

REPORT ON 1 WEEK INTERNSHIP IN NSIC
ELECTRIC VEHICLE

Submitted in partial fulfillment of the requirements for the
Completion of

PROFESSIONAL TRAINING

BY

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND
TECHNOLOGY(DEEMED TO BE UNIVERSITY)**

Accredited with grade “A++” by NAAC

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

BONAFIDE CERTIFICATE

This is to certify that this Internship Report submitted for EPICS is the bonafide work of K.K.YUVARAJHAN (41140098) who carried out the Internship during the period May 2023 to June 2023.

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CHAPTER 1

ABOUT THE COMPANY

National Small Industries Corporation (NSIC) is an ISO 9001:2015 certified Government of India Enterprise under the Ministry of Micro, Small, and Medium Enterprises (MSME). NSIC has been working to promote aid and foster the growth of micro, small, and medium enterprises in the country. NSIC operates through a countrywide network of offices and Technical Centers in the Country. In addition, NSIC has set up Training cum Incubation Centre managed by professional manpower

1.1 SCHEMES OF NSIC

NSIC facilitates Micro, Small, and Medium Enterprises with a set of specially tailored schemes to enhance their competitiveness. NSIC provides integrated support services under Marketing, Technology, Finance and other Support Service.

1.2 MARKETING SUPPORT

Marketing has been identified as one of the most important tools for business development. It is critical for the growth and survival of MSMEs in today's intensely competitive market. NSIC acts as a facilitator and has devised several schemes to support enterprises in their marketing efforts, both in domestic and foreign markets. These schemes are briefly described as under:

1.2.1 TENDER MAKING

Small Enterprises in their capacity face problems in procuring & executing large orders, which deny them a level playing field Vis-a'-vis large enterprises. NSIC forms consortia of Micro and Small units manufacturing the same product, thereby pooling in their capacity.

NSIC applies the tenders on behalf of a single MSE/Consortia of MSEs to secure orders for them. These orders are then distributed amongst MSEs in tune with their production capacity.

1.2.2 SINGLE POINT REGISTRATION

NSIC enlists Micro and Small Enterprises (MSEs) under the Single Point Registration Scheme (SPRS) for participation in Government Purchases. The units enlisted under the Single Point Registration Scheme of NSIC are eligible to get the benefits under Public Procurement Policy for Micro & Small Enterprises (MSEs) Order 2012 as notified by the Government of India, Ministry of Micro Small & Medium Enterprises, New Delhi vide Gazette Notification dated 23.03.2012 and amendment vide order no. S.O. 5670(E) dated 9th November 2018. The enlistment under SPRS is completely online. Login: www.nsicspronline.com

- Issue of the Tender Sets free of cost.
- Exemption from payment of Earnest Money Deposit (EMD),
- In tender participating MSEs quoting price within a price band of L1+1percentnt shall also be allowed to supply a portion up to 25% of the frequirement by bringing down their price to L1Price, where L non-MSEs
- Consortia facility for Tender Marketing.

1.3 INTERNATIONAL CONSULTANCY SERVICES

For the last five decades, NSIC has acquired various skill sets in the development process of small enterprises. The inherent skills are being networked to offer consultancy services for other developing countries. The areas of consultancy are listed below:

1. Capacity Building
2. Policy & Institutional Framework
3. Entrepreneurship Development
4. Business Development Services

CHAPTER 2

NATURE OF WORK DONE

What is an electric vehicle?

An EV is defined as a vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source. An EV includes both a vehicle that can only be powered by an electric motor that draws electricity from a battery (all-electric vehicle) and a vehicle that can be powered by an electric motor that draws electricity from a battery and by an internal combustion engine (plug-in hybrid electric vehicle).

Evolution of electric vehicle:

Electric Vehicle was first popularized as a term in the early 1800s, but the EV has been around much longer. William Morrison of Des Moines, Iowa, invented the first practical electric car in the United States. His automobile is hardly more than an electrified wagon, but it captivates people's curiosity about electric vehicles.

