IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

CONVERSION OF OLD IC ENGINE VEHICLE TO AN ELECTRIC VEHICLE

An economic electric vehicle

[1]Pranav P R, [2]Archa Gopan, [3]Bibin Varghese, [4]Ajmal M A, [5]Sarath S

[1]Student, [2]Student, [3]Student, [4]Student, [5]Asst. professor
Electrical and Electronics Engineering Department,
Musaliar College of Engineering and Technology, Pathanamthitta, Kerala, India

Abstract: India wants to cut its carbon emissions by 2030 in accordance with the WHO's carbon emission control programmed to combat global warming. The use of fossil fuel in motor vehicles accounts for the majority of carbon emissions worldwide. This paper discusses how to convert a car with an internal combustion engine to an electric one in order to further the goals of our country. In order to limit the quantity of waste and the consumption of fossil fuels, the vehicle being converted here is an old scrap car. We are now seeing amazing advancements daily in the rapidly development of electric vehicles. The majority of E vehicles are out of reach financially. With this paper, we hope to increase public knowledge of an electric vehicle that provide the majority of the newest technology at a cost that is both reasonable and minimal.

***Index Terms* – carbon emission, electric vehicle**

I. INTRODUCTION

One of the rapidly expanding fields we are observing in our current environment is the idea of electric vehicles. The primary causes of this field's explosive expansion are the rise in environmental contamination and the decline in the availability of nonrenewable resources. There are many rules, commitments, and pledges in place to protect Mother Earth in response to the serious worry that global warming has raised. There is a growing concern about environmental contamination at every turn as a result of the continuous increase in greenhouse gas emissions. This resulted in an increase in environmentally friendly activities, and many firms that make cars invested in research and development to create electric vehicles that will help customers save money by decreasing use of already-escalating fuel prices, as well as combat global warming. Most electric cars produce no emissions and won't increase smog in cities. The only thing necessary is to maintain the battery in this car charged. The production of electric vehicles is viewed as a grassroots initiative to conserve fossil resources. Fossil fuels are fuels produced by natural processes, such as the anaerobic decay of buried dead organisms, and they contain energy from long-gone photosynthesis. These organisms and the fossil fuels they produce have an average age of millions of years, and occasionally even more than 650 million years. Yet, using fossil fuels causes significant environmental risks. About 21.3 billion tons of carbon dioxide (CO2) are produced annually by burning fossil fuels. Natural processes are thought to be only capable of absorbing roughly half of that, thus there is a net increase of 10.65 billion tons of atmospheric carbon dioxide each year. Carbon dioxide is a greenhouse gas that enhances radiative forcing and causes global warming. To assist in lowering greenhouse gas emissions, there is a global movement towards the production of low-carbon renewable energy. When it comes to achieving low carbon emissions and ensuring energy security, the development of electric vehicles (EV) is seen as an efficient and ecologically benign solution. A traction motor or several electric motors are used to propel an electric vehicle, often known as an EV. Electric vehicles can either be self-contained using a battery, solar panels, or an electric generator to transform gasoline into electricity, or they can be fueled through a collector system by electricity from sources outside the vehicle. Road rail, surface, and underwater vehicles, as well as electric planes and spaceships, are examples of EVs.

The technology utilized to create an electric car is described in this paper, along with reasons why an electric engine is superior to an internal combustion engine and a list of the most crucial components of an electric vehicle. Zero emissions, or a significant reduction in overall greenhouse gas and other emissions as well as a decreased reliance on fossil fuels, are the key benefits of electric cars. This paper's primary goal is to build and develop a cost-effective electric car while also thoroughly examining all of its parts. BLDC motor, which is suitable and compact, is a feature of the economical electric vehicle. The battery pack is a grouping of batteries that is controlled by a controller. The battery is a sealed maintenance-free (SMF) Li-battery, which is more effective than other kinds. This electric vehicle has a number of benefits, including low production costs, simple controllability, improved efficiency, and higher safety standards. It may also be utilized in any terrestrial environment (farm land, industrial area, transportation in educational institution).

