

Electric Vehicle – A Review

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Abstract

In this paper we are going to see about the history and evolution of electric vehicle in the environment. This electric vehicle plays a vital and important role in the environment which reduce the common pollution in the world, but it also has some disadvantages which is impact to the environment. However, technology is enriching the features of that which are also adoptable to the devices and we can modify to use. What are all the materials and why we are all using these materials to make? these are all we are going to see in this paper. The principle and mechanisms used also discussed in this paper. The electric vehicles types are also discussed and the features, efficiency of E vehicles, cost efficiency, stability, range, environmental aspects, battery management, and improvement also reviewed in this paper.

Key-words: Electric Vehicle, Battery Management, Battery Electric Vehicle, Hybrid Electric Vehicle.

1. Introduction

In 1828 Anyos Jedlik produced the first motor for running vehicles in later 1834 Homas Davenport [1] he also introduced a model for the vehicles. In the Netherlands Sibrandus Stratingh he found the first non-rechargeable Electrical vehicle. Up to 1859 we used primary cell batteries which are non-rechargeable so that it may cause a greater number of pollutions like e-waste and also a greater number of cell batteries required for running a single electrical vehicle so that it increases the cost of the e-vehicle. In order to rectify these drawbacks Gaston Plante he introduced the first lead acid battery. In all over the world this battery made a revolution and also many of the countries are started to produce

electrical three-wheeled cars, especially U.S.A had made a first invention of first six-person wagon which was the first electrical vehicle.

It runs with the speed of 14 miles per hour. The electrical vehicle dominates the steam engine and petrol engine because of its reduction in noise pollution and smell released from the burning of vehicles makes an uncomfortable condition has been reduced. In 1900s were one-third of the vehicles are electrical vehicles [2] but in 1920s in order to increase the efficiency of the vehicles the petrol engine replaced the e-vehicles because the e-vehicle travels with the speed of 20-30miles per hour which is like a speed of a bicycle pedaling. The electrical vehicles travel with a distance of 50-80 km and they should be charged for an every single hour [1]. This was the reason why petrol engine replaced e-vehicle in 19th century but now the technology was more advanced and in order to decrease the pollution and also to overcome the shortage of fossil fuel in 21st century comes to play a major role in the automobile industries. It is expected that in 2025 all petrol and diesel engines will be replaced by the e-vehicles. Not long ago, Electric Vehicles are seeming to be a rise in the popularity for many reasons and the reason behind is their contribute in decreasing the emission of Green House Gases. A vehicle that uses one or more traction motors for propulsion is known as an E-vehicle or Electric Vehicle. It came into the existence in the very mid 19th century. Nearly, 25% of the Green House Gases produced by transportation sector in the year of 2009[1]. A number of efforts has been undertaken to reduce the emission of Green House Gases from the transportation sector. On the other hand, it is very quiet and it will be easy to operate and also it has very low fuel costs which does not required for these E-Vehicle. However it is very useful in using as an urban transport mode. While using the E-Vehicle it does not require any stored energy and it will not cause any type of emission of pollution through idling [2]. The continuous improvement of the technology is to improve the performance of the E-vehicle and its diligence. The main use of E-Vehicle is to reduce pollution in major cities. Electric Vehicle was first introduced in America in the early of 19th century. Studebaker Automobile Company was the first to introduce the automotive business with the electric vehicles [2]. At that time the popularity of Electric Vehicle decreased significantly, and with the advance of cheap assembly line cars by Ford. Basically the Electric cars do not gain its popularity because of the limitations in storage batteries. Some of the developments have been contributed to cause a decline in the popularity of the electric cars. First of all, e-vehicles were appeared in America and it was the first mass-produced e-vehicle in the early 1990s [2]. After the invention, the Studebaker Automotive Company has entered their business in automotive with the production of e-vehicles in 1902 and also, they take partake part into gasoline vehicles at the market in 1904. Generally e-vehicle is the one that uses electric motor rather than gasoline motors which had become very popular [1]. Those protect the environment from pollution