It was in 1901 that many inventors were taking note of the electric car's huge demand and working to enhance the technology. For example, Thomas Edison believed that electric cars were the superior means of transportation and tried to develop a better battery.

- **1908 -1912:** Electric vehicles became popular in the United States around the turn of the century,
- **1968 – 1973:** Over the following 50 years or more, cheap, abundant gasoline and ongoing advancements in the internal combustion engine reduced the necessity for alternative fuel vehicles. However, throughout the 1960s and 1970s, petrol costs climbed, boosting interest in electric cars.
- **1973:** Many large and small automakers began to investigate alternative fuel vehicle possibilities. For example, General Motors created a prototype for an urban electric automobile, which it displayed at the First Symposium on Low Pollution Power Systems Development in 1973.

- **1974 – 1983:** Sebring-CitiCar vanguards are a successful electric vehicle at that moment. More than 2,000 CitiCars are manufactured by the firm, which is a wedge-shaped small automobile with a range of 50-60 miles. Due to its popularity, Sebring-Vanguard became the sixth-largest carmaker in the United States by 1975.
- It was the same period when hybrid versions of EVs were released. As EVs gained popularity in the United States in the 1900s, the total EVs comprised 33% of the automobile industry. However, it was also the time when its popularity began to decline. Because, at that time, EVs failed to over long-distance and were less advanced, the liking for motor cars increased. Roads and transportation became better, and because of slower speed and range, fuel cars took over EVs.
- But later in the early 1960s and 1970s, the need for electric vehicles started increasing slowly because of increasing fuel prices and environmental concerns. However, it was not until the 1990s when the EVs finally got a noticeable push.

EV Revolution today

In today's era riddled with issues of global warming and emphasis on cutting carbon emissions, the increased production and uptake of EVs looks inevitable.

According to a McKinney study, the EV industry will explode by 2030, with the US seeing a 32% increase in its sales, China from 7% to 34%, and Europe will see a 5 to 6 times increase in its sales. And in the case of India, we can expect 30% of vehicles to be electric by 2030.

EVs today have penetrated the automobile industry and come in two-wheelers, three-wheelers, and four-wheelers. There are many prime electric leaders in the industry, setting the pace for the EV evolution.

Today's EVs are more advanced than their previous versions. The price of batteries is reducing every year, which has also made them more accessible and in demand.

Additionally, some vital drivers like conducive government policies and incentives and infrastructural development have further ramped up EV production and penetration in the last decade. And hopefully, we will continue to see EVs evolve for affordable mobility in the future.

CHAPTER 3

METHODS AND PROCESSES

3.1 ELECTRIC VEHICLE DESIGN

There are numerous differences in how EVs are manufactured when compared to ICE vehicles. The focus used to be on protecting the engine, but this focus has now shifted to protecting the batteries in manufacturing an EV. Automotive designers and engineers are completely rethinking the design of EVs, as well as creating new production and assembly methods to build them. They are now designing an EV from the ground up with heavy consideration for aerodynamics, weight, and other energy efficiencies.

The single biggest modification of the car is the underbody. While this structure has been very similar in the past, with EVs there is no engine and there are no exhaust systems needed. There is an aerodynamically designed full belly pan under the EV that contains trays where the battery pack is placed. With more and more variations and shapes of battery packs available for different models, the challenge is to be able to make these variations on one Flexible Manufacturing System (FMS). Since all EV battery cells are quite heavy, flexible robotic lines are necessary.

In addition, FMS production lines must accommodate many new robotically performed joining methods. In many instances, spot welding is being replaced by increased use of self-piercing rivets, gluing, sealing, flow drilling, and laser welding — and are specifically chosen depending on the tray used for each particular type of battery cell.

The EV's inner structure is called a "space frame" and is made of strong, lightweight aluminum — and for additional weight-savings; the wheels are also made of aluminum instead of steel. Using manufacturer's molds, these aluminum parts are poured at a foundry. In addition, the steering wheel and seat frames are made of magnesium, a strong, lightweight metal. Even the body panels are made of lightweight aluminum or an impact-resistant composite plastic. Both materials are recyclable, providing long-term disposable advantages.

