International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 06 | June 2021 www.irjet.net p-ISSN: 2395-0072

FABRICATION OF AN ELECTRIC TWO-WHEELER

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Abstract - *India is the second largest producer and manufacturer of two-wheelers within the world. It stands next to China and Japan in terms of the number of two-wheeler vehicles produced and domestic sales. In this paper, the following work is carried out with respect to the fabrication of an electric two-wheeler. The chassis of an existing two-wheeler is selected (110cc bike). The engine is replaced by a battery-motor system. The various calculations like power, torque, specifications of battery and motor and range calculation are carried out. The wiring harness is prepared for the electric two-wheeler. The components like the electric motor having 60V are selected and the respective battery with the battery management system for the motor is conjoined. The motor controller, digital display, electric throttle, etc. are assembled to the motor system. The fabrication of the electric 2-wheeler is carried out by using the procured components and with the help of the calculations, the output of the vehicle is calculated. The testing of the vehicle is performed and compared with the internal combustion engine.*

***Key Words*: Electric vehicles, Battery, Chassis, IC Engine, Fabrication, Testing, Motor, Controller.**

1. INTRODUCTION

India is one among the highest automotive markets within the world these days and having extremely increasing class population with shopping for potential and therefore the steady economic process. However, gasoline value has multiplied over 50% in thirteen completely different steps in last 2 years. Here comes the potential need for various technologies in vehicles like electrical vehicles (EV) in India. though the initial investment is around 1.5 times than standard IC engine, however time has come back once price of setting is currently additional concern than the price of car the aim of this report is to explain the technology accustomed manufacture an electrical vehicle and explain why the electrical engine is best than the interior combustion engine. It includes reasons why the electrical vehicle grew apace and therefore the reason it's a necessity to raise the planet these days. The report describes the foremost necessary components in an electrical vehicle and hybrid vehicle. It compares the electrical to the hybrid and burning engine vehicle. It conjointly includes the long run of the electrical vehicle. The general impact of the electrical vehicle ultimately advantages the individuals. Compared to gasoline steam-powered vehicles, electrical vehicles square measure thought of to be cardinal cleaner, manufacturing no piping emissions that may place stuff into the air.

Environmental problems caused by fossil fuel run vehicles and fuel economy have become a very serious issue in the recent years which has led to the earth's temperature to increase and also causing various global warming effects. It is a necessity to find an alternate to these fossil fuel run vehicles which have a significant role in being green, environmentally friendly and economical and most importantly leaves no carbon footprint behind. Electricity powered vehicles, meet these conditions and because of this, it has become the important goal for all vehicle manufacturing companies to manufacture vehicles with new energy which is green, environmentally friendly and economical. Being an e-scooter, the electrical system plays a promising role in its designing and creation. The electric system consists of battery, motor, motor controller and other equipment. The most important thing that electric system does is that it gives power to the motor which helps within the running of the scooter. E-vehicles now include cars, transit buses, trucks, and even big-rig tractor trailers that are a minimum of partially powered by electricity. Electric vehicles have a very negligible amount of carbon footprint than gasoline-powered cars, no matter where your electricity comes from. It can easily be said that EV is better to the environment taking into considerations the advantages it poses over internal combustion engines. Since it run on batteries, it needs to be charged if exhausted and this can be done at any place, provided there is an electrical outlet, be it an office or at home.

2. LITERATURE REVIEW

Patent drawing for an "Electric Bicycle" (1895)

The history of electrical motorcycles is somewhat unclear. On 19 September 1895, an application for an "electrical bicycle" was filed by Ogden Bolton Jr. of Canton Ohio. On 8 November of an equivalent year, another application for an "electric bicycle" was filed by Hosea W. Libbey of Boston. At the Stanley Cycle Show in 1896 in London, England, bicycle manufacturer Humber exhibited an electrical tandem. Powered by a bank of storage batteries, the motor was placed ahead of the rear wheel. Speed of the tandem was controlled by a resistance placed across the handlebars. The main intend of this electric bicycle was mainly for racetrack use.

The October 1911 issue of standard Mechanics mentioned the introduction of an electrical motorbike. It claimed to own a speed of seventy five miles (121 km) to a hundred miles (160 km) per charge. The motorbike had a three-speed controller, with speeds of four miles (6.4 km), fifteen miles (24 km) and thirty five miles (56 km) per hour.

In 1919, Ransomes, Sims & Jefferies created a prototype electrical motorbike during which then batteries were fitted below the seat of the sidecar. Despite the fact that the vehicle was registered for road use, it never went past the trial stage. In the 1970s, Mike Corbin built a street-legal electric motorbike called the Corbin Electric.

