficient	85-90% efficient
7	Electrically noisy is more	Electrically noisy is less due to less moving parts

Table no. 3.1

3.3 Selection ofmotor

The reason brushed dc motor was chosen because the cost was the one of the main reasonsastheprojectfocusedonaneconomicalanduserfriendlysothemotorhadtobe low cost and easy to work with minimum circuitry design to achieve the required results in this case rotation of the motor with variable speed. And the brushed dc motor has a highertorqueathighloadconductionsowedecidedtogowithabrusheddcmotor.Next, we had to select the voltage of themotor.



Motorfig no 3.3

3.4 Battery

A battery is a device that stores electricity and discharges when required to power up another device such as, flashlights, smart phones, and electric vehicles. Primary batteries are used once and discarded; the electrode materials are irreversibly changed during discharge,commonexamplesarethealkalinebatteryusedforflashlightsandamultitude of portable electronic devices. The secondary (rechargeable) batteries can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and Smartphone's. Battery powered vehicles are starting to play a major role in today'sworld.Therearemanytypesofbatteryfoundintoday'sworld,whichisdifficult to decide which one is best suited for the need from different viewpoint, such as cost price, energy storage, construction and safety. We selected three batteries to go with: Lead acid, Lithium Ion and Nickel cadmiumbattery.

3.4.1 Lead–acid battery

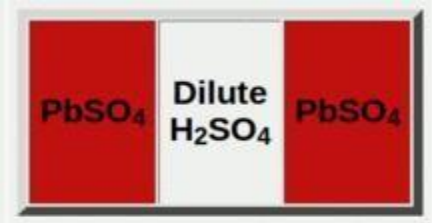
The lead–acid battery is the earliest type of rechargeable battery, yet still most widely used,despitehavingaverylowenergy-to-weightratioandalowenergy-to-volumeratio, itsabilitytosupplyhighsurgecurrentsmeansthatthecellshavearelativelylargepower-to-weightratio.Thesefeatures,alongwiththeirlowcost,makethemattractiveforusein motorvehiclestoprovidethehighcurrentrequiredbyautomobilestartermotors.Asthey are inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities.

3.4.2 Lifetime

Forrechargeable,itcanmeaneitherthelengthoftimeadevicecanrunonafullycharged battery or the number of charge/discharge cycles possible before the cells fail to operate satisfactorily. For a non-rechargeable these two lives are equals incethecellslastforonly one cycle by definition

3.4.3 Discharge

In the discharged state both the positive and negative plates become lead(II) sulphate (pbso4), and the electrolyte loses much of its dissolved sulfuric acid and becomes primarilywater.Thedischargeprocessisdrivenbyanoticeablereductioninenergywhen 2 H^+(aq) (hydrated protons) of the acid react with O^{2-} ions of pbo2 to form the strong O- H bonds inH2O

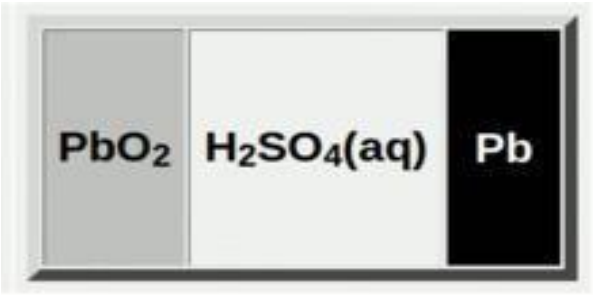


Fully discharged Plate

Fig no 3.4

3.4.4 Charging

In the fully charged state, the negative plate consists of lead, and the positive plate lead dioxide with the electrolyte of concentrated sulfuric acid, which stores most of the chemical energy. Overcharging with high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which is lost to the cell. The design of some types of lead-acid battery allows the electrolyte level to be inspected and topped up with any water that has been lost.