causes and trying to succeed the go green love electrical vehicles. Suddenly there is an early rise and fall of the electrical vehicles. Americans were prosperous and also, they were turned to the newly invented motor vehicle which was available in the various versions like steam, gasoline to get around. At first, they tried the steam version and the true energy source having proved reliable for the powering factories and trains. But these steam vehicles require a long startup times and which in the cold condition takes up to 45 times [2] and also, they need to be refilled up to the limit with water. And after there is a new beginning of the electrical cars and the newly invented e-vehicle named Prius became the World's first mass-produced hybrid electric vehicle and which was the first turning point that so many had suggested and it was the establishment of the Toyota Prius [1].

2. Electric Vehicle

Electric vehicle is a vehicle which runs by means of batteries connected to electrical motor instead of fuel engine which operates by combustion of gases and fuels. this electrical vehicle can accelerate more than the ordinary vehicle by providing energy from the batteries to the motors which rotate the wheel faster than the ordinary vehicle. This vehicle having some of the component that will run the system. Some of the component like battery, dc converter, thermal cooling, transmission and controller etc.



Tesla (Model S)

3. Types of Electric Vehicles

There are majorly four types of electrical vehicle, they are:

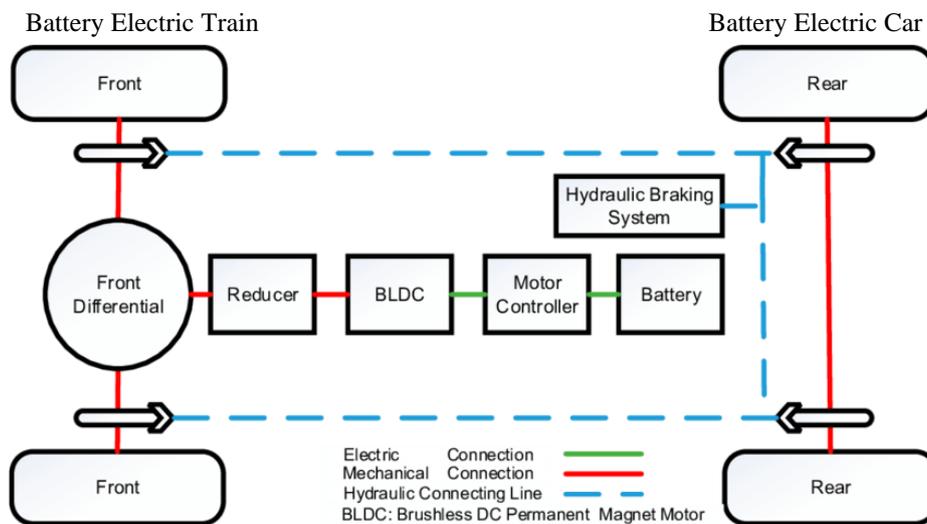
1. Battery Electric vehicle
2. Hybrid Electric Vehicle
3. Plug-in Hybrid Electric Vehicle
4. Range Extended Electric Vehicle