Later in 1974, Corbin, riding a motorcycle called the quick Silver, set the new electrical motorcycle speed record at 165.387 mph (266.165 km/h). The motorcycle used a 24-volt electric starter from a Douglas A-4B fighter plane.[14] In 1975, Corbin built a battery-powered prototype street motorcycle called the city Bike. This E-cycle used a battery manufactured by Yardney Electric.

On 26 August 2000, Killacycle established a problem athletics record of finishing 1 / 4 mile (400 m) in 9.450 seconds on the Woodburn track in Beaver State. Lead acid batteries are used here at a speed of 152.07 mph (244.73 km/h). Later, Killacycle exploitation A123 Systems Li-ion nano-phosphate cells set a brand new 440 yards record of 7.824 seconds breaking the eight seconds barrier at 168 miles per hour (270 km/h) in Phoenix, Arizona at the All Harley Drag racing Association (AHDRA), on 10 November 2007.

In 2012 Electro Force cycles made their debut as a commuter cycle for commuters to ride to figure or for enjoyment. These cycles were built by Jennifer Northern of Issaquah WA. She became the primary woman to develop and manufacture an electrical vehicle within the US. The speeds reached up to 96.5 kmph in 6 seconds, programmable with regenerative braking or on the throttle. Their range was up to 100 miles while maintaining 104.6 kmph altogether weather and hills. It was the primary of their kind built by a lady within the US.

VinFast from Vietnam developed two electric scooter models in Hanoi, with 4 models: VinFast Klara A1 (Lithium-ion battery), VinFast Klara A2 (Lead–acid battery), VinFast Impes and VinFast Ludo, On November 20, 2018.

3. OBJECTIVES

- ➢ Fabrication of an Electric two wheeler using an existing chassis of an Internal Combustion Engine.
- ➢ A Chassis of an Internal Combustion Engine two wheeler was taken.

4. METHODOLOGY

I. COMPONENTS USED

Literature survey was conducted using various journal papers to understand and select the best suited battery and motor and also to know the calculations required pertaining the battery, motor and chassis.

1) Battery-Lithium Ion Battery

Batteries are a group of one or more cells whose chemical reactions create a flow of electrons during a circuit. All batteries are made from three basic components:

- ➢ An anode (the '-' side),
- ➢ A cathode (the '+' side),
- ➢ Electrolyte.

When the anode and cathode of an electric battery is connected to a circuit, reaction takes place between the anode and therefore the electrolyte. This reaction between anode and cathode causes electrons to flow through the circuit and back to the cathode where another reaction takes place. Li-ion batteries are most commonly found in all the electric vehicles in the present market.

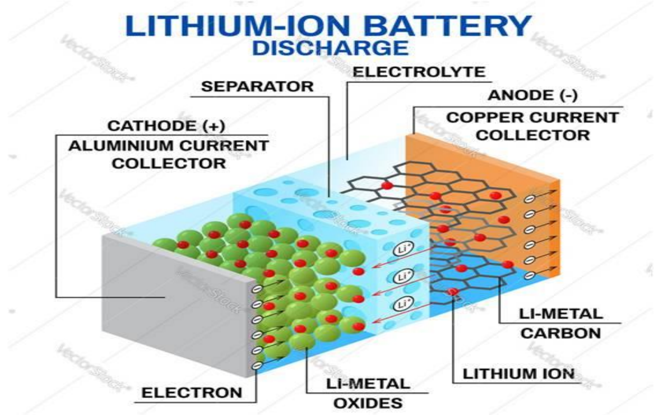

Figure 1: Lithium-Ion Battery.

Sl.No	Item	Specification
1	Type of Battery pack	Li-ion Battery
2	Battery Voltage	60 V
3	Current	30 A
4	Configuration	16S12P
5	Upper & Lower Voltage	67 V & 51 V
6	Voltage & Current per cell	3.7 V & 2550 mah
7	Number of cells	192 cells-12 parallel 16 series
8	Maximum Current	10 Amps
9	Operating Temperature	-20^{o} to 60^{o}

Table 1: Battery Specifications.

2) Motor-Brushless DC Motor

A brushless DC electric motor (BLDC motor or BL motor), also known as an electronically commutated motor (ECM or EC motor) or synchronous DC motor, is a synchronous motor using a direct current (DC) electric power supply. It uses an electronic closed-loop system controller to modify DC currents to the motor windings producing magnetic fields which effectively rotate in space and which the static magnet rotor follows. The controller adjusts the phase and amplitude of the dc current pulses to regulate the speed and torque of the motor. This system is an alternate to the mechanical commutator (brushes) utilized in many conventional electric motors.