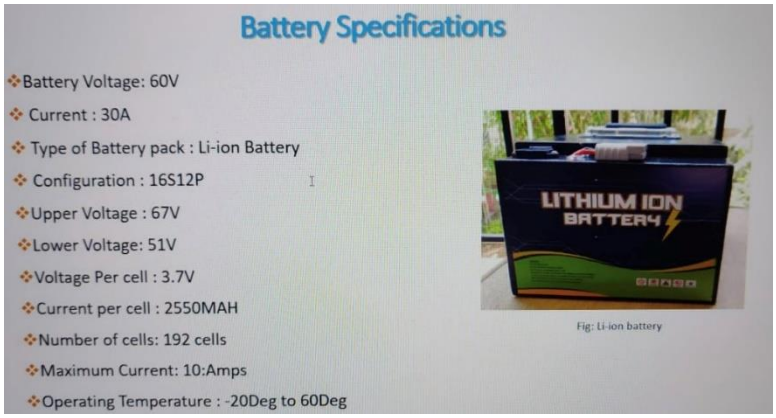
Fully recharged Plate

Fig no 3.4.4

3.4.5 Measuring the charge level

A hydrometer can be used to test the specific gravity of each cell as to check the state of charge. Because the electrolyte takes part in the charge-discharge reaction, this battery has one major advantage over other chemistries. It is relatively simple to determine the state of charge by simply measuring the specific gravity of the electrolyte; the specific gravity falls as the battery discharge.

3.5 Lithium-ionbattery Lithium-ion battery or Li-ion battery is a type of rechargeable battery. Today lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growinginpopularityformilitaryandaerospaceapplications.Inthebatterieslithiumions move from the negative electrode to the positive electrode during discharge and back whencharging.Thethreeprimaryfunctionalcomponentsofalithium-ionbatteryarethe positive and negative electrodes and electrolyte. Generally, the negative electrode of a conventionallithium-ioncellismadefromcarbon.Thepositiveelectrodeisametaloxide, andtheelectrolyteisalithiumsaltinanorganicsolvent.Theelectrochemicalrolesofthe electrodes reverse between anode and cathode, depending on the direction of current flow through the cell. Pure lithium is highly reactive. It reacts vigorously with water to form lithium hydroxide (Lion) and hydrogen gas. Thus, a non-aqueous electrolyte is typically used, and a sealed container rigidly enclosed to prevent moisture from the battery pack. Lithium-ion



batteries are more expensive than nicdand Lead acidbatteries but operate over a wider temperature range with higher energy densities. They require a protective circuit to limit peak voltage.

Lithium Batteryfig no 3.5

3..5.1 Charging

Duringcharging,anexternalelectricalpowersource(thechargingcircuit)appliesanover- voltage (a higher voltage than the battery produces, of the same polarity), forcing a chargingcurrenttoflowwithinthebatteryfromthepositivetothenegativeelectrode,i.e. In the

reverse direction of a discharge current under normal conditions. The lithium ions then migrate from the positive to the negative electrode, where they become embedded in the porous electrode material in a process known as intercalation.

3.6 Difference between Lead Acid battery and Lithium-ion battery

Table: Battery

Lead acid	Lithium battery
It is bulky and robust	It is fragile and inflammable
It can with-stand vibration compared to lithium battery	It cannot with-stand vibration
Cost is less	Cost is high
Damages through excessive discharge and extreme temperature	Less vulnerable to high discharge and climate changes
Life cycle is 1750 at 10% discharge, 250 cycles at 10% discharge	Life cycle is 4000 at 10% discharge, 500 cycles at 90% discharge
Efficiency is low, loss of 15-amp hours	Efficiency is high, no loss of amp hours
Replacement cycle is 2-3 years	Replacement cycle is 7-8 years
Maintenance is required	Maintenance is not required
Emission, gassing and water loss occur when charging	Emission free, zero gassing
Charging efficiency is up to 70%	Charging efficiency is up to 95%
Low energy density	High energy density
No integrated circuit board is used to maintain the discharging of the battery	Integrated circuit which maintains discharge and over charging in extreme temperature
Battery can be charged in various amps rating output to charge battery	Specific charging voltage is required to charge or it could damage the battery

