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STUDY OF CHALLENGES AND OPPORTUNITIES IN ELECTRIC AUTOMOTIVE INDUSTRY

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ABSTRACT

Electric vehicles, also termed as EV's first were introduced in the middle of 19th century, when the electric power was just starting to grow among the preferred methods for automotive propulsion, back in the day it was an attempt in providing state of ease and comfortability of operation that could not be acquired by the generic fuel powered vehicles of the era. Modern day Electric automation have been the primary method of propulsion the automation industry for around 100 years, but electric powered cars have stayed a common place in different modes of automotive, such as rails and smaller automotive of all kinds. In this research module we have focused on studying about different types of applicable motors in the modern EV's along with case study taking Tesla and Mercedes Benz. as our study focus An electric car might be primarily powered by mechanics of collectors by electricity from an off-vehicular source, or might be contained within a solar energy, nuclear energy and tidal energy to use electricity as energy source. In the 21st century, EV's wet into resurgence because of environmental friendly technological advancements, and an increased weight on renewable energy. A considerable demand for electric automotive grew as the generic fossil fuels are an unstable and non reliable source of energy in the upcoming future and thus a small number of D.I.Y. engineers began to share the technical details required for having Electric automation . The Government incentives to rise the funding for these future electric vehicles were made to come up front, in the United States as well in the European Union.

Keywords: *Electric Vehicles, Electric Automation, Off-Vehicular Source, D.I.Y., European Union.*

Introduction

In the last some decades of technological development, the environmental impact by the fossil fuel based vehicles , alongside the risk of sudden peak oil, led towards a refreshed interest in an electric vehicular transportation era which is not only self-sustainable but is also a way for clean energy resources . EV's are different from fossil fuel powered vehicles in the way that the electricity that is consumed can be regenerated from numerous sources, including the likes of tidal power, nuclear power, hydro power, solar power, and wind power or other suitable combination of them. The carbon footprint and other fumes etc. generation from electric vehicles differentiates depending upon the energy source used and technique for electricity generation. Engines sets working on usual principles of the fuel combustion that only derives the energy through a limited number sources, and usually non-renewable natural oils. One of the major advantages of plug-in or hybrid electric automotive is the concept of regenerative braking, capable of recovering the lost kinetic energy, which is usually lost during braking in the form of heat, as the electricity is then restored to the on-board battery. Norway has the largest market share per capita over the globe, with 4 plug-in electric automobiles per thousand inhabitants as of the year 2013 only. Norway is the very first country with more than 1 in every 100 passenger cars on the roads being a plug-in electric which is a huge feature respecting the fact that future is electric ,In the year 2016, around 29% of most new automotive sales for new vehicles in the country were electricity powered or plug-in hybrids vehicles. Norway even had the world's largest plug-in electric segment market acquirement of total new automotive sales around the world, 13.8% in 2014, making a huge jump from 5.6% in 2013.This basic example shows how fast and rapidly the world is changing, we as a human race need to adapt to the idea of electric as a go to source of power. Electrical automotive are expected to rise from mere 2% of International share in 2016 to a considerable 22% by the end of 2030, however this is still quite a low statistic seeing how ecologically complex and economically expensive the system of fossil fuels and the oil based production of energy is getting.

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Origins

Electric based automation started in 1827, when Ányos Jedlik created the first ever crude and viable electrical motor, equipped with components like rotor, commutator and stator which he then used it to fuel an experimental concept car. As of the year 1835, professor Sibrandus Stratingh who taught at University of Groningen, Netherlands, created an experimental small sized electric car, and between the year 1832 to 1839 (the exact year being uncertain to the available data), Robert Anderson a Scottish invented electric carriage, which was powered by non-rechargeable primary cells which were just beginning to grow back in the day. Around the same time period, early experiment based electrical vehicle were started to be built in order to run on rail tracks. An American based inventor and blacksmith Thomas Davenport created an electric locomotive on toy scale, fuelled by a basic electric motor, in the year 1835. In 1838, a Scottish man Robert Davidson made an electrically powered locomotive capable of attaining speed of 4 mi per hour (app. 6 km/h) which was quite an advancement. In England a patent was issued in the year 1840 for the primary usage of rails in the form of electric current conductor ,same American patents were also granted to Colten and Lilley by end of the year 1847. due to the limitations of storage batteries and lack of other essential technology during that time, electrical automation in vehicles did not become popular, however the case was not the same with electric rails which became extremely popular due to their economical cheapness alongside achievable speeds. By the start of 20th century, electric train transportation became quite common because the advancement in the development of electrical locomotives. Over the course of period their generally acquired purpose was commercial usage and deducted to specialist roles, such as the fork lift trucks, platform trucks, urban delivery, tow trucks and ambulances automotive such as the iconic British truck milk float. the most of the 20th century, the England was internationally biggest user of electrical road automotive . Electric rails were then applied for coal transportation, as the electric motors did not consume O2 in the depths of mines which provided a much better workplace in harsh conditions of those mines..