5. Fuel Cell Electric Vehicle
6. Solar Electric Vehicle

3.1 Battery Electric Vehicle

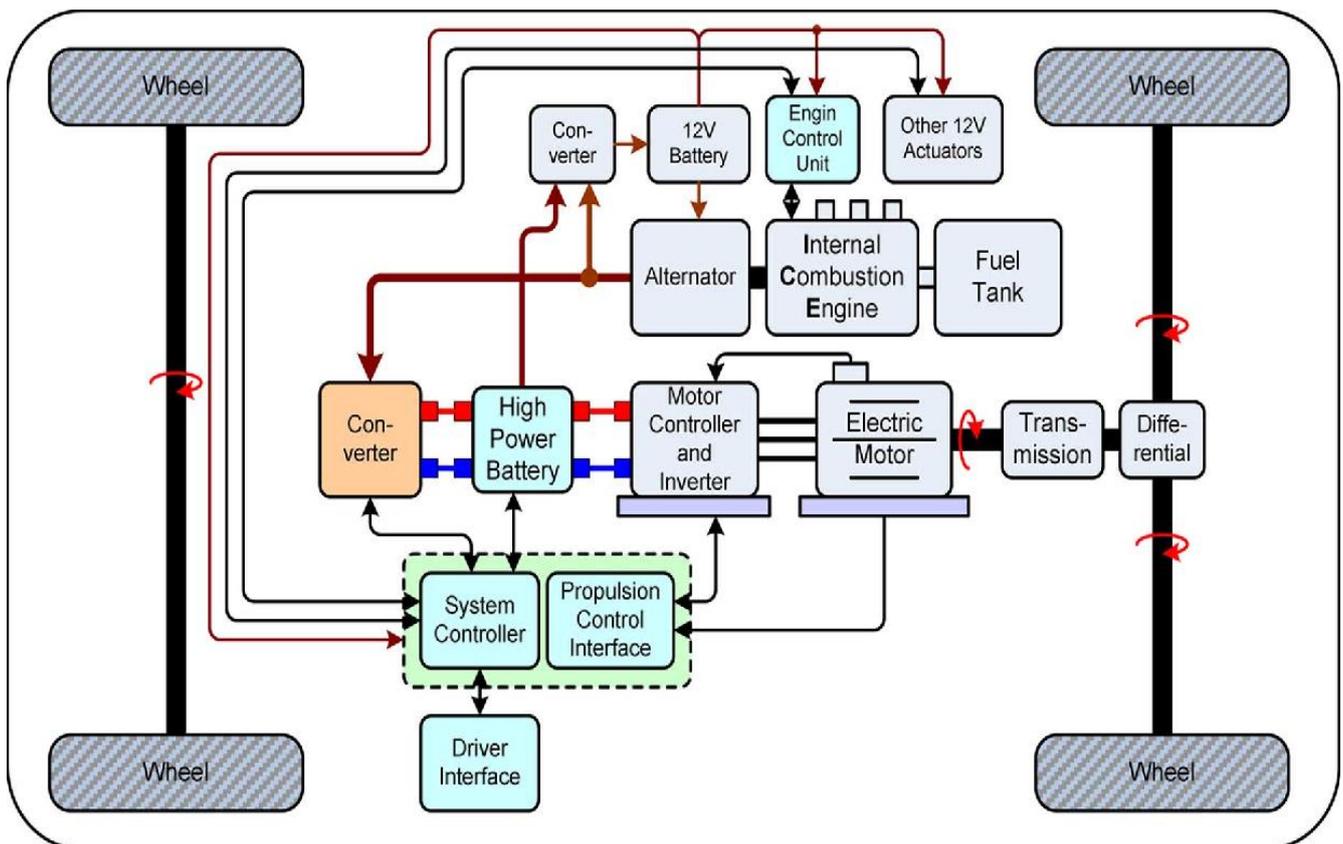
These are the vehicle which runs only with the electrical part without any internal combustion engine and fuel tanks. These vehicle takes energies from the sources which means battery with having high capacitor to run the electric motor. It is rechargeable by means of plugging. It can cover up to the distance of 100 to 250 km. further updated vehicle are cover the distance up to 300 to 500 km. These range are depending upon the various reason like driving style, road consideration, battery type. The advantages of these vehicles are they did not produce any pollution on environmental, it run without any fuels, the efficiency of this vehicle greater than the ordinary fuel vehicle [6].

Disadvantages are charging ability is slower than the fuel vehicle because the fuel vehicles are converting the fuel in to the mechanical energy suddenly, but in BEV the recharging is slower up to 36 hours for train, other vehicles of the same model, cost is higher than the fuel vehicle.