II. RESEARCH METHODOLOGY

2.1 BLOCK DIAGRAM OF CONVERSION PROCESS

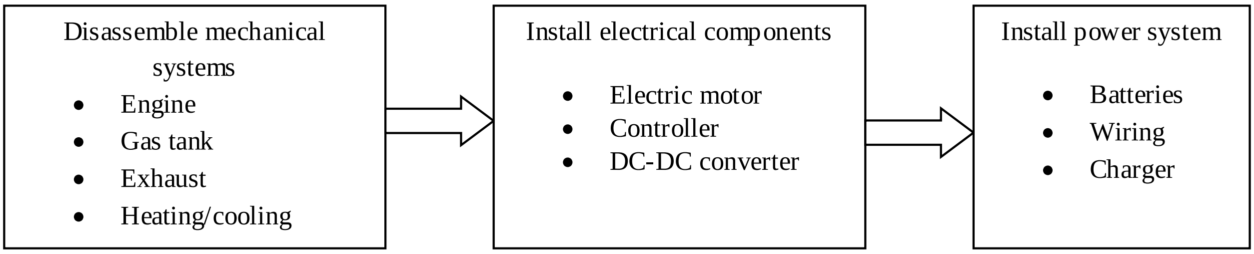


Fig.2.1: Conversion process

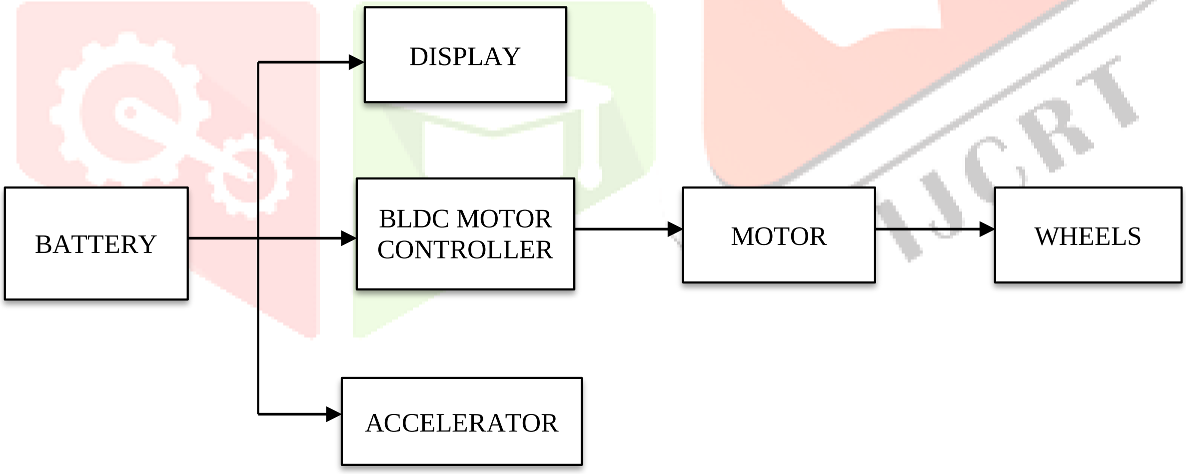
2.1.1 STAGES IN CONVERSION

- Disassemble the mechanical system: During this stage, remove the IC engine's fuel tank, radiators, filters, and other auxiliary components from the chassis up to the differential and the outer body.
- Installation of electrical components: Fixing of motor with differential, controller drive system etc takes place in this stage.
- Install power system: In this stage installation of battery pack and wiring of connection will takes place.

2.2 MATERIALS USED IN CONVERSION

The IC engine gets swapped out for a 1000 W 48V BLDC motor. Regenerative breaking as well as the mechanical braking system are employed for proper breaking. The 1000W 48V BLDC controller is in charge of the BLDC motor. By interconnecting four 12V 14Ah batteries in series, a 48V14 Ah battery pack can be created. Depending on costs, SMF batteries or lithium-ion batteries are both used. The vehicle's headlamps, taillamps, and indicators are powered by a 48 V to 12 V dc-dc converter.