Table no 3.5

3.7 Motor Controller

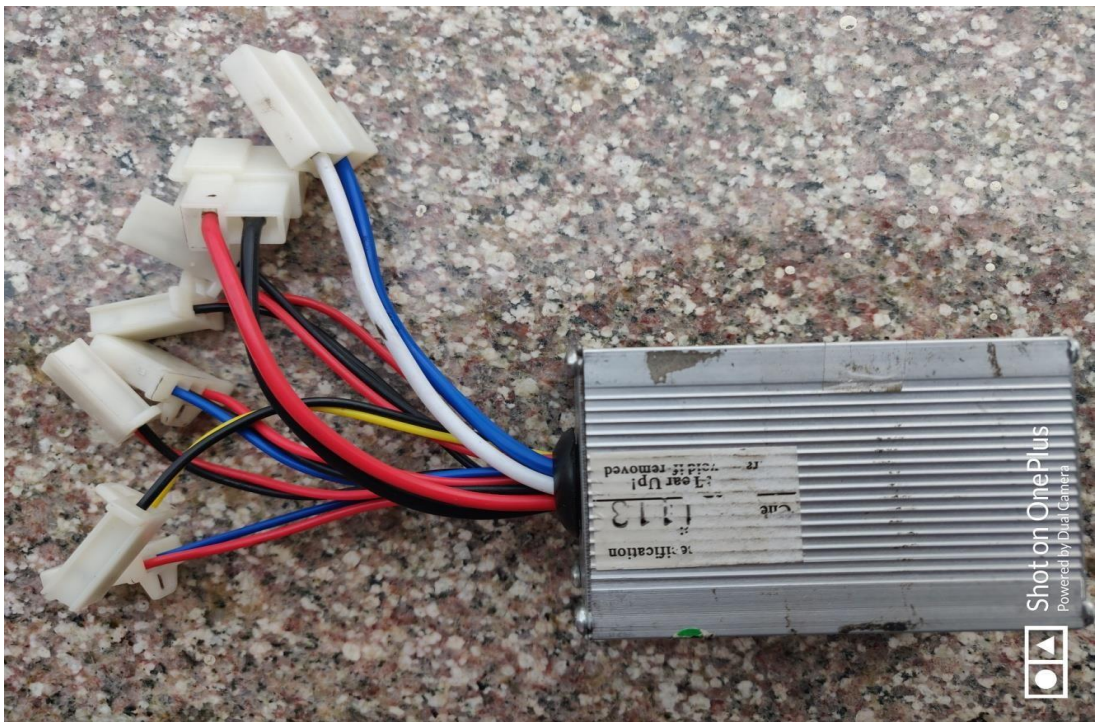
3.7.1 How Does an Electric Bike Speed Controller Work?

The instrument of an electric speed controller shifts relying upon whether you claim a versatile or reason construct electric bike. A versatile bicycle incorporates an electric drive framework introduced on a common bike. A reason fabricated bicycle, more costly than a versatile bike,

gives simpler speeding up and manages more highlights.

3.7.2 Speed Control Basics

The speed controller of an electric bike is an electronic circuit that not just controls the speed of an electric motor yet additionally fills in as a dynamic brake. This controller unitutilizes control from the battery pack and drives it to the motor. Various sorts of controllers areutilizedforbrushedandbrushlessmotors.Forversatilee-bicycles,achangeunitisutilized andtheelectroniccontrolleristheprincipalsegmentofthatpack.



Motor controller

fig no 3.7.2

3.7.3 Functions

The electric bike speed controller sends signal to the bike's motor in different voltages.Thesesignsrecognizetheheadingofarotorwithrespecttothestarterloop.The bestpossiblecapacityofaspeedcontrolreliesupontheworkofdifferentcomponents.In a reason constructed electric bike, Hall impact sensors help recognize the introduction oftherotor.Intheeventthatspeedcontrollerdoesexcludesuchsensors-andthespeed controller on an electric bike may not - the electromotive power of the un-driven loop is determined to get the rotorintroduction.

3.7.4 Current detection

There are some heavy-current situations when electric bike is running. Such as motor is starting and loading too much. Coil Winding and electric components will be damaged by heavy-current in controller. Through measure Voltage crossed Current-measure resistance, when voltage was measured exceed voltage which defined previous. It indicates current exceed safe range, power MOSFET will be closed in short time. As reference potential was transmitted to non-inverting input pin, the voltage was transmitted to inverting input. When voltage was measured exceed reference potential, the output level will be changed and the data transmitted to MCU, MCU stops the motor.