Figure 2: Motor.

Sl.No	Item	Specification
1	Type Of Motor	BLDC mid drive motor
2	Voltage	60 V
3	Normal Torque	39.6 N-m
4	Peak Torque	114.2 N-m
5	Nominal RPM	3000 rpm
6	Peak RPM	2500 rpm
7	Normal output power	1244 Watt
8	Peak output power	2991 Watt
9	Normal Current	25.1 A
10	Peak Current	60.387 A

Table 2: Motor Specifications.

3) Controller

In the early electric vehicles with DC motors, a straightforward variable-resistor-type controller controlled the acceleration and speed of the vehicle. With this sort of controller, full current and power was drawn from the battery all of the time. At slow speeds, when full power wasn't needed, a high resistance was wont to reduce the present to the motor. With this sort of system, an outsized percentage of the energy from the battery was wasted as an energy loss within the resistor. The only time that each one of the available power was used was at high speeds. The electric vehicle controller is that the electronics package that operates between the batteries and therefore the motor to regulate the electrical vehicle's speed and acceleration very similar to a carburetor does in a gasoline-powered vehicle. The controller transforms the battery's DC into AC and regulates the energy flow from the battery. Unlike the carburetor, the controller will also reverse the motor rotation, and convert the motor to a generator (so that the kinetic energy of motion is often wont to recharge the battery when the brake is applied).

Figure 3: Controller.

Sl.No	Item	Specification
1	Voltage	60 V
2	Current	60 A
3	Power	3600 Watt

Table 3: Controller Specifications.

4) Miniature Circuit Breaker

Miniature Circuit Breaker is used to break off circuit connection during over loading. It works as a fuse.

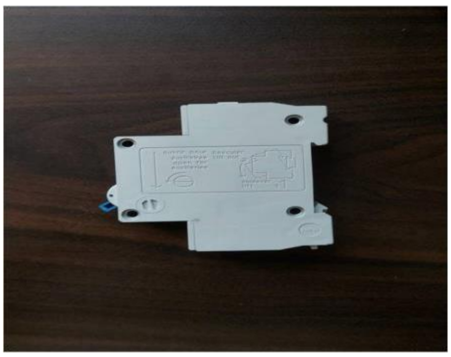

Figure 4: MCB.

5) Throttle

Throttle is used to control the speed of the motor.

Figure 5: Throttle.

6) Digital Display

Display is an essential component which shows all the details regarding the vehicle such as speed, range, battery status etc.

Figure 6: Digital Display.

7) DC-DC Converter

The DC-DC converter has one function and that is to convert the voltage from the battery to supply voltage to the auxiliary systems.

Figure 7: DC-DC converter.

II. CONNECTIONS

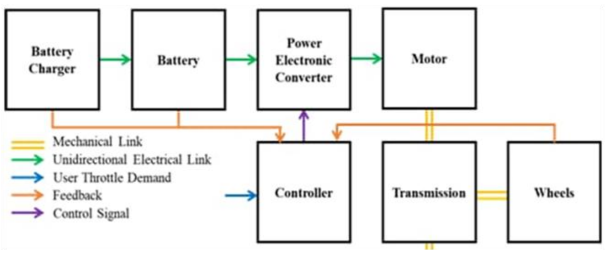

Figure 8: Assembly of Components.

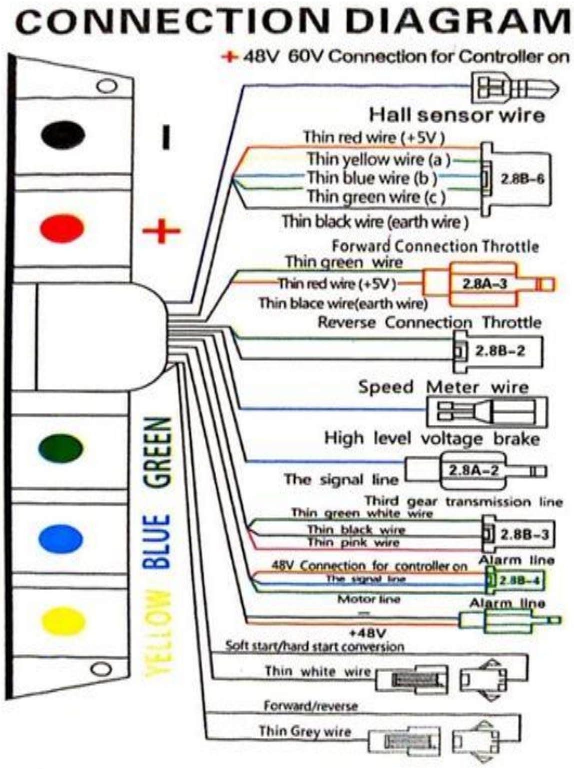

Figure 9: Connection Diagram for Controller.

