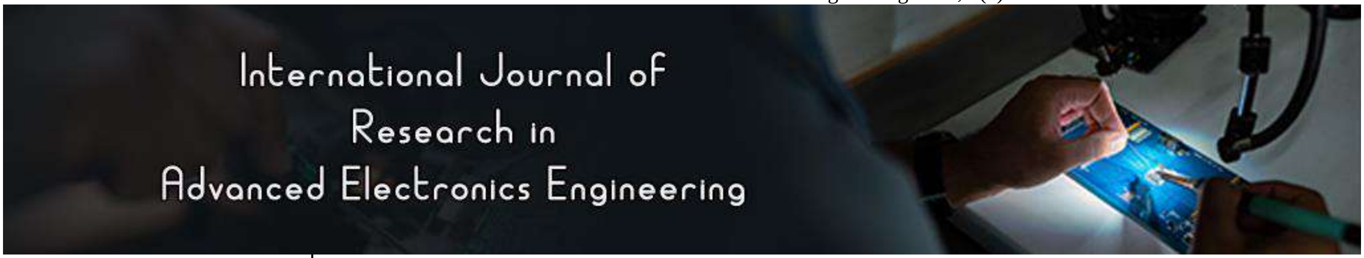

E-ISSN: 2708-4566
P-ISSN: 2708-4558
IJRAEE 2021; 1(1): 17-22

www.electrojournal.com
Received: 10-11-2020
Accepted: 16-12-2020

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New generation vehicles: Electric vehicles

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Abstract
This paper deliver an impression of the fresh work of electric vehicle in the district. The broadside describes the growth and the contrast of dissimilar part of workings. The main components in battery-operated skill, mount design, engine, direction-finding and reduce speed are observed. The paper finally displays some electric vehicle model as a conclusion of the papers.

Keywords: Electric vehicle, AFS, steering system, braking system, ABS, battery management systems, BMS, inverter

1. Introduction
Electrical vehicle (EV) based on rechargeable momentum arrangement. No interior ignition machine is used. All the control is based on rechargeable power as the energy source. The main advantage is the high efficiency in power translation through its proposal system of electric engine. Recently here has been massive investigation and growth work reported in both academic and industry. Marketable vehicle is also available. Many countries have provided motivation to users through lower tax or tax exemption, free space and free arraigning facilities. On the other hand, the hybrid electric vehicle (HEV) is an alternative. It has been used wide in the last few centuries. Almost all the car constructors have at least one classical in hybrid electric vehicle. The enquiries come to us: Which vehicle will govern the market and which one is suitable for future? This paper is to examine the recent change of electric automobile and recommend the impending development in the area.

2. EV and HEV
HEV has been promoted extensively in the last decade. Approximately each manufacturer has at least one HEV in the bazaar [1]. It is supposed to rescue the battery energy packing problematic at that period. By means of mixture bus it permits the electric power can be gotten from engine. The HEV is approximately separated into series hybrid and series mixture. The machine power of the sequence mixture remains associated entirely to the freestyle. All the motor-powered power is resulting from the battery. For the corresponding hybrid, both the engine and motorized donate the propulsion power. The torque is the sum of both motor and engine. The motor is also used as a producer to fascinate the influence from machine through the communication. Together series or mixture can absorb power finished renewal during decelerating or deceleration.

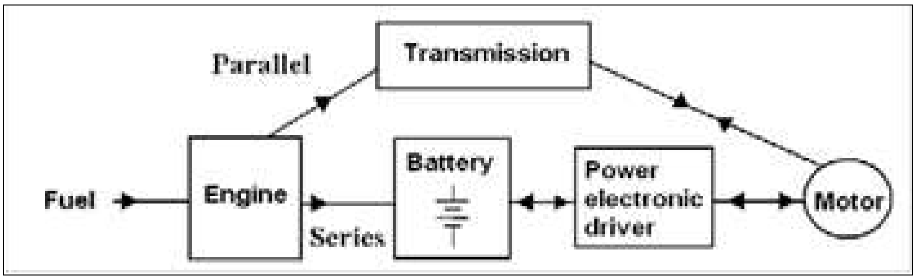

Fig 1: The series or parallel path of an HEV

Yet, HEV still has release. The introduction of plug-in HEV that solves some of the problem [2]. It receives the electronic power to cordless through plug in from the mains. Therefore when convenient, users may charge the battery using AC from the mains.