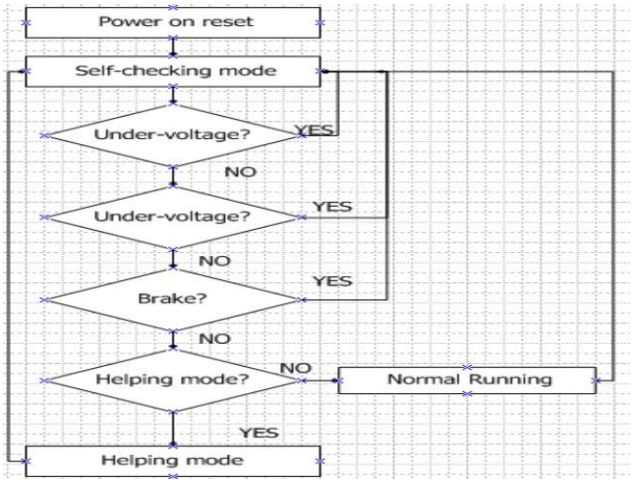


Fig no 3.7.4

Flow chart of a controller

3.8 E – Throttle

The throttle mode is similar to how a motorcycle or scooter operates. When the throttle is engaged the motor provides power and propels you and the bike forward. A throttle allows you to pedal or just throttle it and move forward. There are three main types of throttles:thumbthrottles,halftwistthrottlesandfulltwistthrottles.Ofcourse,eachtype of E-bike throttle has its own advantages and disadvantages, and each have their own effect on your riding experience.

3.8.1 Thumb throttles

Thethumbthrottle,nosurprisehere,isdesignedtobeoperatedbythethumb.Itconsists ofjustasmallleverthatprotrudesfromthehandlebartowardstherider.Unlikeotherthrottletypest hatspreadtheloadouttothewholehand,thumbthrottlesfocustheentire force of the return spring solely on the thumb.

Fig no 3.8.1
Thumb grip throttle

3.8.2 Half Twist Throttle

Half twist throttles are similar to full twist throttles. They operate the exact same way as afulltwistthrottleexceptthattheydon’treachallthewaytotheendofthehandlebar. They reach about half way. The missing half of the half twist throttle is replaced with a matchingrubbergripthatdoesn’ttwist;itremainsfirmlyattachedtothehandlebar.

Half Twist Throttlefig no 3.8.2

3.8.3 Full Twist Throttle

Full twist throttles are sort of the antithesis of thumb throttles as they are the largest type of E-bike throttle and require the whole hand to operate. The full twist throttle takes up the entire end of the handlebar, completely replacing whatever grip would originally be on the end of handlebar. To operate it, the rider simply grabs a handful of throttles and twist it back towards himself.

Full twist throttlefig no 3.8.3

3.8.4 Selection Of throttle

We chose full twist throttle because it gives an immense pleasure like driving motorcycle. It operates just like the throttle on most motorcycles. Many people prefer fulltwistthrottlesbecausetheyareoperatedbythefullhand–allfivefingerswillhavea firm grip, that allows you to hold on tight, handle well and use your wrist instead of your thumb to apply the twistingmotion.

3.9 Brakes

3.9.1 Caliper brakes

Mostly used on motor vehicles, a calliper brake (sometimes called a side-pull) consists of apairofcurvedarmsorcalliperspivotingsomewherebeneaththeheadsetbearings,with 'blocks'offrictionmaterialattheirlowerextremities.Bytheactionofapullrod,pushbar, or more usually a flexible cable these days, the friction blocks are moved towards each other, squeezing the two outer faces of the wheel rim in the process. The calliper is light andcheap,becausetherotatingelementisalreadyinplace,butbeingcompletelyexposed to the elements, it is badly affected by rain, grease, oil and grit. Different callipers and brake blocks are affected in different ways, but the most important element is the frictional co-efficient of the wheel rim material. Chromed steel lasts for ever, and works very well when dry, but loses most of its stopping ability in the wet. Aluminium is less effective in the dry, but relatively good in the wet, making it a safer material overall.Thequalityofthebrake'feel'dependslargelyonthefrictionmaterialandthe construction of the calliper. Poor callipers bend and distort when the brake is applied, giving a rubbery feel at the lever and/or judder or squeal. Callipers are difficult to centre correctly, which can leave one brake block rubbing against the rim, and a wobbly rim will cause one or both blocks to rub intermittently. Generally, the rim disposes of heat quite successfully,butheatbuild-upcanbeaproblemonlongdescents,particularlyforheavily- laden or small-wheeled bikes. Excessive heat in the rim can cause tube failure and a catastrophicblow-out.