3.2 Hybrid Electric Vehicle

This is the second type of electric vehicle which has both mechanical and electric parts to run the system [7]. The mechanical part like internal combustion engine. the electrical part like electrical engine. When the power demand is low the electric propulsion is used. The advantage of this vehicle is low fuel consumption, urban areas are slow speed condition is suitable for this vehicle, the outside of the urban areas we use the internal combustion engine is activated and electric motor is stopped. The batteries are recharged by alternating current. This internal combustion engine is a backup for electric battery when it is dissipated. The breaking system of this vehicle is more advantage. It will improve the mileage performance. The upgradation of this vehicle is to recharge energy by means of plugging. Torque is improved; reduce pollution emission, high efficiency of the electric machine. Disadvantages of this vehicle are cost, electronic complexity, mass of the vehicle, low system reliability [7].



Internal Structure of Hybrid E-Vehicle

3.3 Plug in Hybrid Electric Vehicle



Toyota Prius

PHEV is like the hybrid electrical vehicle because both the internal combustion engine and electric motors are used [8]. But the major difference between these two is it requires larger battery capacity. In PHEV the electric mode is activated first, after the loss of energies in the batteries then the electric mode is turned off and the ICE is used as backup sources. The charging mode of the PHEV is directly obtained from the grid, it can be recharged through external electricity source. These recharged batteries are used to drive the wheels. PHEV is coming under the both BEV and HEV. The advantages of PHEV is zero emission of pollution when the batteries are used, fuel efficient in traffic areas, optimized performance, handle easy to drive, cost-efficient, battery capacities is large enough to drive. The disadvantages of PHEV are fuel economy is not good at on journey, maintenance is complex, consideration of battery life, transmission energy loss, added weight of components, relatively expensive, resale value is not to determine, and it's still using the fuel engine [8].



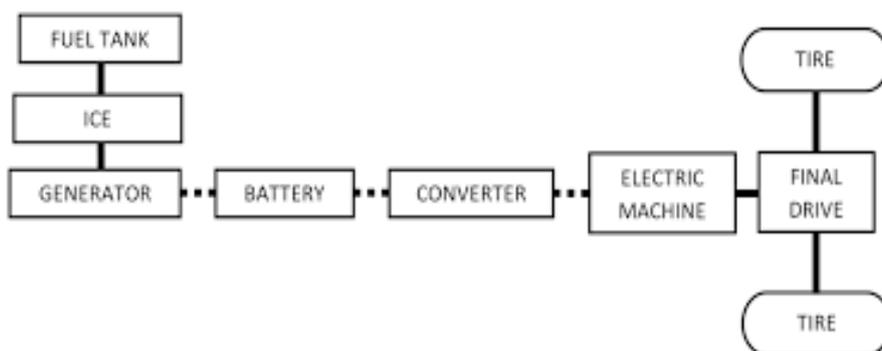
Mitsubishi Outlander PHEV

3.4 Range Extended Electric Vehicle

The major component of REEV is electric motor and majorly the combustion engine is used [9]. The electric motor is driven by the help of high capacity batteries. These batteries are often charged by the help of combustion engine. it is majorly run with the help of electrical motor when the batteries are discharged to run the electric motor, the combustion engine is turned on to run the generator for supplying the energy to the electric motor otherwise to recharge the battery for an average distance REEV can run with fully electrical mode and then efficient like BEV[8].The advantages of REEV is low cost higher power density, fast startup, range of the electric source is increase, quality infrastructure simple design, good scalability. The disadvantages of REEV are low efficiency, noise, vibrations, high emissions, no packaging variability, additional weight of the vehicle.