2.3 ELECTRIC CONVERSION BLOCK DIAGRAM



To integrate an electric drivetrain into a traditional IC engine-powered vehicle, the engine's head must be removed. Then, using welding techniques, a bed must be created for the installation of a BLDC motor in the location of the piston head and battery pack alignment. The vehicle's rear wheels are connected to the BLDC motor using a gear and chain system, and a BLDC motor controller is used to regulate it. The battery pack has a modular design and combines 4 batteries in series. To excite a BLDC motor, the controller needs DC power. The battery pack provides this energy. The controller changes the input DC power to three-phase AC, which powers the BLDC motor. It uses a 1000 W controller. PWM signal is generated by the rotation of the electronic accelerometer and is sent to the micro controller. The motor will be excited by the micro controller as a result of feedback from the hall sensor. The BLDC motor's strong starting torque is its main benefit, and the chain drive system used to connect the motor's shaft to the car's wheels makes this conversion possible. Also, the gear sends the vehicle's rear wheels the power generated by the motor.

III. COMPONENTS

3.1 BLDC Motor

An electronic commutation system rather than a mechanical commutation system based on brushes is used in brushless dc motors, which are synchronous electric motors that are powered by direct current energy. In a BLDC motor, the armature is stationary while the permanent magnets rotate in place of the electromagnets. A three phase electronic square wave controller powers the motor. The BLDC motor has 4 connections, including the hall sensor output and 3 phase inputs in red, blue, and yellow. The hall sensor and the motor's three phase inputs are both connected to the BLDC controller. When the electromagnetic winding in the stator creates the north pole of the stator, the BLDC controller activates the stator winding, and each phase is powered by the PWM signal. When each phase is powered by the PWM 3 phase square wave output from the controller, the flux generated by the electromagnet attracts the south pole of the rotor, resulting in a rotational motion. The speed of the motor is reportedly regulated by changes in PWM signals applied to the SCR gates in the BLDC controller, according to feedback the controller receives from the BLDC motor's hall sensor. A Hall Effect transducer serves as the basis for a Hall Effect sensor. The circuit for a hall sensor consists of hall components, a voltage regulator, a high gain amplifier, a Schmitt trigger, etc. Due to the existence of a magnetic field, the hall sensor detects the rotor position via a voltage difference inside the hall element. The voltage difference is then translated into a digital output with the aid of a comparator and sent to the controller circuit. A common sensor that gives a motor controller feedback on the rotor position is a Hall Effect sensor. Three Hall Effect sensors are typically installed on the stator of a BLDC motor. The position of these hall sensors, which are 120 degrees apart, ranges from 0 to 360. This sensor produces a digital pulse in terms of 1 and 0 when it comes into touch with the rotor's magnet field (high & low). These hall sensors are able to provide the motor position in 6 stages. Depending on whether the North Pole or the South Pole of the rotor has crossed the sensor, a low or high signal is generated when the rotor magnet does so; otherwise, a high signal is generated. Every 60 degrees, the rotor passes over all three sensors, which transition between low and high to reveal the rotor's position.

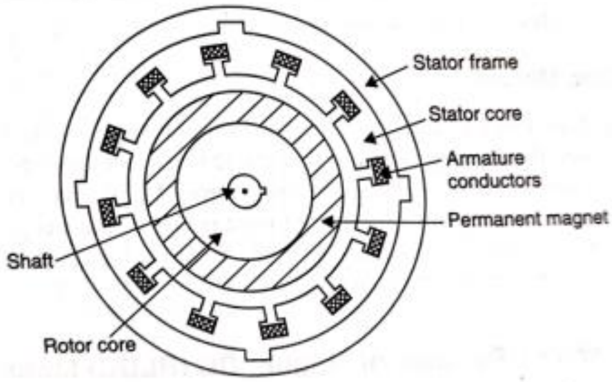


Fig.3.1: BLDC motor internal diagram

3.1.1 REASON FOR CHOOSING BLDC MOTOR

The BLDC motor can operate at high rpm. Moreover, the initial starting torque is high. It doesn't need constant maintenance in comparison to conventional motors because there are no brushes and no mechanical commutation mechanism, so these losses are not real. It doesn't make a lot of noise. Due to the lack of a mechanical commutation system, it ensures extended life and great efficiency.