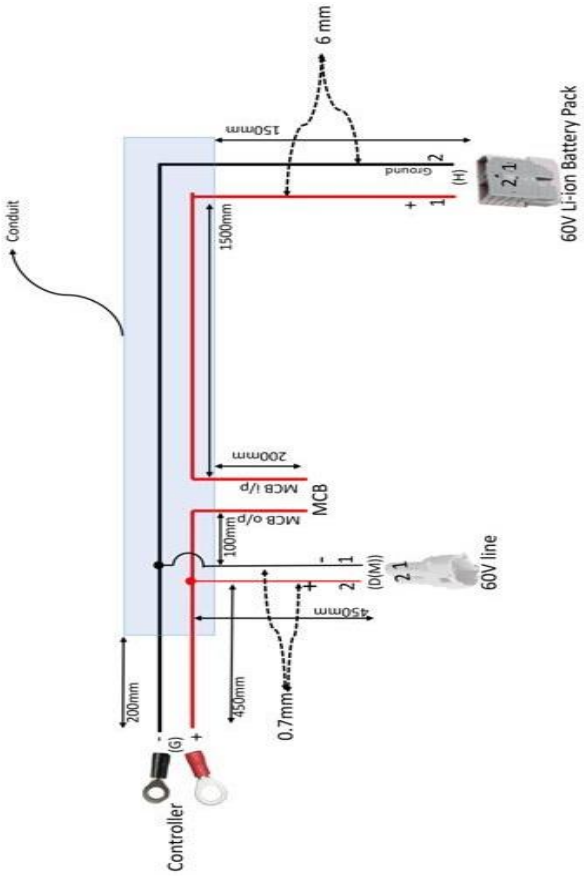

Figure 10: 60V Harness.