3. The key components in EV
The electric vehicle is rather simple in structure. The key gears are the propulsion parts. Fig 2 shows the arrangement.

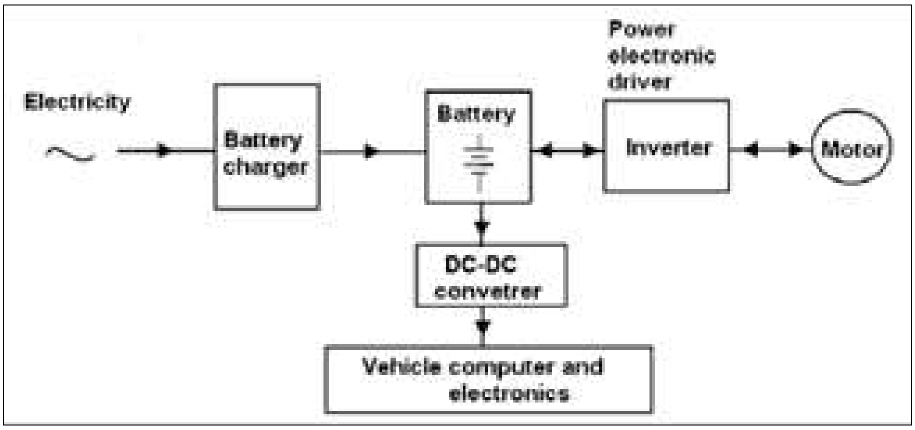

Fig 2: The key components of an Electric Vehicle

The battery is the main vigor storage. The battery mount is to convert the electricity from mains to charge the battery [3]. The battery voltage is DC and I remains inverted into switched-mode indication finished control electronic inverter to determination the motor. The additional electronic mechanisms in a vehicle can be supplied to the battery finished DC-DC converter that step down the voltage from the battery pack to lower voltage such as 5V-20V.

4. The motor
There are a amount of motors obtainable for electric vehicle: DC motors, Induction motor, DC brushless motor, Permanent magnetic synchronous motor and Switched reluctance motor.

4.1 DC motors
It is a traditional engine and has remained used in engine control for a long time. All the power involved in electromechanical change is moved to the rotor finished motionless meetings which are in impression contact by the copper sections of the commutator. It needs convinced maintenance and has a shorter life time. However, it is appropriate for low power request. It has found claims in electronic wheel-chair, transporter and micro-car. Today, most of the golf-carts are using DC motors. The power level is les than 4kW.

4.2 Induction motor
It is a very general AC motors [4]. It also has a great market share in adjustable swiftness drive submission such as air-conditioning, elevator or staircase. Many of the higher power electric cars, for more than 5kW, uses induction motor. Typically a course drive is used to provide torque and speed control.

4.3 DC brushless motor
The straight DC motor is unfortunate automatically because the low control winding, the field, is motionless while the main tall power winding rotates. The DC brushless motor is "curved inside out [5-6]. The high control winding is put on the motionless side of the motor and the field excitation is on the blade using a permanent magnet. The engine has slower life time than the DC motor but is a few times more luxurious. Most of the DC motor can be replaced by the brushless motor with suitable driver. Presently, its applications find in low power EV.

4.4 Permanent magnetic synchronous motor
The stator is similar to that of an induction motor. The blade us on with eternal magnets. It is equal to an initiation motor but the air-gap filed is produced by a enduring magnet. The heavy voltage is sine wave made by Pulse Width Modulation (PWM).

4.5 Switched reluctance motor
It is a variable hesitancy mechanism and its well-known recently because of the responsibility acceptance since each phase is decoupled from additional. The control stage is dissimilar from other the motor deliberated in 2-4. Each point windy is connected in a fly back circuit style [7].