Caliper brake fig no 3.9.1

3.9.2 E-brakes

E-Brakes can be described in many ways but if we named it properly it would be the “MotorCurrentCut-offBrakeLeverSwitch”.TheE-brakeleversarenothingmorethan regularbrakeleversthathaveanadditionalpartadded,thatbeingaswitchtosensewhen the lever is at its normal resting position or is being actuated by the rider. It is important to know how this systemworks.The e-brakes are often called cut out switches and the overall effect is exactly that, the motorcutsoff.Thee-brakeswitchdoesnotactuallycutpowertomakethishappen,what it does is it makes a connection and sends power to the controller, just the opposite of what "cut off switch" implies.

E-brakefig no 3.9.2

3.9.4 Drum Brake

A drum brake is a type of brake that relies on friction created by a set of shoes or pads pressing outward against a revolving cylinder-shaped component known as the brake drum. The phrase "drum brake" usually refers to a brake in which the shoes press against the drum's inner surface. Clasp brakes are used when shoes press on the exterior of the drum. A pinch drum brake is one in which the drum is pinched between two shoes, comparable to a typical disc brake, albeit such brakes are rather uncommon. A band brake is a similar device that uses a flexible belt.

Drum brakes have a common "self-applying" characteristic, way better known as "self-energizing."[5] The turn of the drum can drag either one or both of the shoes into the grinding surface, causing the brakes to nibble harder, which increments the drive holding them together. This increments the halting control without any extra exertion being used by the driver, but it does make it harder for the driver to tweak the brake's affectability. It too makes the brake touchier to brake blur, as a diminish in brake grinding moreover decreases the sum of brake help.

Drum Brake fig no 3.9.4

3.9.5 Brake circuit

The electric bicycle should be aware, when some unexpected things happened. When driver brake, the power supply should be stopped. High-level is a brake signal in this controller. Hall sensor output low level in normal condition, low-level will be changed to high-level when braking. The level to base of transistor is conversed when braking, and output level will be conversed.

This conversed level is transmitted to MCU finally. MCU closes the power supplied. It works as a normal "fail safe" design methods where if something were to damage the E- brake circuit the condition would be "no signal being sent" and hence trigger a motor cut off. The way these are currently configured if your e-brake wire gets cut your motor will still work. This is that do not want to run them can just leave them off and have things still work. It can be argued that having your motor cut out unexpectedly could be dangerous as well. This is not

really a safety issue since if you were to grab your brakes and the motor kept pulling, it is hoped you would stop peddling or let go of the throttle in self- preservation.