3.2 Manufacturing process

Automotive engineers, as well as manufacturing professionals, have given the EV manufacturing process as much design consideration as the overall design of the vehicle itself. To illustrate how EV manufacturing can be accomplished we've taken a brief look at how Tesla builds its EVs using many high-tech robotic approaches.

Tesla's goal to sell 20 million vehicles by 2030 will undoubtedly be realized. With EV sales projected to hit 300 million by 2030, Tesla and other manufacturers will be working at a break-neck pace to meet consumer demand.

3.2 .1 BODY ASSEMBLY

The body assembly process begins with coils of aluminum of different gauges, which are uncoiled into a blanking machine that flattens the metal into blanks. The blanks are then fed into an enormous stamping press. At this stage, large custom-made dies form the body panels, which are then transported to the body center.

This is where the EV begins to be assembled — starting with the underbody, which is the main floor system of the EV where the batteries are seated. The body sides are then added to provide internal reinforcement as well as the outer skin. Inside the framing is where the body sides, the underbody, and the front end of the vehicle are all married together.

3.2.2 GENERAL ASSEMBLY

The Tesla EV is assembled from the inside out. Automation is used to the fullest — as the same robot that installs the seats, then changes tools to position the windshield, apply adhesive, and seat it on the vehicle. In total, about 1,000 robots perform very diverse tasks in the production of the Model 3. Since robots are extremely good at repeatability and accuracy of motion needed, employees are utilized in more flexible situations where human intelligence is required.

EV manufacturing is unique in that many of the components are completely different than for traditional ICE-powered vehicles, including the drive units, battery pack, and battery modules. Many of those components did not previously exist, which required Tesla to build them. However, there are also thousands of fewer components in an EV, so it only takes about two days for a Tesla Model 3 to go from raw material to a completed vehicle.

CHAPTER 4

KNOWLEDGE AND EXPERIENCE

4.1 KNOWLEDGE OF EV

4....2 TYPES OF EV

- Battery electric vehicle (BEV)
- Hybrid electric vehicle (HEV)
- Plug-in hybrid electric vehicle (PHEV)
- Fuel cell electric vehicle (FCEV)

4.2.1 BATTERY ELECTRIC VEHICLE

BEVs are also known as All-Electric Vehicles (AEV). Electric Vehicles using BEV technology run entirely on a battery-powered electric drivetrain. The electricity used to drive the vehicle is stored in a large battery pack which can be charged by plugging into the electricity grid. The charged battery pack then provides power to one or more electric motors to run the electric car

WORKING PRINCIPLE OF BATTERY ELECTRIC VEHICLE

- For the electric motor, power is transformed from the Direct Current (DC) battery to alternating current (AC).
- The accelerator pedal sends a signal to the controller, which modifies the frequency of the AC flowing from the inverter to the motor to regulate the vehicle's speed.
- The motor connects to and rotates the wheels through a gear. When the brakes are applied or the electric vehicle is decelerating, the motor transforms into an alternator and generates electricity, which is then returned to the battery.