Electric Motor: The Key Component

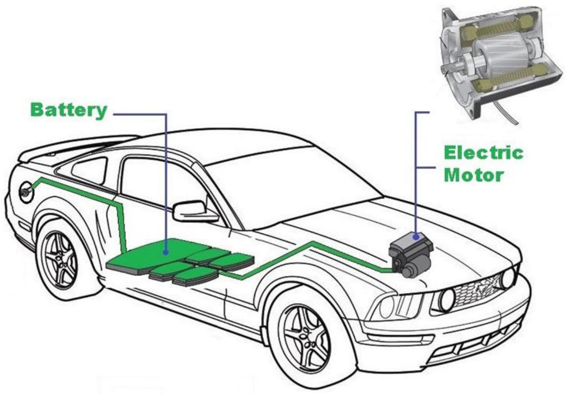

Figure 1: Basic Placement of Electric Motor in Generic Electric Vehicles

Basic elemental unit for the EV’s, beside from the Electrical automation Batteries, which substitutes the IC engines as an Electrical motor. The growth and developments in the area of Powerful electronics and controlling technologies have given a room for different kinds of electrical motors to placed in applied in Electrical automotive. The electrical motors applied for automobile uses must have key features like high power density, substantial efficiency, high starting torque, etc.

The different types of Electrical Motors applied in modern day Electrical automotive:

Literature Review

- Direct Current Series Motor - by Kriti Shrivastava, Prof M.D Pawar
- Brushless Direct Current Motor - by Abbas K. Kadhim, Adel A. Obed
- Permanent Magnet Synchronous Motor (P.M.S.M.) - by Prajakta Shankar Shinde Dr. A.G.T hosar Associate Professor and Head , Punit Lalji Ratnani
- Three Phase Alternating Current Induction Motors - by Atiqah Farhana Khazin, S. Rajendran, K. Anavet
- Switched Reluctance Motors (S.R.M) - by B. Bekkouche ,A. Chaouch, Y. Mezari

D.C. Series Motor

The ability of DC Series motor that places it in a considerably suited choice for applicable in traction for modern day EV's is the high starting torque. It's widespread usage was for its application in traction as in the early years for EV's. Key advantages for the motor are easy basic but must such as speed control and ability to be easily handle a sudden rise in load. All of these features qualify for being an ideal match as traction motor and best suited for purpose. **The Drawback for DC series motor is its high cost of maintenance due to its constituents like commutators and brushes**. These are now applied for Indian railways.

Brushless D.C. Motors

Quite similarly to the DC motor who have the Permanent Magnet, it does not constitute of commutators and brush type arrangements. The commutation for this particular one is done electronically because of this B.L.D.C. motors being maintenance free moreover these motors contain traction features like considerably high efficiency of 95 to 98% and high starting torque etc. These B.L.D.C. are best suited for high density of power and approachable design. B.L.D.C. motors are one of most considered motors for the electrical vehicular application because of the traction characteristics.

