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Analysis of Electrical Parameters for Formula Style Electric Vehicle

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***Abstract*—**The main objective of the project is to build a formula style electric vehicle. Formula one car is a single seat racing car with an engine behind the driver. In the case of electric vehicle the battery is placed behind the driver. Globally there are various championship on formula one. Traffic and pollution has been one of the primary concerns in the recent lives. Electrical parameters are very important for an formula electric vehicle. Its helpful for the environment since its zero emission. The popularity for electric vehicles have come in every fields and it would be a great initiative touse in the formula one.

***Keywords*-**Motor,powertrain,battery,controller,inverter,etc.

INTRODUCTION

In the recent times electric vehicles have a great demand globally due to various advantages towards the environment and efficiency[1]. As pollution is one of the leading causes of global warming so switching to electric vehicle is very beneficial. Electric vehicle uses an electric motor instead of an IC engine . The electric motor gets the charge from the batteries. Formula style cars can be designed using the electric motor. The main objective of the formula one car is the speed and the same speed can be achieved even using the electric motor and if it is able to last longer with the help of effective batteries it can be a very effective formula one vehicle. It would be a great change. The cost would be low since the maintenance cost of an electric vehicle is low.

Formula E is the fastest growing EV motorsport [3].It is considered to be innovative, technological and organized .It is great initiative to implement this as encourages EV in the automobile industry. There's a significant progress om electric vehicles in automobile industry Tesla Motors, Lightning Car Company, and Detroit Electric.[2]

WHY NOT COMBUSTION

We realize we want to track down a trade for petroleum derivatives. Automakers are striving to track down answers for the situation. The vast majority of those arrangements appear to include disposing of our cherished gas powered motors. Be that as it may, wouldn't we be able to simply upgrade the run of the mill cylinder motor to run on something cleaner, similar to hydrogen?

Hydrogen is an enticing elective fuel. When consumed accurately, its just outflow is water fume. Fenske has been investigating hydrogen's prospects in numerous recordings currently this month, both as a fuel for cylinder motors and turning motors.

There are two significant issues with a hydrogen gas powered motor. To start with, hydrogen isn't as energy-thick as different powers, implying that you really want a ton of it to do a tad of work. Couple that with the intrinsic shortcoming of a cylinder motor, (best case scenario, you're just transforming around 30% of the fuel's energy into forward movement), and you have a recipe for dissatisfaction.

The subsequent issue? At the point when you combust hydrogen, you get different outflows other than water fume. For the most part, you get NOx, the harmful emanation at the core of the Volkswagen diesel outflows tricking outrage. On the off chance that you're searching for a spotless option in contrast to fuel, hydrogen's NOx emanations remove it from the running.

OBJECTIVE

EV's have received global attention at present. Range was the major concern in the EV's when compared to combustion engine vehicles but now that issue has been resolved to an extent to make it convenient to use. Pollution has been a major concern at present and transport has been one of the major reasons for it. Bringing in EV's in the mode of transport would be a great change. Formula E provides both motorsport championship and provides awareness for the use of EV's.

BACKGROUND

The first electric car was developed by Scotsman Robert Anderson sometime between 1832 and 1839.Thomas Davenport was also credited during 1834-1835 for developing electric car [4]. There was a rise and fall of

electric vehicles during the start of 19th century. There were 3 types of e vehicles available steam ,gasoline and electric vehicles. Steam was a tried and tested energy source is was used in various factories and trains. Steam was not considered a effective transport for the personal vehicles, during cold winters it would take around 45 minutes to start the engine. Electric vehicles were in a good demand in 1910's,It was considered to be silent as easy to drive when compared with the internal combustion or gasoline vehicles. Gasoline cars were made cheaper with the release of model T by ford. It was very low in terms of price when compared to electric vehicles. Gasoline vehicles were very suitable for long travels which was people's main interest. Gas and crude oil were cheap and available easily so gasoline vehicles had gained lot of interest and electric vehicles disappeared by 1935.During 1960's and 1970's the oil and the gasoline prices were increased and many automobile and government departments started showing interest for developing and researching on electric vehicle. General Motors developed a prototype for an urban electric car that it displayed at the Environmental Protection Agency's First Symposium on Low Pollution Power Systems Development in 1973, and the American Motor Company produced electric delivery jeeps that the United States Postal Service used in a 1975 test program