EXAMPLE OF BATTERY ELECTRIC VEHICLES

- Tesla Model 3
- Tesla X
- Toyota Rav4
- BMW i3
- Karma Revera
- Kia Soul

ARCHITECTURE OF BEV

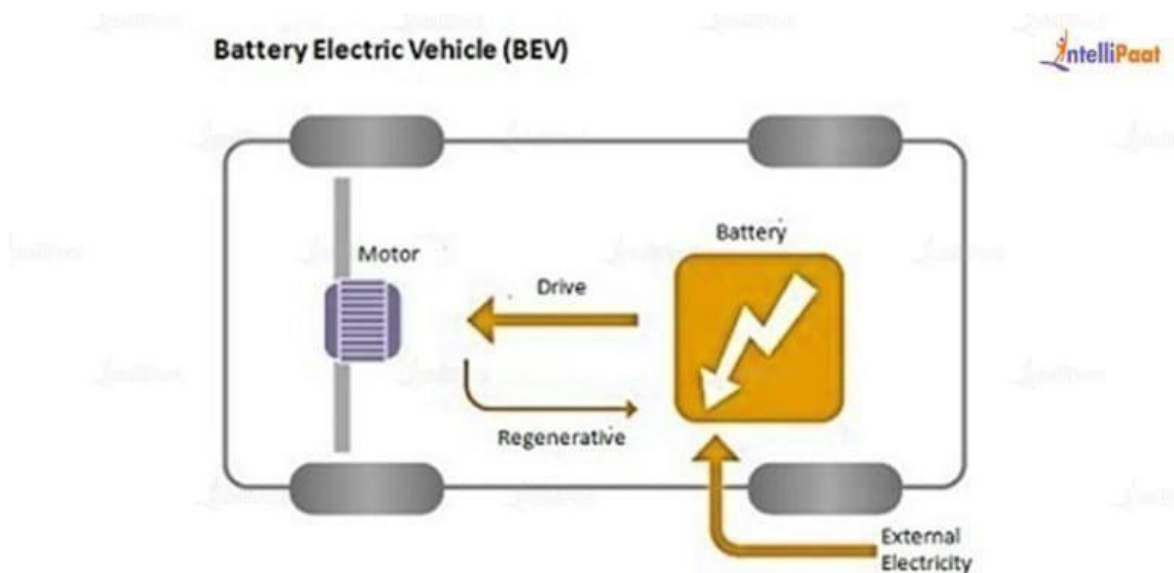


Fig 1. BEV

4.2.2 HYBRID ELECTRIC VEHICLE:

HEVs are also known as series hybrid or parallel hybrid. HEVs have both engines and electric motors. The engine gets energy from fuel, and the motor gets electricity from batteries. The transmission is rotated simultaneously by both the engine and the electric motor. This then drives the wheels

WORKING PRINCIPLE OF HYBRID ELECTRIC VEHICLE:

- similar to a standard automobile that has a fuel tank that delivers gas to the engine.
- It also contains a battery pack that powers an electric motor.
- Both the engine and the electric motor may turn the gearbox simultaneously.

EXAMPLES OF HYBRID ELECTRIC VEHICLES:

- Toyota Prius Hybrid
- Toyota Camry Hybrid
- Honda Civic Hybrid

ARCHITECTURE OF HEV:

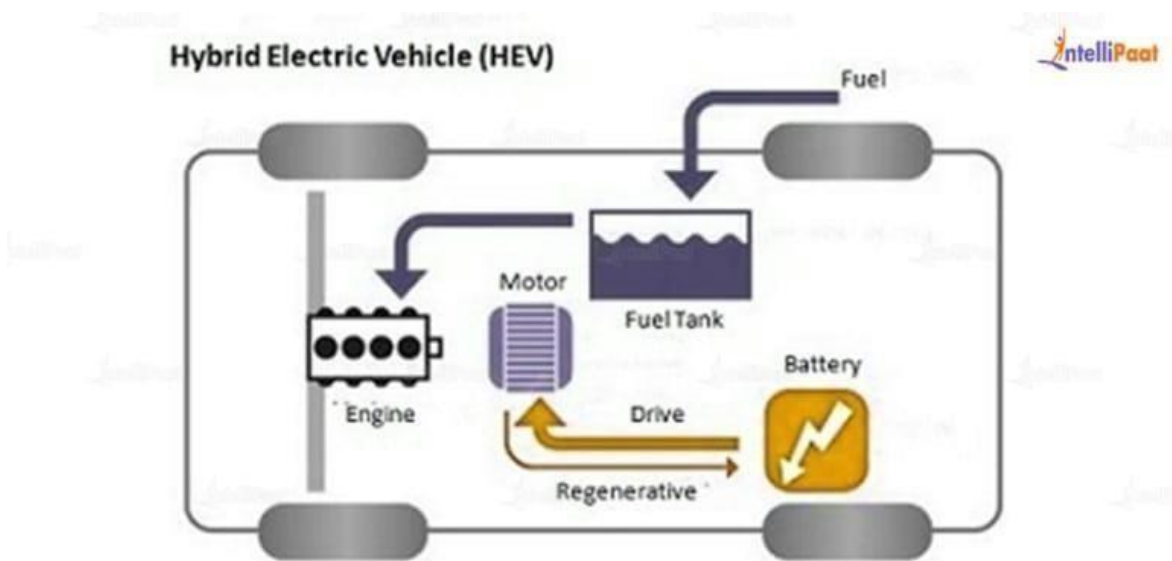


Fig 2. HEV

4.2.3 PLUG-IN HYBRID VEHICLE:

The PHEVs are also known as series hybrids. They have both an engine and a motor. You can choose among the fuels, conventional fuel (such as petrol) or alternative fuel (such as bio-diesel). It can also be powered by a rechargeable battery pack. The battery can be charged externally.

WORKING PRINCIPLE OF PHEV:

- PHEVs normally start in all-electric mode and run on energy until their battery pack runs out of juice.
- When certain models reach highway cruising speeds of 60 or 70 miles per hour, they switch to hybrid mode.
- When the battery runs out, the engine kicks in and the car works as a standard, non-plug-in hybrid.
- PHEV batteries can be charged by an internal combustion engine or regenerative braking, in addition to connecting to an external electric power source.

- During braking, the electric motor functions as a generator, transferring energy to the battery. Because the electric motor supports the engine's power, smaller engines can be used, enhancing fuel efficiency without sacrificing performance.

EXAMPLES OF PHEV:

- Porsche Cayenne S E-Hybrid
- BMW 330e
- Porsche Panamera S E-hybrid
- Mercedes GLE550e
- Hyundai Sonata
- BMW X5 xdrive40e

ARCHITECTURE OF PHEV:

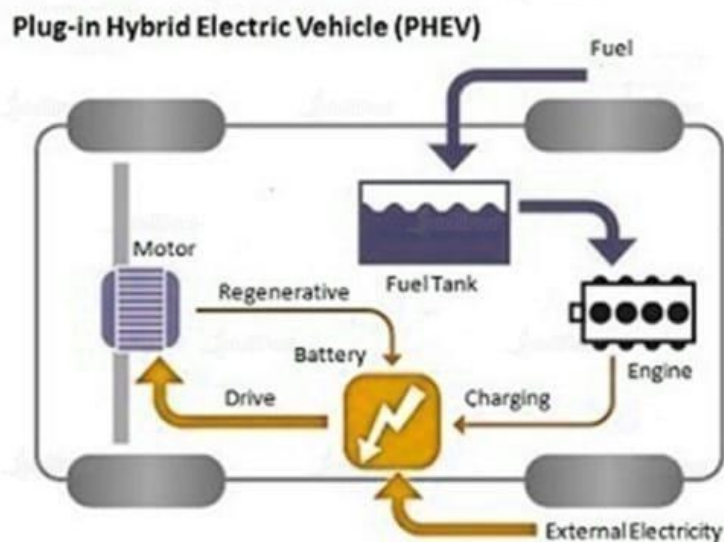


Fig 3. PHEV

4.2.4 FUEL CELL ELECTRIC VEHICLE

FCEVs are also known as Zero-Emission Vehicles. They employ 'fuel cell technology' to generate the electricity required to run the vehicle. The chemical energy of the fuel is converted directly into electric energy.

WORKING PRINCIPLE OF FCEV:

- The operation of a 'fuel cell' electric car differs from that of a 'plug-in' electric vehicle.
- This sort of electric car exists because the FCEV creates the electricity needed to power the vehicle.