5. Direct drive and in-wheel motor
Through drive reduces the loss in the powered units of the drive train. The motor is connected directly to the shaft to reduce needs of transmission, clutch, and gear box. Recently the in-wheel motor is promoted by researcher [8]. The in-wheel engine is to turn the rotor private out and attached to the helm's rim and the tire. There is no gear box and drive shaft. Fig 3 shows the in-wheel motor.

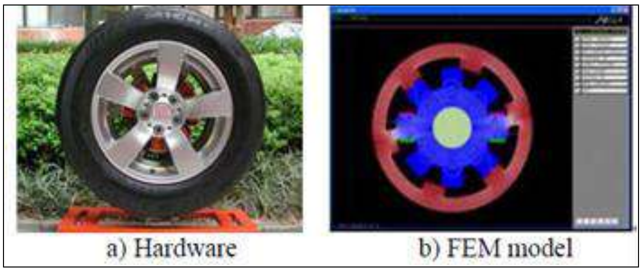

Fig 3: The in-wheel motor

The engine is also called wheel-hub motor. It's main benefit is the self-governing control of each wheel. Fig 4 demonstrations the 4-wheele drive vehicle. All of the wheels everything any speed and way. Therefore the parallel growling can be succeeded easily. The Anti-lock decelerating system can be implemented easily by the technology. It has been shown that it can successfully prevent spinout. The whole vehicle is much humbler in structure. Many different types of motor can be used for in-wheel motor. The projecting one is the switched-reluctance types. Its phase-snaking is independently from each and therefore the fault tolerance is much more advanced that the other. There is no permanent magnetic in the motor, it reduces any interference by permanent field and the variation of the enduring magnetic materials.

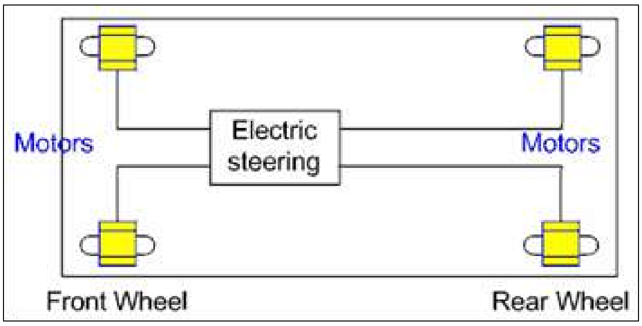

Fig 4: True 4-wheel drive vehicle

6. Energy storage
6.1 Batteries
The battery is the main energy storage in the electric automobile. The sequence in-fact governs the success of the electronic vehicle [9]. Recently there are great works existence reported in battery development. The battery such as Li-ion is now existence charity by new group of electronic vehicle. The risk of the uncertainty of the cordless has been calculated by numerous testified. It seems that the LiFePO4 type is preferable since of its chemically stable and integrally safe. Other Li-ion such as LiCoO2, LiMn2O4 and Li(Ni1/3Mn1/3Co1/3)O2 may has the current and overprice concern [10]. For low cost answer, the lead-acid battery-operated is still dominant part of the market. The battery has initiate applications in electric wheel chair, Golf-cart, micro-car and neighborhood town air. The recent RoHS has also stopped the use of NiCd battery. All the research is looking towards the fast charging for batteries. MIT reported [11] the technology of a crystal structure that allows 100 times of charging speed than conventional Li-ion battery. Other alternative is to use ultra-capacitor.

6.2 Ultra-capacitor
Capacitor is basically a static component. There is no chemical reaction in the components. Its charging and discharging speeds are very fast. However, the energy storage is limited. Its energy storage density is less than 20% of the lead-acid battery. Although the expected ultra-capacitor density will go up in next few years, its total solution for main energy storage is a challenge. The number of cycles and the temperature range is excellent. Table 1: Shows the comparison

Table 1: Comparison of different energy storage unit

	Lead-acid	NiMH	Li-ion	Ultra-capacitor
Energy density Whr/kg	40	70	110	5
Cycle life	500	8,00	1,000	500,000
Working temperature (°C)	-30 — +50	-40 — +50	-40 — +60	-40 — +85
Cost $/kWhr	1,000	2,400	5,000	50,000

Therefore ultra-capacitor is useful for fast speed or transient energy storage. As it allows high current charging, its charging time can be shortened to within a few minutes. The ultra-capacitor is still in the initial stage of development. It is expected that the cost will be going down and the energy density will go up rapidly in next few years.