Chapter-4

MODELLING AND DESIGNING

4.1 Concept Model

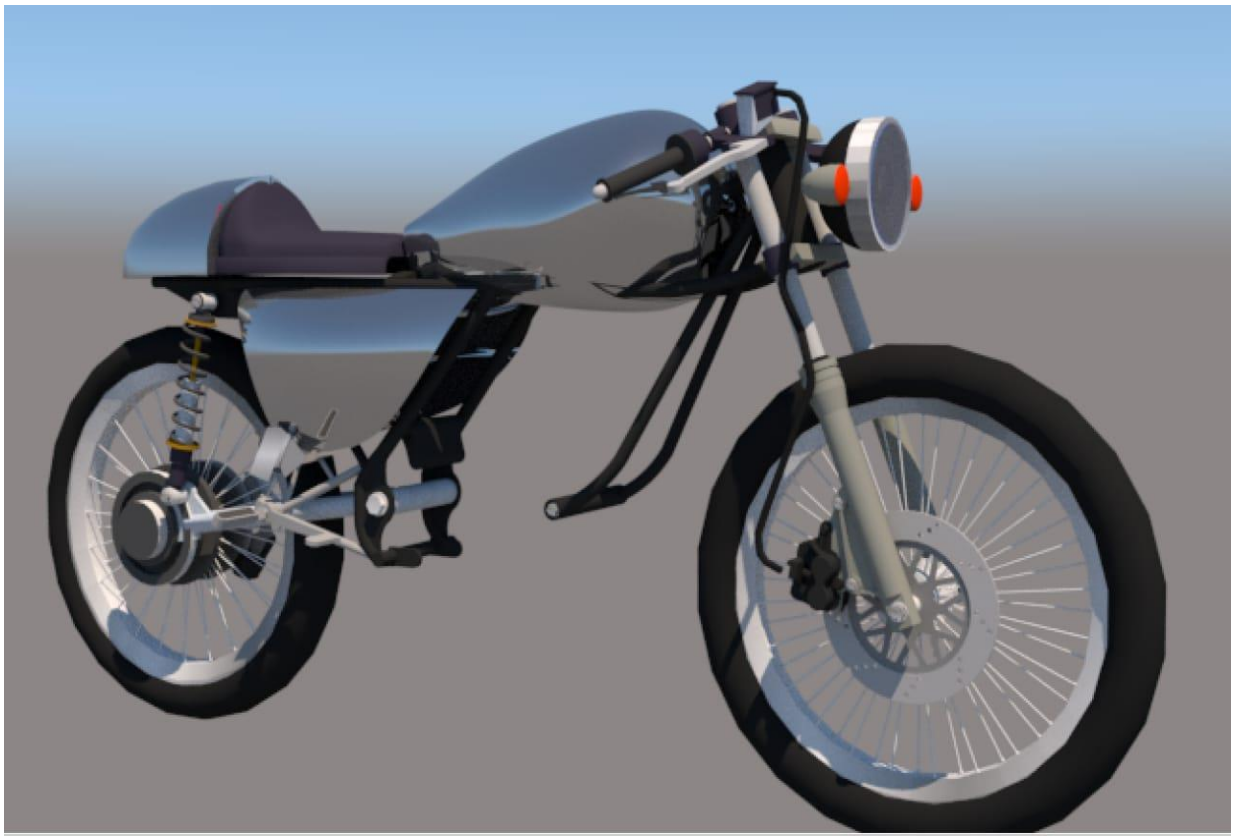


Fig 4.1 3D Model of the Electric Bike

4.2 IC Engine Bike

Fig 4.2.1 Before Disassembling the Bike

Fig 4.2.2 After Disassembling the Bike

4.3 Conversion of IC Engine Bike to Electric Bike

Fig 4.3 Assembly of the components


HERO
HONDA


HERO
HONDA

Fig 4.4 Finished Product

Chapter 5

WORKING

5.1 Working Procedure:

Fundamental guideline: -It deals with the rule that the electromotive power of an A.C. engine which gets electrical energy put away in D.C. battery.

Working: -

The guideline behind the lithium-particle battery is to course electrons by making a distinction in potential between two terminals, one negative and the other positive, that are drenched in a conductive ionic fluid called the electrolyte. At the point when the battery is driving a gadget, the electrons collected in the negative anode are delivered through an outside circuit to venture out to the positive anode: this is the releasing stage.

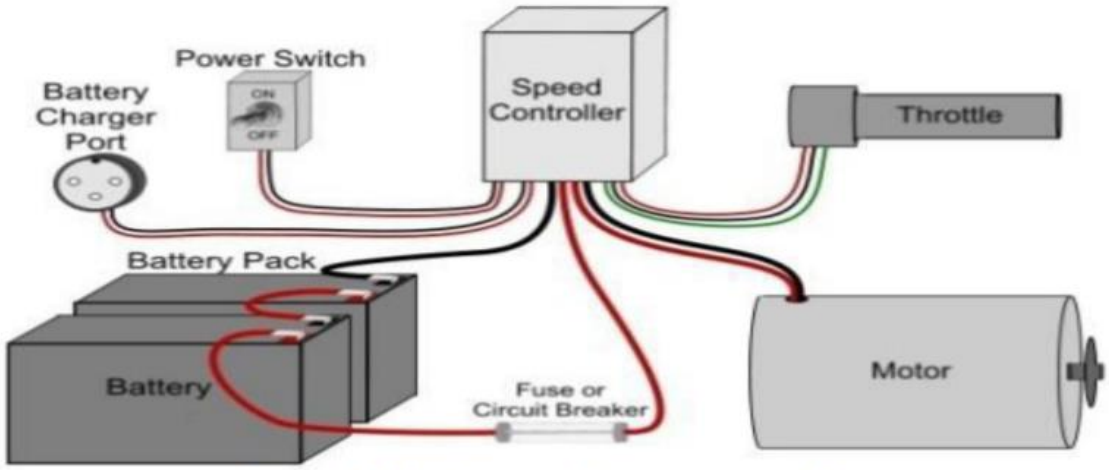


Fig 6. Block diagram electric motorcycle

In this a DC waveform which is acquired id made sinusoidal due to functional Transistorized D.C. to A.C. enhancing circuit by exchanging the electric energy as electric current which streams from battery. To drive the circuit through the condenser, this intensified current is taken care of to the stator twisting of the DC engine. The condenser which is utilized goes about as a capacity of electric energy and conveys at the hour of necessity. The sprocket

wheel introduced on engine shaft is driven by the intention force of the electric energy. The back-sprocket wheel is being pivoted by the chain drive component on which the other two excess sprocket wheels are introduced. The wheel is driven by the back tire introduced on the back sprocket. Accordingly, the electric bicycle is activated by utilizing electric force.