Audi portfolio

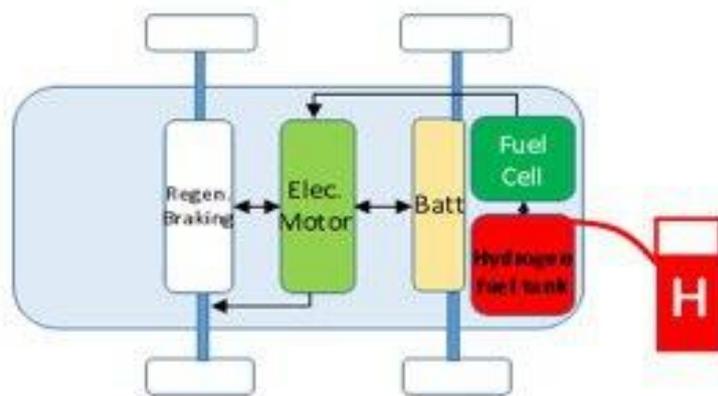


Internal Structure of Range Extended E-vehicle

3.5 Fuel Cell Electric Vehicle

In this vehicle the name itself they denoted that the fuel cell is used so the fuel cell produces electricity to run this vehicle [10]. In this vehicle the hydrogen is used to carry out the reaction so they are often known as hydrogen fuel vehicle. In this the hydrogen is taken as high pressure tank and

oxygen is also taken for the production of power generating process. The fuel cell produces electricity and this electricity generated to run the motor which turns the wheel. The super capacitors or batteries are used to store the excess amount of energy. The by-product of FCV is water which can be ejected from the car by the tail pipes [10]. The advantage of the FCV are they produce their own power which does not emit carbon, refilling of this vehicle is same as that of conventional vehicle, it reduces greenhouse gas emission, reduce the oil ripens, less air pollutants, vehicle costs, getting hydrogen to customers, public education, no need of oils, silent operation in the vehicle, easy maintenance and no need of petroleum [10]. The disadvantage of this vehicle is expensive, need hydrogen stations, low durability and reliability, highly inflammable, limited range etc [8].



Internal Structure of Fuel Cell E-Vehicle

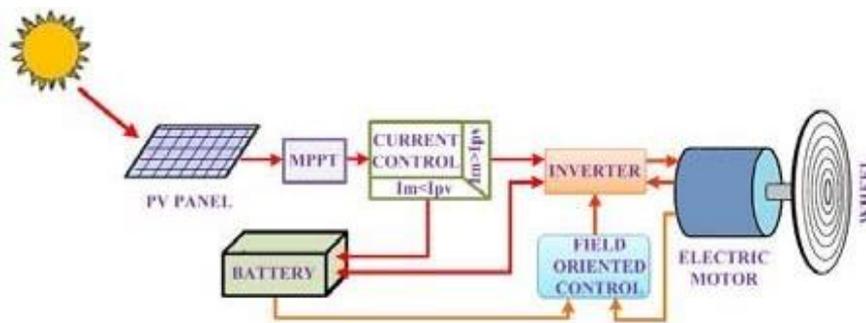


Toyota FCV

3.6 Solar Electric Vehicle

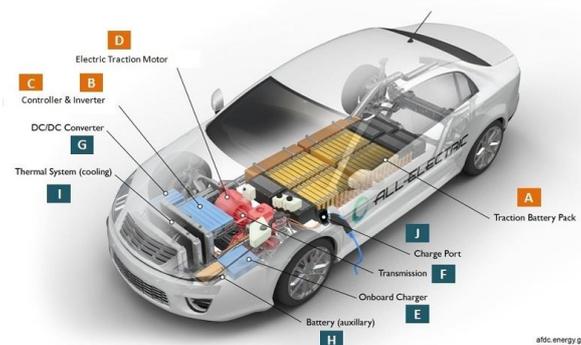
This vehicle where the energy was dominated or contributed directly by means of sunlight in which solar energy was produced and that was converted into electrical energy by photo voltaic cell [9].

In this vehicle the battery also attached for complete working of day and night to drive extended range [10]. In this vehicle the solar panel is attached to the roof of the vehicle to take energy directly from sun light [10]. The advantages of this vehicle are ability to use their enough power at any level of speed, harmless, acquires low maintenance, eco-friendly, zero emission, reduce maintenance, using renewable energy, reduces electric power compared to other vehicles, integrated body material to use comfortable, applied improved technology, no need of petroleum, this vehicles are barebones[9]. The disadvantages are costly, depended on weather, energy storage is expensive, cause's pollution during the manufacturing the vehicle, indirectly affecting environment by using the photo voltaic cells, spacing of the solar panel taking large, speed of this cars is low compared to other vehicles[9].