B.L.D.C. Motors Further have Two Types

- **Out-Runner B.L.D.C. Motor**

In this, rotor is placed outside along with stator being placed inside. It is referred **Hub motors** because wheel is joined to the outside rotor directly. This motor requirement for an external gearing system is zero, so In some of the scenario, the motor already has an inbuilt system of planetary gears. This motors makes the gross automotive a lot less bulky as the gear system is non present. It also removes the requirement of the space for mounting of motor. However there are restriction on the dimensions of the motor thus limiting output of power in the configuration of inn-runner parameters. This motor is used widely by electrical bicycle manufacturing companies like Spero, Hullikel, Trounx, and light speed bicycles. also manufactured by two-wheeler automotive manufacturing companies like NDS, Eco Motors and 22 motors etc.

- **In-Runner type B.L.D.C. Motor**

For this, the rotor is placed inside along with stator being placed on the outside like the standard motors. This type of motors demand external based transmission system in order for power transferring to wheels, due to this the configuration for out runner is little more bulky in comparison to that of in-runner configuration. Many three-wheeler manufacturing companies like Speedo Vehicles, Volta Automotive, Kinetic Green use B.L.D.C. motors. Medium to low performance scooters are also fitted with B.L.D.C. motors for propulsion. Because of these factors it is majorly considered motor for electric automotive application. **only backlash for B.L.D.C. is the expensive pricing due to usage of permanent magnets.** Overloading the motor reduces the usage life of permanent magnets substantially because the heat factor, therefore it is not suitable for overdrive.

- **Permanent Magnet Synchronous Motor (P.M.S.M.)**

This motor is quite like BLDC motor having the magnets(permanent) placed on the rotor, like BLDC motors even these motors too possess necessary traction features like higher efficiency and high density power . The difference that lies in P.M.S.M. and B.L.D.C. is P.M.S.M contains EMF that is sinusoidal back and BLDC contains trapezoidal back. PMSM are rated for high power ratings. Thus making PMSM the best available option for heavy performance related works like commercial vehicles, PMSM stands as stiff competition for induction motors because of the higher efficiency Han induction motor. PMSM is expensive than BLDC motors. automotive manufacturers apply PMSM motors mostly for their electric (hybrid) automotive. Examples for such automation are,, Chevrolet Bolt EV,, Toyota Prius, zero motorcycles S/SR, Nissan Leaf, Ford Focus Electric, Honda Accord electric, BMW i3,

Phase A.C. Induction Motor

This induction motor does not generate higher starting torque how Direct Current series motors with the fixed voltage and operation on frequency criteria. However these characteristic can be substituted using different types of controlling techniques as F.O.C. and V/F techniques. By using these tricks of controlling, maximum torque can be provided at the starting portion of the 3 phase which is just applicable for traction purposes. cage(squirrel) is the type of induction that is found giving the motors a elongated life because of low maintenance cost. Induction motor is designed to be tuned up to point where the output rate lies at 92 to 95% which is very favourable. **only drawback for a three phase**

induction motor is the requirement of complex and complicated circuit of inverter and handling the motor is complex too. The permanent magnets motor's magnets contribute in the density of flux of B, resulting in easy adjustment the value of B in induction motors in comparison to that of permanent magnet ones and the reason being that in Induction motor adjustment of B's value can be done by changing the frequency and voltage (V/f) on torque needs this gives a hand in deducting losses which then increases the overall efficiency.

The **Tesla Model S** is the perfect suited example for this to show the performance capabilities of **induction motors** when kept one on one to significant counterparts. By choosing for this motor, Tesla might aimed for eradicating the dependency on the permanent magnet which is must requirement for the vehicular travel to be completely independent of mooching of the natural resources. Even the **Mahindra Reva e2o**uses three phase induction motor for the propelling purposes**.** Some huge automotive manufacturing companies such as TATA motor have started to go with Induction motor in their automotive as their primary motor. The two-wheeler manufacturer TVS motors are expected to launch electric based scooter which utilises an induction motor for its primary engine/motor. Induction motor is the major choice for the performance based electric automotive because of its cheaper costing than others. The other advantage is that it can withstand harsh conditions without taking considerable toll. these advantages made the Indian railways to consider replacing their D.C. motors with these new A.C. induction motor as their primary propelling motor.