5.2 Calculation

5.2.1 DESIGN CALCULATION

Component	Mass(kg)
Vehicle	70
Battery	16
Motor	8
Rider	80
Controller	1.5
Accessories	1
Total	176.5

Table no 5.2.1

5.2.2 Force Calculation

F=Crr*m*g

F=Force in Newton

Crr=Co-efficient of rolling resistance (0.01)

G=Acceleration due to Gravity (9.81m/s^2)

M=Mass of the vehicle (total load)

F=0.01*176.5*9.81

F=17.31N

5.2.3 Power Calculation

P=F*(V/3600)

P=Power in Watts

V=Velocity=60 km/h=60000 m/h

Power=17.31*(60000/3600)

Power=17.31*12.5

Power=288.5W

6.2.4 Selection of Battery

Ah*V=Wh

30*60=**1800Wh**

Where,

Ah= Ampere hour = 30Ah

V= Voltage= 60V

Wh= Watt hour

6.2.5 Distance Calculation

D=Wh/F

D=1800/17.31

D=103.98 km

6.2.6 Range Calculations

Battery= 1.8kWh

Motor= 1.2kW

Time Taken= 1.8kWh/1.2kW

Time Taken=1.5h

Assuming the motor runs at 80% efficiency 80% of 1.5h = 0.8*1.5h

=1.2h

Assuming the top speed as 60 km/h

Range= 60km/h*1.2h

Range= 72 km

Chapter-6

EXPERIMENTAL RESULTS AND DISCUSSION

SL No	Vehicle characteristics Values
1	Motor power 1200W
2	Motor rated voltage 60V
3	Voltage per cell 3.7 v
4	Upper voltage 67 v
5	Lower voltage 51 v
6	Maximum torque on wheel 40-60nm
7	Vehicle maximum speed 80 kmph
8	Brakes drum brakes
9	Range 72 Km
10	No of cells 192 cells

Table no 6

The motor power is 1200 w/60v. The motor we have used for our café racer has a maximum power of 30 amps and the motor has rated voltage of 60V. After the gear reduction between motor and rear axle the torque is increased to 50 N-m. The maximum speed reached by our E-Bike is around 80 Kmph. We have used 1 battery with rating of 60v consisting of 192 cells with each cell providing 2550 MAH. The range achieved inasinglechargeofthebatteryisupto100Km (Only Electric Drive).

Chapter-7

SUMMARY AND CONCLUSIONS

Less expensive and reasonable to anybody. It very well may be utilized for more limited distances by individuals of all ages. It very well may be thought up consistently. The most indispensable component of the electric bike is that it doesn't burn-through petroleum derivatives subsequently saving crores of unfamiliar monetary standards. The second most significant element is it is sans contamination, eco – well-disposed and silent in activity. For balancing ecological contamination utilizing of on – board Electric Bike is the most reasonable arrangement. It very well may be accused of the assistance of AC connector in case there is a crisis. The Operating expense per/km is very less and with the assistance of sun-based board it can diminish up additional. The estimated range of an café racer is100 Km, with the speed of 70 kmph and the torque obtained on the wheels is 40-60 N-m. These are claimed to have a significantly lower environmental impact than conventional automobiles and generally seen as eco-friendly.

Chapter-8

SCOPE OF FUTURE WORK

The current vehicles that are powered by gasoline pollute, but as technologies improve and the human way of life changes alternatively powered vehicles enter the automotive industry. These vehicles develop to achieve better gas mileage and to help slow the production of gasses that cause global warming. The electric vehicle is one of newest and most popular alternatively powered vehicles. Electric vehicles are energy efficient vehicles that run with a battery and an electric motor of an electric vehicles. These electric vehicles consume fewer natural resources that gas vehicles and almost produce no emission fumes compared to the standard gas vehicle.