3.1.2 OTHER MOTORS USED RATHER THAN BLDC MOTOR

We can also use DC series motor, permanent magnet synchronous motor, 3 phase AC induction motor and switched reluctance motor.

3.1.2.1. DC series motor: -

The high starting torque capability of a DC series motor makes it an appropriate choice for traction applications. Its motor's simple speed control and ability to sustain a rapid rise in load are further benefits. DC series motors, however, require more maintenance than BLDC motors do since they have brushes and commutators. Also have a high level of noise. Compared to BLDC motors, the motor draws a lot more ampere. If the load is not provided, the speed abruptly climbs to infinity, burning the winding. Frictional loss and power loss also happen. These factors prevent us from replacing the DC series motor in this electric vehicle.

3.1.2.2 Permanent magnet synchronous motor: -

Due to its smaller size and fewer coils, this motor ensures high efficiency while producing a high power density. As a result, it produces great speed at a quiet volume. Due to its low torque ripple, this motor may produce torque ripple at a consistent pace. It requires a drive, which is its main disadvantage. A steady magnetic field surrounds its rotor. However a changing magnetic field is required. These motors therefore need a variable frequency power source to begin. Hence, it cannot function without a driver. Furthermore, demagnetization is brought on by high current and temperature. We can only alter the stator current in this motor. Hence, the stator's AC supply must be changed to control the motor. These factors prevent us from using this motor in our electric vehicle.

3.1.2.3 Three phase AC Induction motor: -

Up to a design efficiency of 92%–95%, induction motors are possible. For traction use, the greatest torque made available at startup is acceptable. Despite all these advantages, we don't use it because it doesn't continuously produce torque. Its requirement for a complicated inverter circuit is another major issue. For each phase to operate properly, 3 inverters must be placed. The motor is very challenging to regulate. We are unable to use this motor in our electric vehicle for the aforementioned reasons.

3.1.2.4 Switched reluctance motor: -

This motor's rotor is a piece of laminated steel that lacks permanent magnets and windings. This reduces the rotor's inertia, which aids in fast acceleration. The complexity of control and growth in the switching circuit, however, is the major disadvantage. It has some noise problems as well. The converter needs a lot of KVA. So, we must install a costly converter. We are unable to use this in our electric vehicle for these reasons.

3.2 BLDC MOTOR CONTROLLER

In essence, the BLDC motor controller is a 3-phase square wave inverter. The controller receives the DC supply as input, and after some regulation, the DC supply is converted to 5 volts Vcc for the microcontroller. The DC power is transformed into an output of a three-phase AC square wave. The IRF series of MOSFETs, which have a high ampere rating, do this. The PWM signal produced by the driver unit in the BLDC controller controls and ignites each MOSFET's gate terminal. The BLDC motor's three phases are fired using a total of 6 MOSFETs, with two of them being assigned to each phase. The commutation speed control unit of the controller detects the hall sensor output from the BLDC motor and regulates the speed of the BLDC motor by adjusting the PWM signal output to the MOSFET units of each phase. The BLDC controller unit changes the motor's speed in response to input from the electronic accelerator unit.

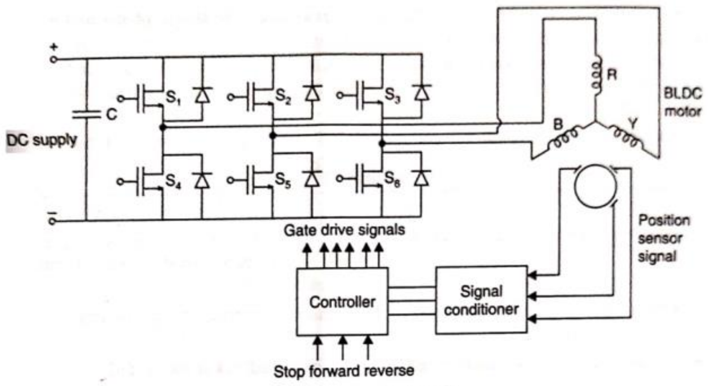


Fig.3.2: BLDC motor-controller basic diagram

3.3 DC - DC CONVERTER

The input to output DC voltage may be increased or decreased using the DC-DC controller. The DC voltage is reduced using a buck converter, and increased using a boost converter, respectively. In an electric car, a DC-DC converter is used to reduce the battery pack's greater voltage to 12 volts, which is then utilized to power the vehicle's headlamps, taillamps, and indicators. Because the LT3845 is a synchronous current mote step down controller with a variable working frequency, it is utilized to lower the voltage.