- **Switched Reluctance Motors (SRM)**

S.R.M. type of motor with varied reluctance along its double salience. Switched Reluctance motor is quite easy to construct and mechanics are simpler than others and are more robust than others. The rotor placed in SRM is component of laminated steel with zero windings and permanent magnet placed on it making inertia for rotor lower resulting in higher speed acceleration. This robustness of SRM places it at a very obvious choice for the velocity related application related vehicles. SRM provides with high density of power which is one of the needed characteristics for Electric automotive since the generated heat is limited to stator only, making it much easier to reduce temperature of the motor down. **The backlash for SRM is amount of complexity input control and considerable increase in the circuits for switching. It lacks in the zone of silence making it quite noisy**. Once SRM is perfected for the commercial vehicle market, it can be used to replace the Induction motors and PMSM as primary propelling in the near future.

Core Challenges in Electric Automation

Future of the automobile industry is pinned on electric vehicles and highly dependent on innovation and mass scale acceptance. When we talk about the challenges in electric automation the challenges that surface the table are majorly application based rather than technological based.

Some of the major faced problems by industry are as follows:

Commercial Challenges

- Limited choice of vehicles
- Backing up the correct technology globally
- The zero-carbon fantasy

Technological Challenges

- The backlash for DC series motor is its maintenance costing which is substantially high due to commutators and brushes.
- BLDC - in-runner type only drawback is the expensiveness due to permanent magnets dependency.
- Drawback for an induction motor lies in the requirement of complexity in an inverter circuit and controlling of motor is complicated.
- PMSM Motor :- VFD control techniques increase complexity

Limited Choice of Vehicles

In the current scenario the global roads utilise oil based vehicles and the manufacturers produce the models according to the at the point availability it is quite difficult for the manufacturers do release the models without the threshold demand, resulting in less number of available models and designs to choose from.

Backing up the Correct Technology Globally

There are fast developments happening in charging in battery technology, but this is also root cause of deep uncertainty, on which of them becoming the go through for the vehicles, so the construction is stagnant to take a global turn, This is problem is particular for people living in apartments and houses lacking private parking spaces which accounts for most of the common mass this uncertainty about selecting the correct approach has become the most general slow down for investment area in private sector, charging structures making already delayed change affected for the worse. It also makes the job of local authorities more complex as dealing with the problem becoming severe. Acting too soon in single direction could mean betting on the wrong horse causing billions of dollars to go to waste. Waiting for too long can result in encouraging more people towards hybrid vehicles, which are even though less dependent on charging infrastructure, but still use the fossil fuels, which is just delaying the inevitable which can lead to a generational gap for the EV era for which we do not have time viewing the rapid oil exhaustion and global warming.

Fantasy for Zero Carbon

Even one hundred percent fully electrically supported automotive are not a solution for no carbon emissions. They might not be emitting the usual exhaust pipe fumes but still all generated electricity was from natural sources, there still remains an environmental debt like mineral sourcing as requirement for batteries then dismantling of the deteriorated batteries, manufacturing and delivering worldwide has its fair share of substantial carbon emissions. That is why it's impossible to break all of the links in the carbon emission chain with our current state of technology.

Electric automotive are an important part of global attempts to considerably deduce transport carbon emission, yet that is not easy as said.

High Maintenance

In order to make electric cars a commodity for daily transportation the prices are expected to be low in order to make common mass follow the change, however the electric battery used are mostly expensive and high maintenance making it difficult to produce the vehicles at a cheaper rate.

Tesla Model - S

Table 1: Tesla Model s Specifications

Manufacturer	Tesla, INC.
Body Style	5-DOOR LIFT-BACK standard design
Layout	1.REAR MOTOR- REAR WHEEL DRIVE 2. DUAL MOTOR ALL WHEEL DRIVE
Electric Motor	825 BHP{615 KW}, 960LB-FT THREEPHASE A.C INDUCTION MOTOR
Transmission	1 SPEED-FIXED GEAR
Battery	100 kWh BATTERY -LITHIUM ION
Electric Range	75 kWh 249-259 mi 85 kWh 253-272 mi 90 kWh 270-294 mi 100 kWh 348-390 mi
Plug in Charging	SUPER CHARGER AT 150 TO 200 kW
Wheelbase	116.49 in
Length	195.89in
Width	77.29 in (without mirrors) 86.19 in (with mirrors)
Height	56.49 in (1440 mm)
Curb Weight	4323-4690 Lb