EXAMPLES OF FCEV:

- Hyundai Tucson FCEV
- Honda Clarity Fuel Cell
- Riversimple Rasa
- Toyota Mirai
- Hyundai Nexo

ARCHITECTURE OF FCEV:

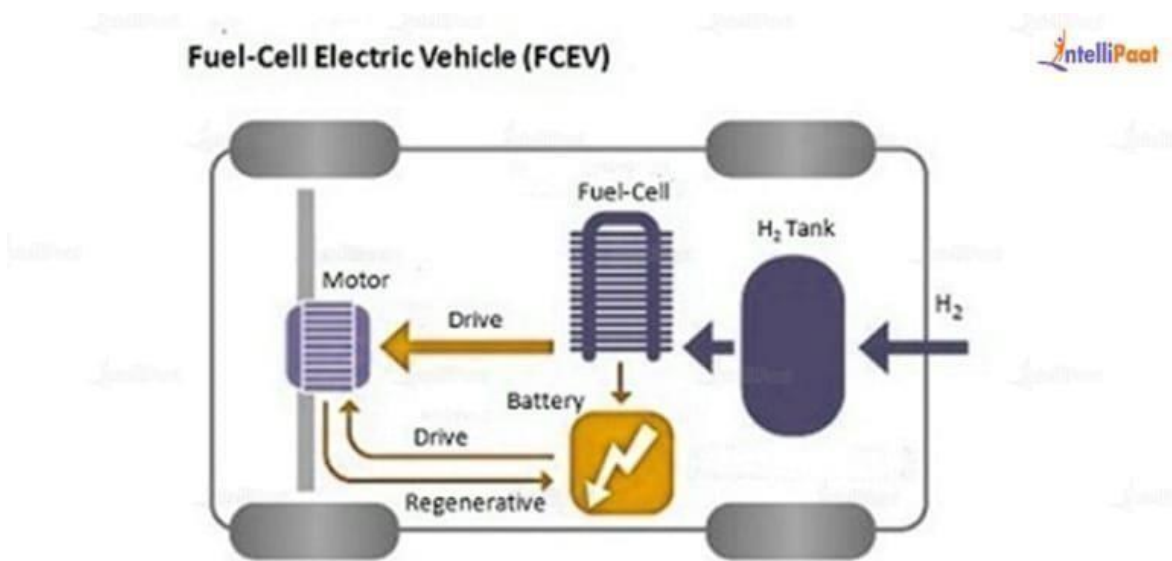


Fig 4. FCEV

4.3 TYPES OF ELECTRIC MOTORS USED INEV:

- DC Series Motor
- Brushless DC Motor
- Permanent Magnet Synchronous Motor (PMSM)
- Three Phase AC Induction Motors
- Switched Reluctance Motors (SRM)

4.3.1 DC SERIES MOTOR:

High starting torque capability of the DC Series motor makes it a suitable option for traction application. It was the most widely used motor for traction application in the early 1900s. The advantages of this motor are easy speed control and it can also withstand a sudden increase in load. All these characteristics make it an ideal traction motor. The main drawback of DC series motor is high maintenance due to brushes and commutators. These motors are used in Indian railways. This motor comes under the category of DC.

4.3.2 BRUSHLESS DC MOTOR:

It is similar to DC motors with Permanent Magnets. It is called brushless because it does not have the commutator and brush arrangement. The commutation is done electronically in this motor because of this BLDC motors are maintenance free. BLDC motors have traction characteristics like high starting torque, high efficiency around 95-98%, etc. BLDC motors are suitable for high power density design approach. The BLDC motors are the most preferred motors for the electric vehicle application due to its traction characteristics. You can learn more about BLDC motors by comparing it with normal brushed motor. brushless dc motor further have two types they are,

1. Out-Runner type BLDC motor
2. In –Runner type BLDC motor

Out – Runner type BLDC motor:

In this type, the rotor of the motor is present outside and the stator is present inside. It is also called as Hub motors because the wheel is directly connected to the exterior rotor. This type of motors does not require external gear system. In a few cases, the motor itself has inbuilt planetary gears. This motor makes the overall vehicle less bulky as it does not require any gear system. It also eliminates the space required for mounting the motor. There is a restriction on the motor dimensions which limits the power output in the in-runner configuration. This motor is widely preferred by electric cycle manufacturers like Hullikal, Tronx, Spero, light speed bicycles, etc. It is also used by two-wheeler manufacturers like 22 Motors, NDS Eco Motors, etc.