7. Charging systems
7.1 General charger
The charger needed for the battery system for slow charging or fast charger are both required to handle high power. The H-bridge power converter is needed [12]. Fig 5 shows the converter. The converter is famous for its efficiency and has found application in charger and DC-DC converter.

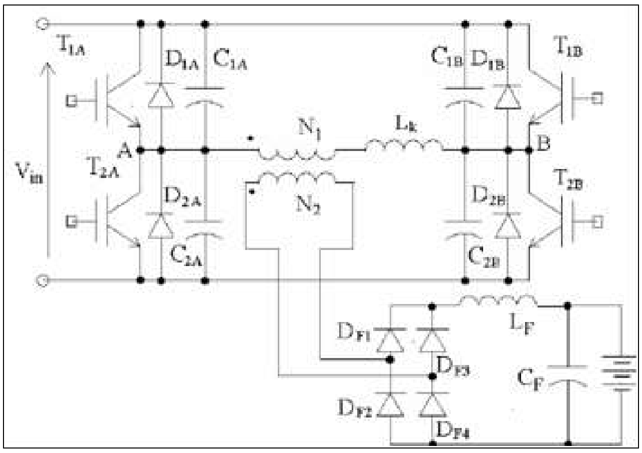

Fig 5: The H-bridge converter for charger

7.2 Ultra-capacitor charger
The voltage on the ultra-capacitor various from the full-voltage to zero when nits energy storage varies from full to zero. This is different from the battery as its voltage will only varies within 25%. The capacitor voltage is internal point and is not in contact with users. The transformer isolated converter is not necessary. A tapped converter should be used as it will have higher efficiency for power conversion [13]. The efficiency of the power converter is higher than the transformer-isolated version. The structure is simple.

7.3 Battery management systems
It is also referred as BMS. The battery system is formed by a number of battery ells. They are connected in parallel or series that is according to the design. Each of the cell should be monitoring and regulated. The conditioning monitoring includes the voltage, current and temperature. The measured parameters are used to provide the decision parameter for the system control and protection. Two parameters are usually provided. They are the state of charge (SoC) and the State of Health (SoH). SoC is like the oil tank meter that provides the battery charging condition. It is measured by the information of voltage and current. The SoH is to record the health or aging condition. There are a few definitions but the prominent one is:

$$SoH = \frac{\text{Nominal Capacity} - \text{Loss of Capacity}}{\text{Nominal Capacity}}$$

Cell balancing is to ensure each cell is operating under the same conditioning or a regulation is used to charge or discharge each cell by the balancing control. This avoids the overload of a particular cell.

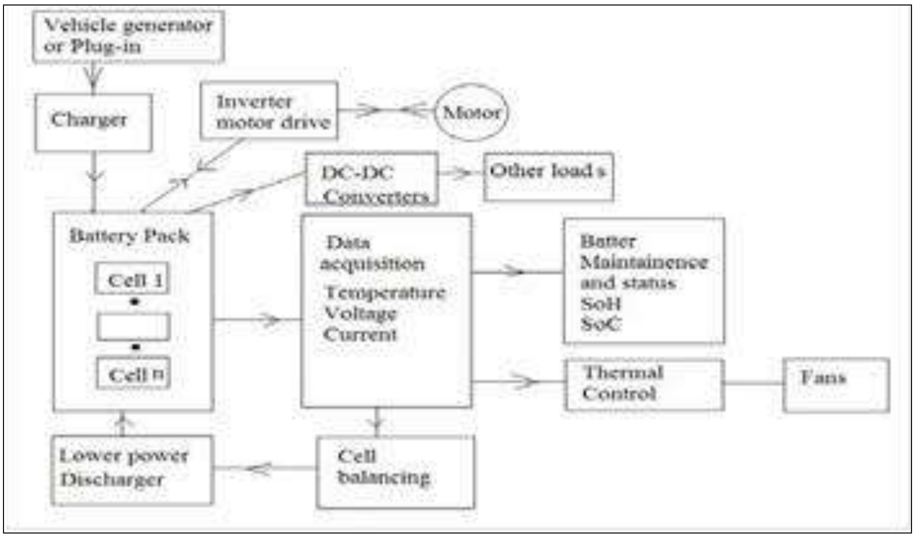

Fig 6: Schematic of the BMS

7.4 Energy management systems
Even for ultra-capacitor system, the energy storage is made by a number of capacitors or in a combination with other energy storage devices such as battery. The same conditioning monitoring and management system will be used.