Construction and Working

- **Three Phase Induction Motor : Lifeline for Tesla**

The Tesla model is currently world fastest accelerating car, the car primarily powers from standard lithium ion battery and above synchronised vehicle mechanism, the model s primarily runs on three phase A.C. induction motor, containing prime parts stator and rotor, the three A.C In the coils generated rotatory magnetic-field which is a four pole field for Tesla specifically, this magnetic field which is rotating induces the current on bars of the rotor to rotate, as three phase standard induction motor the rotor is always lagging behind the R.M.F. A three phase standard induction motor it neither contains brushes nor any permanent magnets and still being robust and powerful at the same time. The excellence of an induction motor lies in speed dependency upon frequency of an AC power supply hence by changing the frequency of the supply of power slightly we are made able to drive speed of wheel according to will thus making speed control of an electric based vehicle easy and much more reliable, since the supply for motor is from variable frequency drive which controls the motor speed in turn, thus the motor speed rise from 0 to 18000 rpm making it the most sizeable advantage over IC engine cars. Because an IC engine produces usable torque and power output within limited speed range only the rotation of directly connected engine to the wheel for drive is not a very smart idea, the transmission must be placed in order to differentiate the speed whereas in case of induction motor the speed variation is directly controllable. Moreover I.C. engines never produces rotational motion that is direct so the motion of the piston that is linear is needed to be converted into standard rotational motion and this originates some major problems in balancing the vehicle. Since the IC engine is not the self started kind the induction motor output for power is mostly uneven and thus multiple external features are required in order to resolve the problems on the other scenario electric vehicles have direct motion that is rotational and power output is uniform with a three phase ac induction motor. Many parts hence can be bypassed here so ratio of power to weight naturally gives out a superior performance than counterpart. since motor is powered from battery, D.C. power is produced so before the supply of power gets to the motor it certainly needs to be turned to AC. Thus an inverter is applied for this purpose, because frequency of ac power is also controlled by this thus controlling speed of motor as well, the amplitude of the AC power is also varied by the inverter which in turn controls the output of power of motor thus acting as brain for vehicle.

- **The Battery Pack** : there are a number of common lithium ion cells placed together t work as a big battery, the cells are connected in a combination of parallel and series in order to produce the power needed to run the electric vehicles, standard **in order to keep the heat in check glycol coolant is used, the fluid tubes are set up in such a manner that they go through gaps between the cells, this is one of the most fundamentally innovative way Tesla did for the battery by using lot of small cells instead of few large ones thus minimising thermal hotspots and maximising battery efficiency and life since the effective cooling is certainly guaranteed,** The cells are placed in sets of numerous module and are 16 modules placed in battery pack constituting of a whopping seven thousand cells.
- **Cooling System**: the heated glycol temperature is lowered by passing through a radiator which is placed in-front of car. Moreover the battery is placed substantially low to lower centre of gravity providing it with much more stability and smoothness. The battery is fitted across the floor securing structural rigidity for the slide collisions

- **Tesla's Drivetrain**

The transferring of the generated power by motor in order to the drive wheel is done by a gear box as studied Tesla model S utilises a simple transmission of single speed because of motor being efficient in an extremely varied range of operation, since the motor velocity is reduced in two set process , the reverse gear functionality is easy to obtain in an electric car just by changing the power phase order for this will do the trick. The transmission in an electric car is placed for reasons for reduction of speed along with its associated multiplication of torque, the second component that is placed in the gear box is differential the reduced speed of drive is past to it, it has a differential that is open, but the open differential suffers from the problem with controlling the traction but still it is preferred over limited slip differential because open differential is roughed and carries more torque, thuproblemof traction can be overcome by the method of selective braking and lower supply disconnection, in an internal combustion engine the supply of power is reduced by cutting short the supply of fuel but it is not highly responsive however in the case of induction motor power supply can be quite effective.