In- Runner type BLDC motor:

In this type, the rotor of the motor is present inside and the stator is outside like conventional motors. These motor require an external transmission system to transfer the power to the wheels, because of this the out-runner configuration is little bulky when compared to the in-runner configuration. Many three- wheeler manufacturers like Goenka Electric Motors, Speego Vehicles, Kinetic Green, Volta Automotive use BLDC motors. Low and medium performance scooter manufacturers also use BLDC motors for propulsion. It is due to these reasons it is widely preferred motor for electric vehicle application. The main drawback is the high cost due to permanent magnets. Overloading the motor beyond a certain limit reduces the life of permanent magnets due to thermal conditions.

4.3.3 PERMANENT MAGNET SYNCHRONOUS MOTOR(PMSM):

This motor is also similar to BLDC motor which has permanent magnets on the rotor. Similar to BLDC motors these motors also have traction characteristics like

high power density and high efficiency. The difference is that PMSM has sinusoidal back EMF whereas BLDC has trapezoidal back EMF. Permanent Magnet Synchronous motors are available for higher power ratings. PMSM is the best choice for high performance applications like cars, buses. Despite the high cost, PMSM is providing stiff competition to induction motors due to increased efficiency than the latter. PMSM is also costlier than BLDC motors. Most of the automotive manufacturers use PMSM motors for their hybrid and electric vehicles. For example, Toyota Prius, Chevrolet Bolt EV, Ford Focus Electric, zero motorcycles S/SR, Nissan Leaf, Honda Accord, BMW i3, etc use PMSM motor for propulsion.

4.3.4 THREE PHASE AC INDUCTION MOTORS:

The induction motors do not have a high starting torque like DC series motors under fixed voltage and fixed frequency operation. But this characteristic can be altered by using various control techniques like FOC or v/f methods. By using these control methods, the maximum torque is made available at the starting of the motor which is suitable for traction application. Squirrel cage induction motors have a long life due to less maintenance. Induction motors can be designed up to an efficiency of 92-95%. The drawback of an induction motor is that it requires complex inverter circuit and control of the motor is difficult. In permanent magnet motors, the magnets contribute to the flux density B . Therefore, adjusting the value of B in induction motors is easy when compared to permanent magnet motors. It is because in Induction motors the value of B can be adjusted by varying the voltage and frequency (V/f) based on torque requirements. This helps in reducing the losses which in turn improves the efficiency.

4.3.5 SWITCHED RELUCTANCE MOTOR (SRM):

Switched Reluctance Motors is a category of variable reluctance motor with double saliency. Switched Reluctance motors are simple in construction and robust. The rotor of the SRM is a piece of laminated steel with no windings or permanent magnets on it. This makes the inertia of the rotor less which helps in high acceleration. The robust nature of SRM makes it suitable for the high speed application. SRM also offers high power density which are some required characteristics of Electric Vehicles. Since the heat generated is mostly confined to the stator, it is easier to cool the motor. The biggest drawback of the SRM is the complexity in control and increase in the switching circuit. It also has some noise issues. Once SRM enters the commercial market, it can replace the PMSM and Induction motors in the future.

4.4 COMPONENTS OF EV

1. Traction battery pack
2. DC-DC converter
3. Power inverter
4. Charge port
5. Onboard charger

6. Controller
7. Auxiliary batteries
8. Thermal system
9. Transmission

TRACTION BATTERY PACK: A traction battery pack is also known as an Electric vehicle battery (EVB). It powers the electric motors of an electric vehicle. The battery acts as an electrical storage system. It stores energy in the form of DC. The range will be higher with increasing kW of the battery.

DC-DC CONVERTER: The traction battery pack delivers a constant voltage. However different components of electric vehicles have different requirements. The DC-DC converter distributes the output power that is coming from the battery to a required level. It also provides the voltage required to charge the auxiliary battery.