8. Charging network
8.1 Charging network
The charging method of EV is controversial because of the uncertainty of the power needed, location and the charging time. The charging time of batteries has been reported to be shorter in the recent development. The lead-acid batteries are restricted by its technology. The charging rate is less than 0.2C and quicker charging rate seriously shortens its life time. Other battery such as Li-ion has recommended charging rate of 0.5C. Usually most of the electric vehicles have an on-board battery charger. A power cable is connected from the vehicle to a charging point. A charging station should provide a number of power points and a suitable transaction program to calculate the tariff. The power needed for the charging station is not a concern. Usually for private car, a standard charging power is less than 2.8kW. Single-phase power line is used. In average a vehicle is needed to be charged every 3 days. Using Hong Kong as an example, it will only affect the power consumption of less than 2% even all the private cars are charged to EV.

8.2 Fast charging station
For fast charging, a high current is needed, therefore three-phase power is usually used. The charging station should consider the method to connect the 3-phase socket to users as not all the civilian can handle the use of 3-phase socket system. The following has been discussed:

a. Magnetic contactless charging: There is no metal contact, all the power transfer is through magnetic induction. This reduce the concern when a civilian to handle high power cable and he/she does not need to contact the conductors.
b. High voltage power transfer: The heavy and large 3-phase socket and cable can be reduced in size by high voltage connection. The power source is stepped up to high voltage of several kV, and the cable is reduced. There is another step-down converter in the vehicle that reduced the high voltage to suitable lower voltage to charger the battery.
c. Battery rental: This has been suggested from the 1st day of the promotion of EV. All the batteries are not owned by the users but on a rental arrangement. Users go to charging station to swap the batteries to fully-charged ones. The time needed is just a few minutes. The design of the EV should be made for such changes. The vehicle battery charging in the station can also be used for energy storage to ease peak demand through valley supply compensation.

9. Braking and steering
9.1 Braking and power regeneration
The braking of a vehicle in the past based on mechanical system such as disc brake. The braking method of an EV should be integrated with both mechanical and the electrical braking. In the initial region of the braking pedal, it electrical power regeneration braking should be applied. This is usually for deceleration or going down a slope, the kinetic energy of the vehicle can be returned to the battery. The final region of the braking, mechanical braking is used. This provides a compromise of the energy saving and safety. Today, we can make motors with high power of regeneration that is in the expenses of the motor size, a compromise between the motor weight, cost, power regeneration efficiency and safety are needed. To increase the region of the power regeneration, the motor should be made with acceptance of the high power design plugging mode which is to provide high reverse torque to stop the vehicle. The motor drive should also be implemented with high frequency decoupling capacitor to absorb the fast transient of the reverse current.

9.2 Anti-lock braking (ABS)
Conventional ABS is installed in most of the vehicle to prevent skidding and to obtain a stable braking performance.

The braking characteristic depends on the wheel slip as well as the road condition [14]. It combines continuous slip changing and discrete valve action which induces discrete hydraulic pressure, PID and finite state machine theory are applied to the anti-lock braking system. Fig 6: ABS braking system model. The ABS optimization consists to maximize the tire forces whatever the conditions of the road. Therefore, it must to localize the wheel slip ratio which corresponds to the peak tire road adhesion characteristic. The location and the value of these peak values varies in large range depending on the road, tire and many other different factors, For any rolling conditions, the optimal wheel slip rate, which will be used as control reference to optimize the braking force. Fig 6 shows a scheme of ABS based on all electrical motor drive system.