- **Tesla's Innovation in Braking Systems**

The model S is officially certified to be capacitive to be driven by just accelerator because of their powerful regenerative braking system that they place and also results in Saving a huge amount of kinetic energy of the vehicle as electricity by not letting it off as heat and also helping in maintaining the cool temperature. when the accelerator released the placed regenerative braking system activates , here is thing is that when regenerative braking is taking place the induction motor starts to act like a generator. Here the wheels then drive the placed rotor of the three phase induction motor, Since 3 phase ac motor speed of rotor is less than speed of RMF so in order to convert motor to a generator it has to be made sure that speed of rotor is greater than speed of RMF. Hence the inverter plays a important role by adjusting input frequency of power and maintaining the speed of RMF lower than speed of rotor that originates the electricity in coils of stator relatively much higher than the provided amount of electricity, the generated electricity is then stored in the battery after the transformation an opposing electromagnetic force is then applied on rotor between the process so that driving wheels and the vehicle slows down . This way speed of vehicle is controlled precisely during the drive using only accelerator pedal also the provided brake pedal can be applied for a complete stop.

- **Safety and Smoothness and Economical Factors**

The electric cars are far more safer than the internal combustion cars that is due to less heat engagement and internal combustions, also the crumble space is much more providable in electric vehicle making it quite comfortable even with luggage. The pricing of driving and maintaining electric vehicle is far lower than internal combustion automotive, with the minor drawbacks removed with improved technology electric cars pave a bridge to the future.

Mercedes-Benz EQC

The EQC is based on concept of EQ that is Mercedes official trade mark for electric generation of Benz and was unveiled at 2016 Paris motor show, and The final production for commercial version was debuted in Sweden on 4th September, 2018 and the car publicly unveiled during the Paris motor show of 2018 .While EQC runs primarily in the front wheel drive mode, rear sided placed electric motor is activated when serving is required with extra performance when floor is throttled.

The Mercedes-Benz EQC runs on the same motor as the Tesla model Sbut the change is that Tesla only uses a single motor, the EQC whereas uses two motors one on either ends, the front motor is the primary driver for the vehicle and the second motor is used for the extra power and performance when so ever needed.

Table 2: Specifications for Mercedes Benz EQC

Manufacturer	Mercedes Benz
Production	2019- Present
Class	Compact SUV
Body Style	5 Door SUV
Layout	Dual Motor-All Wheel Drive
Engine	2X Asynchronous
Transmission	Single Speed Fixed Ratio
Battery	80 KWH Lithium Ion
Range	220 MI - 259 MI
Plug in Charging	7.4 KW AC- 110 KW DC
Wheelbase	2874 mm
Length	4760 mm
Width	1883 mm
Height	1623 mm
Kerb Weight	2425 KG

Construction and Working

- **X Asynchronous Motor: Blasting Performance at its Peak**

Sometimes revolutions start very quietly, the pioneering E- drive technology is only revealed when the innovation is maxed at its peak, developed specifically for the EQC the vehicles has an electric drive unit on the front axle and another on the rear axle , the two electric motors the two staged one speed transmission including a differential casing and cooler the battery at the bottom of the vehicle and power electronics including the software from the highly compact and fully integrated unit. The unit integral overall concept which also incorporate the cooling system is designed for high efficiency, the two electrical drive units are closely related in technical terms but in order to reduce energy consumption and increased dynamics each is designed in different respects, the front motor is geared towards the best possible available efficiency for low or medium load range while the rear ended motor boosts up the dynamics, in costing and braking operations the mechanical rotation is converted into electrical energy charging the high voltage battery at the vey same time, Torque shifting allows the fully dynamic torque distribution between front and rear axle in order to ensure an ideal balance between performance and efficiency as a result the EQC has superior characteristics of a four wheel drive, driving with foresight and thus efficiently. The battery is positioned low in the vehicle between the front and rear axles, the entire battery system is cooled at low temperature by liquid cooling the heater for the battery ensures the best possible

performance efficiently, depending on the cycle the powerful high voltage battery allows for a range of 450 kms in single charge, the EQC comprises of a water cooled on board charger as standard and as such is prepared for charging using alternating current at home and at public charging stations , a much faster charging option is a Mercedes-Benz wall-box and it is even faster with combined charging system allowing rapid charging with direct current.