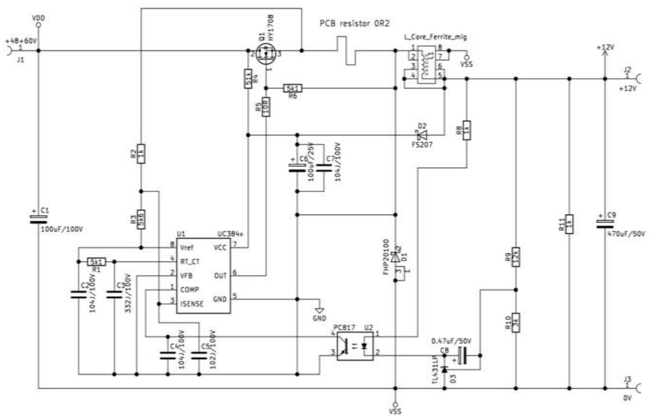


Fig.3.3: DC-DC converter diagram

3.4 BATTERY PACK

To excite the BLDC motor, the BLDC controller requires DC power. The battery pack is built taking into account the input voltage requirements for the BLDC controller and the maximum range required for the vehicle. Each battery in the battery pack is connected in a series of parallel configurations depending on the needed DC output. Although the voltage can be raised with a series connection, the Ah (Ampere hour) rating stays the same. The voltage stays constant and the ampere hour (Ah) increases when the batteries are connected in parallel. The maximum range that the electric motor cycle can travel is determined by the battery's ampere hour rating, which is significant. For instance, a 12 Ah 12 V battery is capable of continuing to give 12 amps to a load at 12 V. SMF (sealed maintenance free) batteries and lithium-ion batteries are the two battery kinds that are most expensive for electric vehicles. SMF battery is what we utilize for this conversion. 48V, 14 Ah input is required for the thrilling 1000W BLDC controller. For this, we series-connect four 12V 14Ah batteries. The required voltage of 48V may be obtained using this method, and the constant current of 14Ah will also be maintained.

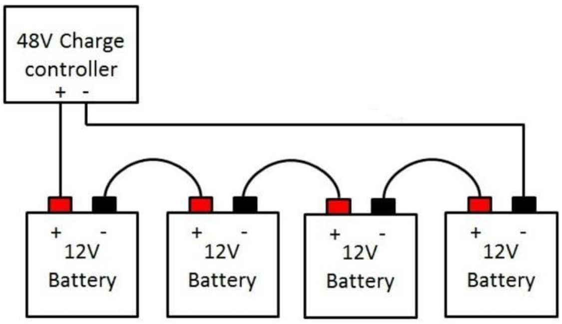


Fig.3.4: 48V battery pack

3.4.1 REASON FOR CHOOSING SMF BATTERY

Compact and flexible, the SMF battery can be used in any direction. i.e., we can position ourselves in any direction and travel in any direction. The battery does not emit any fumes or odors. Because the battery's acid is in the shape of a gel. The battery can be placed before shipment because there isn't a leak or water spill. Compared to other batteries, SMF batteries are more cost-effective.

3.4.2 OTHER BATTERIES USED RATHER THAN SMF BATTERY

We can also use Lithium-ion battery, Lead acid battery, Nickel metal hydride battery and Lithium phosphate battery.

3.4.2.1Lithium-ion battery: -

It features a better energy density, greater voltage capacity, and a 5% monthly self-discharge rate. Li-ion batteries are more stable and may be recharged numerous times. Toxic chemicals are employed in its production and processing as opposed to SMF battery. It explodes violently. because it draws 16A of current. The battery warms up and explodes when there is such a quick current flow. Our planet contains barely 0.002% lithium, according to global databases. These are the reasons we stay away from this battery.