9.3 Skid Steering

Steering is achieved by differentially varying the speeds of the lines of wheels on different sides of the vehicle in order to induce yaw. To satisfy the requirement of the turn radius, the longitudinal slip must be controlled, so a method of slip limitation feedback is used in the simulation. When the vehicle is turning on a slippery surface, because of the drop at the coefficient of road adhesion, the drive wheels may slip. The traction control system reduces the engine torque and brings the slipping wheels into the desirable skid range. Fig 7 shows the locus of skid steering for different turn radius.

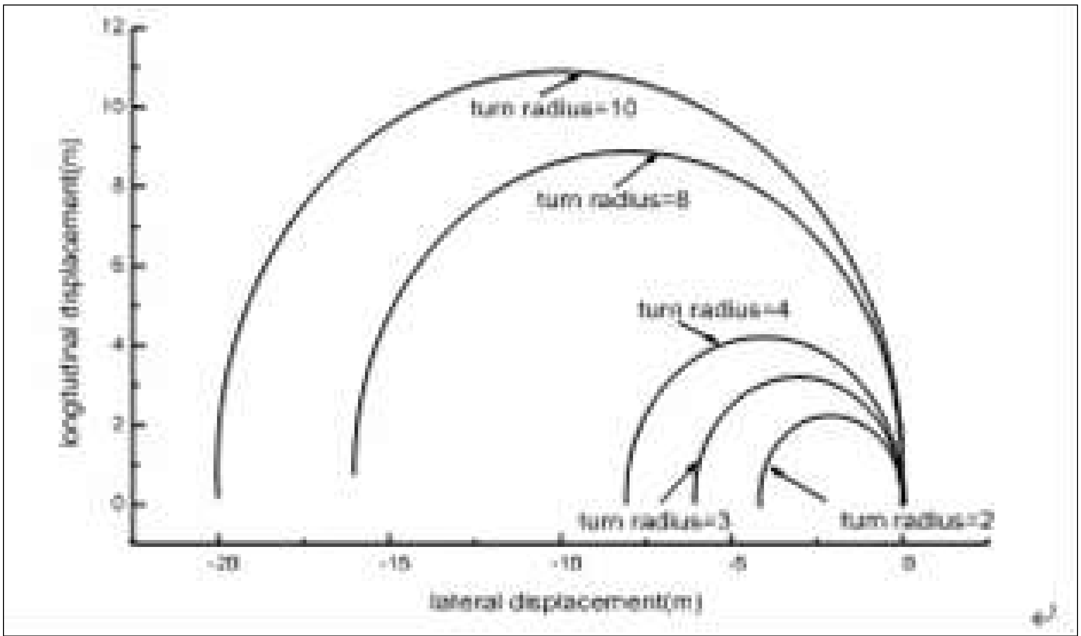

Fig 7: Locus of different turn radius achieved by skid steering

10. Other accessories

The front lighting system based on LED and Adaptive front-lighting systems (AFS) is a vital safety lighting organization in automobiles. An AFS functionality is separated into three parts, one is the headlamp leveling subsystems, which work to save light parallel to the path shallow when the automobile's slope state alterations in dynamic and static mode; the additional one is revolving subsystem, which matches the bright distribution with the automobile's revolving angle so as to yield the best lighting effect for driver. The last one is lowering scheme, which fade or dim up lighting along with the ambient light and lane situation changes. Fig 9 shows a sample of an LED front-light.

Fig 9: AN LED front-lighting unit

11. Electric vehicle show cases

Lately there are a quantity of local and foreign Corporations and organizations have been employed on electrical automobile. The growth on electric parts and fittings from force, safety and regulator has been stated. A local academy has freshly conveyed their EV change. Fig 10 shows the private car, security car, micro-car and motorbike.

Fig 10: Electric vehicles developed

12. Conclusion

This paper discusses the recent development in electric vehicle. The paper first describes general structure and discusses the energy storage. It then extends to the future vehicle components. The paper provides an overview of the recent EV work in the region.

13. Acknowledgment
The author acknowledges the support of Hong Kong Polytechnic University and the Power Electronics Research Centre for the EV work.

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