Tesla Light Year 1

4. Component of E –Vehicle



Component of E-vehicle

4.1 Electrical Inverter

The inverter is a device which converts dc to ac current which also helps in the change in frequency and change in alternating voltage so that it can alter the speed of the vehicle and also it helps in the process of regenerative braking system so that it is used to conserve the energy [4].

4.2 Controller

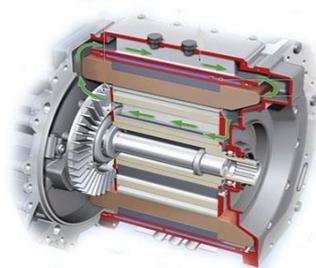
It is a device that act as a brain of the E vehicle as the technology is advanced now a days that takes input from the pedal of the E vehicle and by using integrated circuits[4] it gets the information how much electric current should flow to the inverter from the electrical battery so that it can also help in the regulation of the speed of the vehicle and also it is connected between battery and motor and it is light in weight and handy and also it changes the current and voltage so that it can vary the speed[4].



4.3 Electric Traction Motor

It is a motor which is used to move the vehicle which gets regulated voltage and current from the battery by the controller and then it rotates the wheel to move the vehicle and the motor mainly consist of stator and rotor which helps the motor to rotate as the motor works under the principle of electromagnetic force [3].

ELECTRIC TRACTION MOTOR



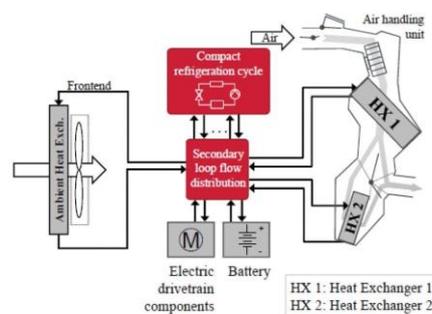
4.4 Battery

This is the component which supply the electrical energy to the motor to run the vehicle [3] if controller is brain, then battery is the heart of the e-vehicle without nothing is possible and the battery is the lead acid battery which is light in weight and are cheaper then lead acid battery.



4.5 Thermal System – Cooling

It is a component that is used to cool the battery as the battery are the thing which can get heated like a hell after a long time use if it is not cooled it affects the other part of the e-vehicle so that in order to avoid the damage we should use the thermal cooling system that protect the internal accessories from the heat caused by the overrunning of the battery [3]



4.6 Charger Point

It is the thing which is used to recharge the battery after it's battery gets drained as it is rechargeable we made a port in the vehicle which is usually situated in the front part of the vehicle that means in the place of the engine as e-vehicle does need any IC engine to run the vehicle the recharging may cost up to \$15 dollars and there are three level of charging the first one is the 120 volt charging which can be done in the home itself and the second stage is the 220v-240v[4]as it can make the vehicle to run a distance of 20-40mph for one charge and the next is the DC charge as it take only half an hour

to get it fully charged and an single charge makes the vehicle to run a distance of 340mph and the rate of charging varies depending on the size and capacity of the battery.



5. Working of E-Vehicle

5.1 Principle

It works mainly by the alternating current because we know that current released from the batteries are DC current which cannot be used to alter the speed of the vehicle so that we need an alternating current it is the main and important principle[5].

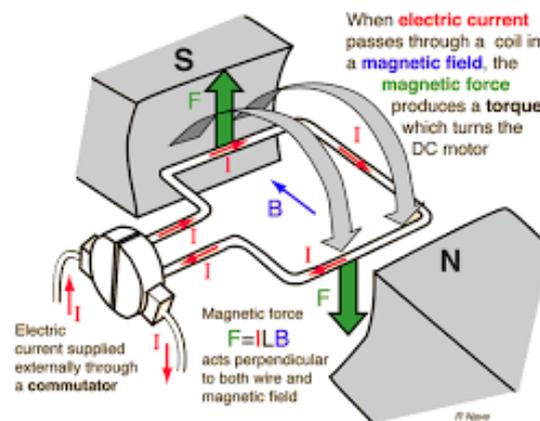
5.2 Working of Controller

As when vehicle the battery starts to run and it release electron in the form of DC current and it reaches the controller as the controller consist of so many number of integrated chips which receives the signal from the clutch [5] and it regulates the flow of voltage to the battery and it also converts the DC current from the battery to the AC current and then supply it to motor [5].