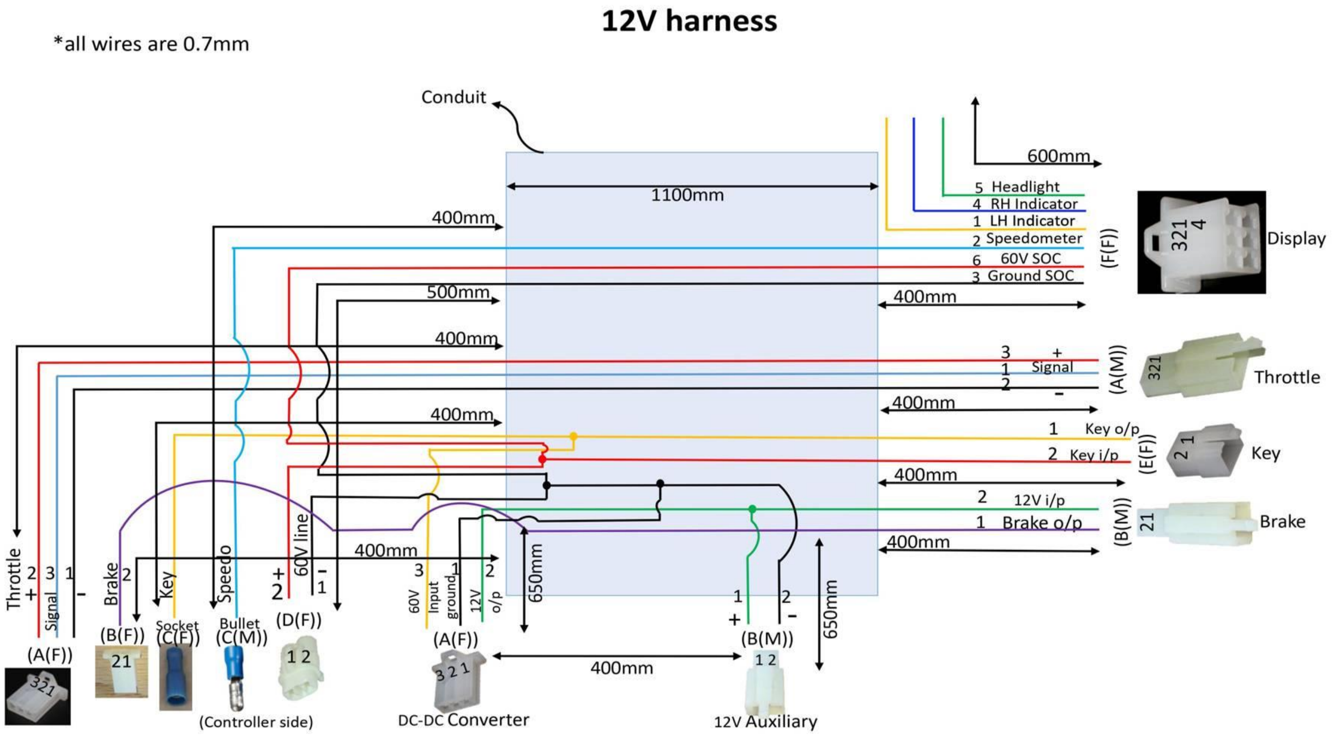

Figure 11: 12V Harness.

5. RESULT AND DISCUSSIONS

- **Motor- battery Calculations**
  Given

  Vehicle weight: 75 kg
  Battery weight: 16kg
  Motor weight: 8+2 kg
  Rider weight: 80 kg
  Gross total weight: 181kg

- **Motor specification**

  Volts (v) = 60V
  Power (P) = 1200W
  Speed=60kmph
  Velocity= 60*5/18 **= 16.6m/s**

- **Speed of Motor in RPM**

  N_{motor}=speed/ (d*0.001885)
  d - Wheel dia in cm= d =45.72
  N_{motor}=60/ (45.72*.001885) **= 696.86rpm**

- **Motor Torque-Torque on the wheel**

  T_{motor}=P*60/ (2*pi*N_{motor})
  =1200*60/(2*3.14*696.86) **= 16.45Nm**

- **Selection of Motor**

  Force required for moving the vehicle
  $F_{total}=F_{rolling}+F_{gradient}+F_{aerodynamic}$

- **Rolling Resistance**

  $F_{rolling}=C_{rr}$*mass*g
  C_{rr}=0.004-tire on asphalt road
  M=181kg
  g=9.81
  =.004*181*9.81 **= 7.10N**

- **Grade Resistance**

  F_{grad}= M*g*sin2.5°
  =181*9.18*sin2.5° **= 77.9N**

- **Aerodynamic Drag**

  $F_{aerodynamic}=0.5*C_d*A_f*p*v^2$
  $=0.5*0.5*0.7*1.16*(16.6)^2$ **= 55.93N**
  F_{total}=55.93+77.9+1.10 **= 140N**

- **Battery Calculations**

  Watthour=watt*1hour
  =1800w*1hour

  Out of the full battery 80% should be in use and 20% should be remaining in this case.

  Watthour=1800*1.20 **= 2160wh**
  Current=2160wh/60V **= 36Ah**

- **Battery specifications**
  Voltage rating=60V
  Current rating=36Ah
  Wattage of battery = 60*36
  =2160wh
- **Range Calculations**
  Power=V*I
  Battery=1.8kwh
  Motor=1.2kw
  =1.8kwh/1.2kw

=1.5h

Assuming the motor runs at 80% efficiency

80% of 5h
=0.8*1.5h
=1.2h
Assuming top speed as 60kmph
Range=60km/h * 1.2h **= 72km**

6. CONCLUSION

The project on Design and analysis of electric two-wheeler has the following outputs

- This paper presented the conversion of a standard IC Engine vehicle into an electrical Vehicle.
- All battery motor calculations were carried out and noted for further use
- The chassis of the bike was modeled using CATIA software and it was exported to ANSYS for the analysis on it
- From the analysis we can say that the chassis is safe to take on the newly added weight of the Battery and Motor and other electrical components.
- The vehicle will be a fully operational and eco-friendly electric vehicle.
- The comparison between the internal combustion engine and the electric vehicle is performed

7. ACKNOWLEDGEMENT

We wish to express our sincere gratitude to "**Dr. Shridhar Kurse**, HOD-Automobile Engineering" for his constant encouragement and cooperation, we extend our deep sense of gratitude to our teacher and guide "**Prof. Jayasheel Kumar K A**, Department of Mechanical Engineering" NHCE, for his valuable suggestions, guidance, care & attention shown during the planning, conduction stages of this work. We thank all the teaching and non-teaching staffs, our classmates and friends for sharing their knowledge and valuable suggestions.

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