POWER INVERTER: It converts DC power from the batteries to AC power. It also converts the AC generated during regenerative braking into a DC. This is further used to recharge the batteries.

CHARGE PORT: The charge port connects the electric vehicle to an external supply. It charges the battery pack. The charge port is sometimes located in the front or rear part of electric vehicle components.

ON BOARD CHARGER : The onboard charger is used to convert the AC supply received from the charge port to a DC supply. The on board is located and installed inside the car. It monitors various battery characteristics and controls the current flowing inside the battery pack.

CONTROLLER: A power electronics controller determines the working of an electric car. It performs the regulation of electrical energy from the batteries to the electric motors.

AUXILIARY BATTERIES: Auxiliary batteries are the source of electrical energy for the accessories in electric vehicles. In the absence of the main battery, the auxiliary batteries will continue to charge the car.

THERMAL SYSTEM : The thermal management system is responsible for maintaining an operating temperature for the main components of an electric vehicle (EV) such as an electric motor, controller, etc. It functions during charging as well to obtain maximum performance.

TRANSMISSION : The gearbox transfers the mechanical power from the electric motor to the wheels. The advantage of electric cars is that they do not require

multi-speed transmissions. The transmission efficiency should be high to avoid power loss.

4.5 EXPERIENCE

Gained practical experience in working on motors and batteries in EVs.

WORKING OF MOTOR:

In an electric vehicle, when the driver applies the accelerator, the battery in the car supplies electricity to the stator, causing the rotor to turn, and subsequently provide mechanical energy to turn the car's gears. Once the gears are rotating, the wheels turn too. All this happens in the blink of an eye and without fossil fuel combustion.

Alternating current (AC) and direct current (DC) are two different types of electric flow. As their names would suggest, direct current is when the electric charge flows in only one direction, while alternating current periodically reverses direction.

Motors powered by direct current can be found in an electric vehicle, but only as small, mini motors used, for the windshield wipers and electric windows, for example, but not to drive the vehicle itself. For the traction of an electric vehicle, an alternative current motor is used.

WORKING OF BATTERIES:

The principle behind the lithium-ion battery is to circulate electrons by creating a difference in potential between two electrodes, one negative and the other positive, that is immersed in a conductive ionic liquid called the electrolyte. When the battery is powering a device, the electrons accumulated in the negative electrode are released via an external circuit to travel to the positive electrode: this is the discharging phase. Conversely, when the battery is charging, the energy supplied by the charger sends the electrons back from the positive electrode to the negative.

CHAPTER 5

SUMMARY AND CONCLUSION

SUMMARY:

PROS:

Eco-friendly: Because electric vehicles do not utilize fuel for combustion, there are no emissions or gas exhaust. Vehicles that run on fossil fuels contribute significantly to hazardous gas accumulation in the environment, thus driving an electric car can help contribute to a cleaner environment.

Renewable energy source: Electric vehicles run on renewable power, whereas conventional automobiles function on the combustion of fossil fuels, which reduces the world's fossil-fuel stocks.

Less noise and smoother motion: Driving an electric car is significantly smoother. Because they lack fast-moving elements, they are quieter and produce less noise.

CONS:

High initial cost: Electric vehicles continue to be quite expensive, and many buyers believe they are not as inexpensive as traditional automobiles.

Charging station limitations: People who need to travel long distances are concerned about finding adequate charging stations in the middle of their journey, which are not always accessible.

Recharging takes time: Unlike conventional automobiles, which require only a few minutes to replenish their gas tanks, charging an electric vehicle takes many hours.

Limited options: Currently, there aren't many electric car models to pick from in terms of appearance, style, or customized variations.

CONCLUSION:

We have seen massive changes, particularly in terms of technology, but also in terms of people's attitude towards cars' environmental impacts and other mobility solutions, from the first electric car established in 1837 up to the present time. Although the electric vehicle market is currently a lucrative goal for companies and start-ups in India, several obstacles remain to be addressed for EVs to be ready for mass adoption. High-cost barriers include, for example, manufacturing electric vehicle domestically.