5.3 Working of Motor

As we are very familiar that motor is a device that rotates but how does it work? We can see it briefly here as motor work in the principle of electromagnetic force[3] it is the force induced by disturbing the magnetic field that passes from North Pole to South Pole so that in the rotor the magnetic flux produced by the stator opposes the flux produced by the stator this happens according to the principle of lens law[4] and the two force acting in the opposite direction makes the rotor to rotate and thus vehicle accelerates and as we know that e-vehicle are single pedal vehicle as we remove our legs from the pedals it will starts to decrease it speed and come to stop this happen because when we remove our leg from the pedal the motor starts to rotate in opposite direction to the speed of the vehicle so that the motor is automatically converted to generator so that according to first law of thermodynamics the

one form of energy is converted to another form of energy so that the kinetic energy is converted to electrical energy and It flows back through the controller and reaches the battery and it gets recharged as that in normal vehicle the kinetic energy is lost in the form of heat in order to avoid that loss it converts the motor to the generator when it runs with a speed greater than synchronous speed and it is called as regenerative breaking [5].



6. Advantages of E-Vehicle

6.1 Low Cost Efficiency

As the electrical energy is used as fuel for running the e-vehicle we can save more money from investing in the fuels for running and also the recharging is also not so much cost it is lower than the cost compared to the fuel used by the petrol engine and diesel engine vehicle [4].

6.2 NO Pollution

It uses the electrical energy it so that it does not release any form of gases consist of carbon monoxide and carbon dioxide that causes pollution but in fossil fuel vehicle the petrol burns and emit carbon dioxide and carbon monoxide[3] so that it causes pollution such as global warming and greenhouse gases.

6.3 Saving the Resources

Resources can be saved by using the electrical vehicle as the petrol and diesel are getting drastically reduced so that if we use the e-vehicle as an alternative one we can save a greater number of resources like fossil fuel [4].

6.4 Maintenance

As maintaining of the e-vehicle is not necessary and it requires the replacement of the battery for 8 years [4] once as the fossil engine it has carbide which may sometime blocks and reduce the combustion efficiency but in e-vehicle it is not there.

7. Disadvantages of E-Vehicle

7.1 Travelling Distance

As the main disadvantage is the e vehicle does not cover the distance that is covered by the fossil fuel vehicle.

7.2 Costlier

As the initial payment for the e-vehicle is more compared to that of fossil fuel as due to the expensive circuits and battery.

7.3 Recharging Time

It takes more time to recharge the battery then fossil fuel vehicle refueling as in fossil fuel vehicle we just go the petrol station and refuels it within 30 seconds [4] but in the e-vehicle it is completely different because it takes nearly half an hour to recharge the battery of the e-vehicle.

7.4 Recharging Station

As the recharging station are not in every place like the petrol bunk as petrol bunk may be situated in every 5 km but a recharging station present in the city areas not in the highways [4].

8. Conclusions

As in 21st century all resource linked to the fossil fuel are drastically reducing due to increase in more number of fossil fuel vehicle in order to decrease the reduction we cannot control the population which is the major reason for the rise of the fossil fuel engine vehicle so that we should find an

alternative way so that we can conserve fossil fuel and the way is e-vehicle it is expected that in 2025 all the fossil fuel vehicle are going to be replaced by the e-vehicle even though the awareness about the e-vehicle is poor in rural areas as in order to improve the sales of the e-vehicle and in order to replace the fossil fuel completely the government or the private sector should assign an crew to give awareness about the e-vehicle so that we can improve the sales of the e-vehicle and we should thank the each and every scientist for their technology their ideas are not taken into consideration because in the past there is no advanced technology to make their idea success but now we have enough technology to do an automated e-vehicle.

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