NASA also helped to raise the profile on electric vehicles by landing the first electric lunar rover on the moon by 1971.In 1990s many governments started to bring in energy policy act to cut down the pollution by building electric vehicles. GM developed a car named EV1 from the scratch ,it had a range of 80 miles and reached 0-50 in 5 seconds it received a good popularity but had to cut down the production in 2001 due to increase in production costs. One of the turning point was with the introduction of Toyota Prius in 1997. Prius was the first mass produced electric car. Prius has been one of the best selling hybrid vehicles. One of the major companies which reshaped the electric vehicles was a small silicon valley named tesla motors in 2006. Tesla was very much acclaimed for there cars and one of the largest auto industry employer. There's a great potential for creating a sustainable future. There's a lot of awareness created and the demand has been increasing for electric vehicles.

FORMULA E

Formula one is the highest class for international racing in the single seat open wheel driving cars. It is the premier racing forms which has huge recognition around the globe. Formula one cars are considered as the fastest regulated road race course. Formula one cars are gasoline powered vehicles Formula one has been a place which helped creating the best and get better with every aspect.

Formula E is a racing championship founded by AlejandroAgag and FIA President Jean Todtin 2011. It is one of the fastest growing motorsport series around the globe.The founding mission for formula E was to race through different cities around the globe with the best drivers to show the capability of sustainability and for the cleaner future. It debuted in the grounds of Olympic park at Beijing at 2014.Currently it has 12 teams and 24 drivers and it a racing destination of most of the riders. Gen1 was the first car in this league it had a power of 150kw and reached 0-60miles in 3 seconds. Lucas Di Grassi (Audi Sport ABT) stamped his name into the history books by becoming the first race winner in Formula E. In the second season the power was increased to 170Kw or 230bhp.

Table1: types of formula e vehicle

Sl no:	Type	Max power	Max speed	Energy source
1.	First generation formula e car	230kW	225km/hr	28kWh lithium ion battery
2.	Second generation formula e car	250kW	280km/hr	54kWh battery developed by McLaren applied technologies
3.	Third generation formula e car	350kw	320km/hr	

ELECTRIC VEHICLE

Electric vehicle is a vehicle which runs on a electric motor. The motor receives the power with the help of batteries. A controller is used to convert the DC supply into AC supply. Currently electric vehicles is being used in every mode of transport. Electric vehicles produce zero emission. Electric vehicles are present in every transport fields road, aircraft, rail and water. EV 's are considered to be the future mobility. EV's are almost 3 times more efficient compared to the internal combustion vehicles. EV's are comfortable to drive and are silent.

Figure 1. Formula style e vehicle

Electrical components of Formula E car/electric car

Powertrain: In a combustion engine race car there consists a fuel tank, IC engine ,gearbox and the parts controlling it. In a electric version the power is supplied from the battery not by the fuel. Instead of a combustion engine there consists a electric motor. The electric motor is considered to be lighter and efficient than the combustion engine. During breaking the motor acts as a genitor and passes the electrical energy to the battery, it is known as regenerative breaking. The electric motor produces better torque and RPM compared to the combustion engine. Inverter is used to convert the DC to AC.

An electric engine is a trade for the burning motor, as opposed to the battery, an electric engine is more modest and lighter than an identical motor. Additionally it just makes them move part, accordingly less course, contact and things to turn out badly.A veritable benefit is that the engine can likewise go about as a generator, making electrical energy under slowing down that can be put away in the battery. This is the identical to an ignition motor making petroleum to return into the tank, something that is can't do! As the one gadget can work in the two modes, the engine is in many cases called an Engine Generator Unit or MGU for short. Furthermore, the engine delivers full force from zero rpm, as opposed to a lot higher RPM as on a burning motor.

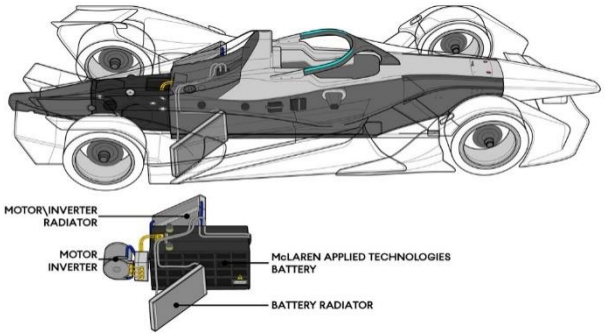

Figure2: Powertrain

Battery **:**Battery is considered as a core part of the powertrain it is placed in the middle or behind the seat of the driver. A battery is a collection of cells. In electric vehicles batteries which are suitable for higher range is preferred as it would help in travelling for longer distances .Casing and insulation is very important for a battery. There shouldn't be much heat surrounded by the battery as it may catch fire.6Kwh 316V Lithium ion battery is used as it is the best battery suited according to the rules and they give the best mix of power, energy and density at a time. Lithium ion battery is used considering the various advantages like safety, lightweight, longest life, temperature tolerant etc. Coolant case and insulation is given to the battery. Coolant casing is given at the top of the battery . Swapping technology can be used as it helps in reducing time for charging it is a instant process and would be a better option for travelling for longer distances.