- **Internal drive assistance and system control innovation:** navigation and traffic sign recognition by intelligent AI and information from the artificially intelligent safety assistant system are all used in actively for this purpose. when it comes to implementing this effective efficiency the eco assist driver system comes into play and provides with the extensive support with functions of targeting and coasting management of recuperation. tailor made for EQC the Mercedes-Benz engineers focused particularly on the interaction between the dynamic and performance combined with high level efficiency and performance and convenience .

As the slogan says “driving experience in intelligent drive”.

- **Intelligent Braking :** Another striking feature is that active brake assistance with the active pedestrian detection and complete stoppage assurance, using the similar systems like Tesla’s braking system the system is integrated with the artificial monitoring to peak the efficiency of braking, (exact details on braking systems have been kept confidential). However with some in depth study some of the details were been figured out like the active brake assistance is also combined with vehicle detection, active braking assistance with congestion emergency braking function.

Future is Elecric

In these modern times when the public, the common mass depends upon vehicular travel as a go to the powerhouse for these vehicles have been the fossil fuels that we have been extracting as our primary of energy , however due to the considerable usage and pollution caused both noise and air the upcoming times require a much more efficient and environment friendly and that source being electric energy,

In this research module we discussed the advanced vehicular automotive technology that is the key to revolutionise the industry, as the title says future is electric the numerous opportunities that come in the path of changing the global perspective into a much safer and sound surroundings sustaining the nature and advancing the technology the better the place earth will become

The given chart is a basic description on how going fully electric opens our gates to a new and advanced world.

Table 3: Basic Advantages and Disadvantage Discussion

Advantages	Diadavantages
Extreme high performance	Comparatively Long charging time (20-25)mins
High responsiveness	Lower travel range
Noise less travel	Expensive pricing
Lower maintenance cost	NA
Highly safe	**NA**
Single speed transmission	NA
High Torque and power	NA
Effective traction control	NA

The prime benefit of electrical vehicles is the contributing towards improving quality of air in villages, towns and cities. Since there are no tailpipe, 100% electrically based vehicles can produce no carbon emissions specially Co2 when they are being driven. This substantially reduces the air pollution. To put it simply, the electric vehicles provide us with cleaner roads making our own villages, cities and towns better places for the cyclists and pedestrians. In a year, only one electric vehicle can save around 1.5 million grams of Co2 emissions so it's thinkable how benefited we will be going full electric.

Researches into the reuse of second-hand batteries in new profound technologies such as storage of electricity containers are going in full swing. One day we would have batteries fitted in homes being used in order to store energy to power the vehicles. These type of Opportunities will considerably reduce the lifetime of impact on environment by battery manufacturing.

Even after calculating battery manufacturing into account, electric automotive still holds up as much greener option. This is because of the reduction in emissions in over the lifetime of a car. Many sections of people still question how production of green electricity that is required to power an electric car really is, so in order to answer that research by European industries came up with results that, even with generation of electricity for the manufacturing purposes, the emissions of carbon in an electric automotive is still only 17 to 30% lower than an internal combustion car. The emission generation of electricity are also improved drastically when low carbon electricity is used.

Conclusion

In this research module we did a subjective study on the challenges and opportunities in the field of electric automation, we discussed different type of electric motors their features and drawbacks and their applications in automation industry, throughout the module the main focus of the study was to emphasise on the possible automation of the future which is completely electric based keeping in mind the ample amounts of positive effects that will occur on the environment, not only we studied the in-depth functioning of the electric cars we did an ample amount of study of the Tesla and Mercedes that are currently the leading world producers in the field of electric automation, we found out how with the current technology can be merged with the developed softwares and how the computer sciences and the mechanical systems can be merged together to form the advance technologies for the future. The study has taught us how the basic fundamental mechanical objectives are completing the much required innovation by bending the rigid construction of contemporary mechanics,

We also learned about the challenges faced by the automotive industry and the means to resolve them as well, however some of the challenges that are not technological but commercial and economical and the factors that are not in control of the industrial manufacturers but are affected by it, in order to resolve those challenges the progress is being made continuously.

With a word of thanks the research module comes to a completion.

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