3.4.2.2 Lead acid battery: -

Although lead is widely distributed throughout the globe, it is pricey. Its melting point is low. In a lead acid battery, overcharging is not a concern. This ensures a high level of safety. Despite all that's good. We avoid using it because of its poor volumetric energy density and dangerous character. The charging cycle is short.

3.4.2.3 Nickel metal hydride battery: -

Only minimally hazardous ingredients are utilized in its production. It has more energy per volume. Also, it guarantees a longer life cycle. A nickel metal hydride battery has a lifespan of 5-7 years. But we don't use it for our project. Because one of its biggest flaws is that it self-charges. Specifically, at a rate of 12.5% every day at room temperature.

3.4.2.4 Lithium metal hydride battery: -

The improved thermal and chemical stability of lithium-ion batteries is one of their main advantages over competing lithium-ion batteries. Compared to lithium-ion batteries, it offers stronger safety features. Moreover, the output power is consistent. The main drawback to avoid this battery has ageing effect and high protection required. These limitations prevent its usage in applications involving electric mobility.

IV. CALCULATIONS

The total load calculated is about 500Kg (motor weight, vehicle weight, control units' weight with the batteries weight and the weight of rider and accessories). The force required to bear the load is calculated as about 60N with the equation

$$F=Crr*M*g$$

taking the Crr value as 0.012 and g as 9.81N/m^2

The maximum power requirement of the motor is calculated as approximately 670W by the equation

$$P=F*V/3600$$

while taking the maximum velocity (V) as 40km/hr

The maximum range is calculated as 25.6km from the equation

$$\text{Distance (D)}=Wh/F$$

Where F is the Force in Newton and Wh is the watthour calculated as 1.5 Kw while using 48Volt 32 Ah batteries.
The expected charging time is about 2hours while using a charger of 48V 15A.The expected charging cost per kilometer is about 4 paise, Taking the tariff as 6 rupee per unit consumed.

V. ADVANTAGES

- Lower running costs: Compared to a comparable gasoline or diesel vehicle, an electric vehicle has substantially reduced operating costs. Instead of using fossil fuels like gasoline or diesel, electric vehicles charge their batteries using electricity. Since electric vehicles are more cost-effective than gasoline or diesel, charging an electric vehicle is more affordable than filling it up with fuel for your travel needs. Using renewable energy sources can increase the environmental friendliness of using electric vehicles. If charging is done using renewable energy sources like solar panels that are placed at home, the cost of electricity can be further decreased.

- Low maintenance cost: Due to their lack of moving parts compared to internal combustion vehicles, electric vehicles require very little maintenance. Electric vehicles require less maintenance than conventional petrol or diesel vehicles. As a result, operating an electric vehicle has very little cost per year.

- Zero Tailpipe Emissions: Due to the absence of tailpipe emissions, driving an electric vehicle can help you lessen your carbon footprint. By using renewable energy sources to power your home, you may further lessen the environmental impact of charging your car.

- Tax and financial benefits: Compared to gasoline or diesel automobiles, registration and road taxes for electric vehicles are lower. Depending on the state in which you reside, the government offers a variety of programs and incentives.

- Petrol and diesel use is destroying our planet: The use of fossil fuels, which are scarce, is endangering the environment. Long-term, detrimental effects on public health are caused by toxic emissions from gasoline and diesel cars. Electric vehicles have significantly lower emissions than those powered by gasoline or diesel. Electric vehicles are more efficient than gasoline or diesel cars, which can only transfer 17% to 21% of the energy contained in the fuel to the wheels. Electric vehicles can convert about 60% of the electrical energy from the grid to power the wheels. That represents a waste of almost 80%. Although gasoline or diesel vehicles release approximately three times as much carbon dioxide as the average EV, fully electric vehicles have zero tailpipe emissions, even when electricity production is taken into consideration. India has the lofty goal of generating around 40% of its installed electric power capacity from non-fossil fuel sources by the year 2030, which will lessen the impact of charging electric automobiles. As a result, we must transition to electric vehicles right away if we want to improve Indian transportation.