Electric vehicles are one solution to the preserving air quality for the future. The electric vehicles greatest advantage is that they almost release zero emission into the atmosphere. When the bike is slowing down it takes the energy being released when slowing the bike down. The result is a use of energy that does not require the bike to be plugged in. these vehicles reduce the dependency on fossil fuels because they are run on alternate fossil fuels.

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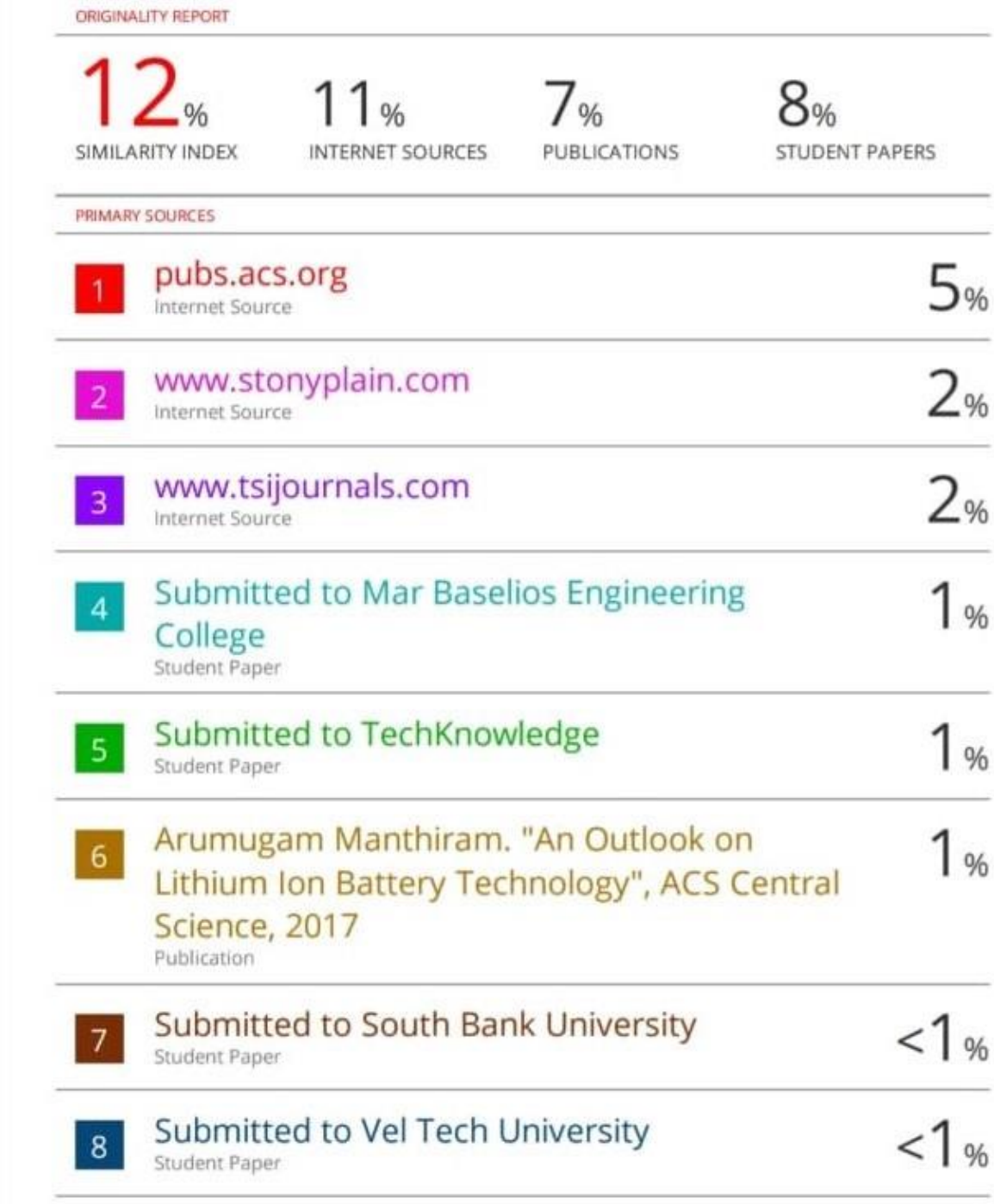

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