Figure 3 : Battery

Electric motor**:** For a formula E car the speed is very important and motor is major part which controls it. Brushless DC motor is being used. It is powered by a direct current voltage supply and is commutated electronically. More popular than conventional DC motors because of its efficiency. In BLDC motor the permanent magnet is attached to the rotor and the current carrying conductors are attached to the rotor. It works on the principle of Lorentz force law, it states that when a current carrying conductor is placed in a magnetic field it experiences a force. The magnet will experience equal and opposite force. The maintenance is very low and has superior thermal stability. Other advantages are high speed of operation, longer life and less noise. Brushless motor with 68KW power rating is being used ,it can produce a peak power of 68kW and a continuous power of 41KW Peak torque of 140Nm and a continuous torque of 80Nm and the efficiency ranges from 92-98%..

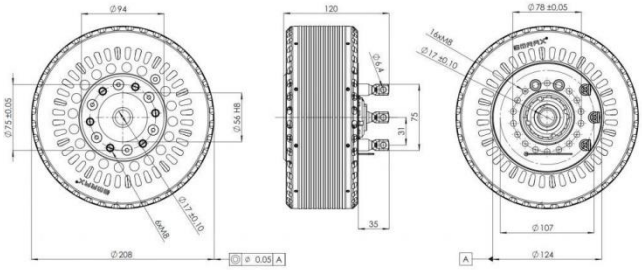

Figure 3: Electric motor

Controller **:** It consists of all the electrical connections and controls the power supply to all the connected sections. It is used to convert the DC supply of the battery to the high frequency ,high voltage for the battery. They can switch more current as faster frequencies.

Figure 4: Controller

WORKING

The working of electric starts by plugging in the charge from the electricity grid. The energy is stored in rechargeable batteries which powers the electric motors and turns the wheel .EV's feel lighter to drive as they accelerate faster. It consists of 3 major sections electric motor, battery and controller. The controller consists of inverter which converts the DC supply of the battery to AC and transmits it to the electric motor which rotates the wheel of the vehicle. Formula E cars can reach a top speed of 280km/h with a power of 250kw and they can accelerate 0-100km/h in 2.8seconds.The speed is varied with the accelerator pedal or

electric throttle. The throttle is connected to the controller which adjusts the speed by varying the varying the frequency of ac power from the inverter to the motor.

Charging of electric vehicles: Electric vehicles can be charged with the normal household sockets with the socket plug of the battery and it may take 6-8 hours for a normal mid range battery to charge and the time may increase depending upon the capacity of the battery .Some EV's support fast charging which charges within 1-2 hours. If the batteries are removable swapping technology can be used.

ADVANTAGES

1. Creates awareness about using sustainable energy through the championship program.
2. Since the fuel or gas prices are high using electric vehicles the money can be saved as the maintenance cost is very low.
3. Environment friendly as it doesn't emit harmful pollutants like CO in the atmosphere.
4. The performance of electric vehicles is better than the fuel combustion vehicles as it is lightweight and has better acceleration.
5. There is no noise produced like the combustion engine .
6. Very efficient and more convenient.

DISADVANTAGES

1. Recharge points are not widely spread.
2. The initial investment is more .The battery costs a lot of amount and has to be replaced in the coming years.
3. It is not much efficient for long range and the speed has to be compromised for the mid range vehicles.
4. The charging time is more .It usually takes 4-5 hours to charge a battery and the cost gets high if the battery swap is practiced .
5. The load carried is slightly low.
6. It is not suitable for places where there is shortage of power or electricity.

CONCLUSION

Formula E is a motorsport where sleek battery powered race cars are used. It has the motive to demonstrate the ability of electric vehicles and create a solution for the clean energy .Envision exists to accelerate the transition to clean, secure, and affordable renewable energy and speed up the mass adoption of e-mobility.

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