- Electric Vehicles are easy to drive and quiet: Electric cars are highly practical to drive because they lack gears. Just accelerating, braking, and steering are the only controls. Simply connect your car to a home or public charger when you need to charge it. Due to their reduced noise emissions, electric vehicles help to lessen the noise pollution caused by conventional automobiles.
- Convenience of charging at home: Consider yourself in a crowded gas station during high traffic times, and you are running late to work. With an electric vehicle, these issues are readily resolved. Simply connect your car to the charger at home four to five hours before you intend to leave. Planning your trips in advance is quite easy if you can find a charger close to where you keep your car at home. What happens if you ever forget to plug your device in? When this happens, you can easily use rapid chargers or even battery changing services if you're riding a two-wheeler.

- No noise pollution: As there is no engine beneath the hood, electric vehicles are capable of operating quietly. Lack of an engine implies silence. You must look inside your instrument panel to determine whether the electric motor is turned on because it operates so quietly. Because electric cars are so silent, manufacturers have to add fake noises to make them audible to pedestrians.

VI. FUTURE SCOPE

Future automobile restrictions on gasoline and diesel engines will be brought about by the growing environmental challenges. For instance, the government will support electric mobility. To assist the objectives of sustainable development, the government has launched Atmanirbhar Bharath, Nitt Aayog, and made in India. We can extend the vehicle's range by using a high-wattage motor and powerful batteries. By employing chargers with high ampere ratings, we can shorten the charging time. Any scrapped automobiles can use the same conversion technology. As all fossil fuels are not renewable, the future of public transportation depends on the electric mobility industry. For instance, electric buses, road trams, and metro trains. Daily advancements are being made in battery technology. Lithium-ion phosphate batteries, which are strong and offer greater mileage per charge, can be used. The longer-lasting batteries also reduce the weight, cost, and time associated with recharging. Also, this will support electric mobility. Large-scale automobile manufacturers are making daily increases in their investments in the field of electricity. Future opportunities for the electric car industry include a reduction in the number of scrapped automobiles, which will increase electric mobility. By utilising eco-friendly electric drive train technology, it is possible to significantly reduce carbon dioxide emissions while still utilising fossil fuels, which will undoubtedly result in a more environmentally friendly transportation system. This will also significantly improve passenger health while reducing overall air pollution and noise pollution. The eco-friendly electric drive train technology reduces air and noise pollution and emits zero carbon dioxide. Due to the IP65 water resistance of the electric drive train, there is no risk of damage from moisture in the future. Following technologies can also be included in this vehicle:

1. Battery management system
2. Solar roofing
3. Keyless car technology by using biometric sensing
4. Intelligent security system
5. Self-driving technology
6. Remote driving technology

VII. CONCLUSION

In comparison to hybrid and internal combustion engines, the electric car offers a number of advantages and benefits. It is both considerably cleaner and more effective. It does, however, have some drawbacks, notably the requirement for constant charging. Each vehicle has unique qualities nowadays that set it apart from the competition. We can lower the cost of building by utilising waste materials. A BLDC motor serves as the engine in this cost-effective electric vehicle type, which also features powerful battery packs. This can be done by taking off the internal combustion engine, the exhaust system, and other extraneous parts of the car and replacing them with a BLDC motor, an intelligent controller, a battery pack, a wiring system, and monitoring devices. Electricity is a more efficient and economical energy source than fossil fuels. Due to the IC exhaust CO2 produced by IC engine vehicles, the global output of carbon is rising.

REFERENCE

[1] K.S Sathish Kumar, Franklin Xavier A, Avinash R, Muthupitchiya P, Jerrin K Abraham, "*Conversion of an IC engine vehicle into electric vehicle",* International Journal Of Engineering Research & Technology, 2019

[2] Varadmurti Patil, Shubham Kurunde, "*An Overall Review On Electric Vehicle And Its Conversion Perspective"*, International Journal Of Advances In Science Engineering And Technology, vol.6, Issue 4, 2018

[3] S Vasanthaseelan, D S Dharun, S Sreerag, R Gokul, "*Conversion of IC engine vehicle to electric vehicle",* International Research Journal of Engineering & Technology, 2019

[4] Akash Anil Vaidya, Prof. T.S. Sargar, Saket P. Joshi, *"Conversion of IC Engine Bike into Electric Motor Bike",* JETIR, Volume 6, Issue 4, 2019