Electric Vehicle for Smart Cities

Aniket Kumar and R.P. Agarwal*

Abstract

Today transport accounts for about 60 % of total world oil consumption. This global problem of Energy for propulsion motivates the automotive industry to turn to the electric drive. All major automobile manufacturers attentions are shifted to electrically propelled battery-operated electric vehicles (BEV).

Keywords: *Battery, Electric vehicles, Traction motor, Battery Management Systems*

INTRODUCTION

Electric Vehicles (EV) was invented in 1834. During the last decade of the 19th Century, a number of companies produced EVs in America, Britain, and France. Due to the limitations associated with the batteries and the rapid advancement in internal combustion engine (ICE) vehicles, EVs have almost vanished from the scene since 1930. In the early 1970's, some countries, compelled by the energy crisis, started the rekindling of interests in EVs.

Massachusetts Institute of Technology (MIT) suffered from failures in virtually every critical component; whereas a commercially built EV in 1998 running from Los Angeles to Detroit exhibited a success with no component failures. Within the 1970's, EVs were still in research and development stage.

However, since both specific energy and energy density of batteries are much lower than that of gasoline, the development of fuel cells for EVs has taken on an accelerated pace in recent years. Meanwhile, the development of commercial hybrid electric vehicles (HEVs) is also going on rapidly. HEVs essentially improve the range and performance of EVs at higher complexity and cost because of the additional energy source, engine and other accessories.

As per configurations of EVs, it was observed that the conversion EV is becoming less attractive than the purpose-built EV while the HEV is of growing interests. It was observed that EVs are on the verge of commercialization, demonstra-tion as well as standardization and marketing of EVs. In the next few decades, it is anticipated that both EVs and HEVs will be commercialized, and will have their market shares.

* SIET, Deemed to-be University, Meerut U.P. India

CONFIGURATION OF ELECTRIC VEHICLE

Fig. 1 shows an overview of an electric vehicle indicating all the key components such as battery, electric motor, battery management system, charging port, DC/DC Converter etc. Power Inverter/Controller converts energy from DC to AC to power the electric motor to drive the vehicle. Battery Charger/ Onboard charger receives 230V single phase from mains supply and then converts to DC in order to store in the battery. BMS shown in Fig. 2 acts as a CPU of the vehicle that manages the output power, charging and discharging of the battery. It is used to meet critical features such as voltage, temperature and current monitoring, battery state of charge (SoC) and cell balancing of lithium-ion (Li-ion) batteries.

As shown in Fig. 3, on-board chargers (OBC) allow plug-in hybrid (PHEV) and battery electric vehicles (BEV) to charge

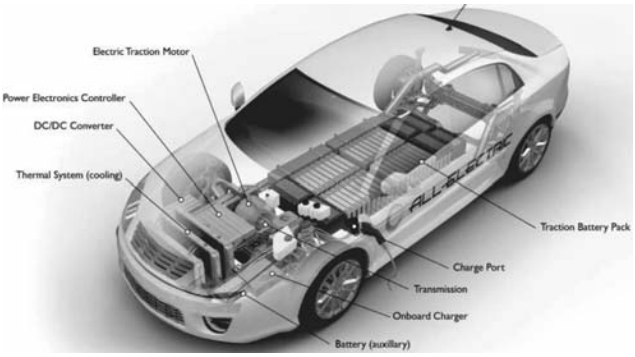

Fig. 1. Electric Vehicle (EV)

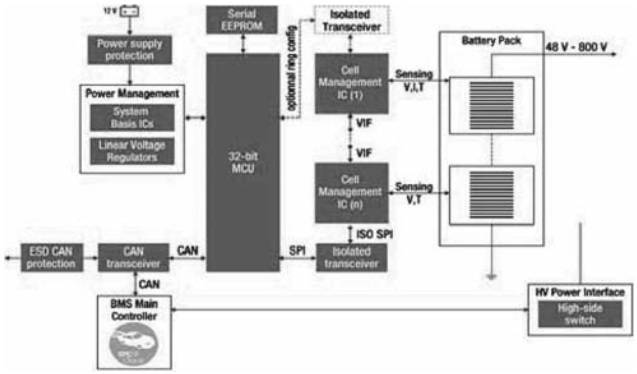

Fig. 2. Battery Management System

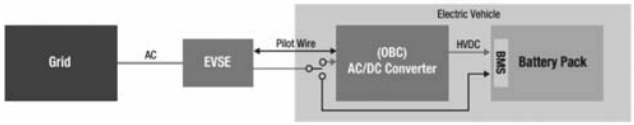

Fig. 3. On-board Charger

anywhere there is AC power, not just at charging stations. An AC charger powers the battery through the vehicle's onboard charger.

POWER INVERTER/CONVERTER

It is a key component in EV, similar to the Engine Management System (EMS) of IC Engine vehicles, that determines driving behavior and supplies proper voltage and current.

The electronic controller commands the power converter by providing control signals to it, and then controls the operation of the electric motor to produce proper torque and speed, as per the command from the driver. The electronic controller is divided into three functional units i.e. sensors, interface circuitry, and Processor. The sensor is used to translate measurable quantities such as current, voltage, temperature, speed, torque, and flux into electric signals through the interface circuitry.

Energy Sources: The energy source are batteries, fuel cells, ultracapacitors, flywheels, and various hybrid systems.

ELECTRIC MOTORS

The motors used in EVs and HEVs require frequent starts and stops, high rates of acceleration/deceleration, high torque and low-speed hill climbing, low torque and high-speed cruising, and a very wide speed range of operation. Commutator Motors are traditional motors that needs commutators and brushes to feed current into the armature, thus making them less reliable and unsuitable for maintenance-free operation and high speed.

Commutatorless Motors: Induction motors are widely accepted as a commutatorless motor

type for EV and HEV propulsion. Field-oriented control (FOC) or vector control of induction motors has been accepted to overcome their control complexity due to their nonlinearity.

Permanent Magnet brushless AC Motors field winding of conventional synchronous motors are replaced with Permanent magnets(PM). It has no conventional brushes, no slip rings, and no field copper losses. Actually, these PM synchronous motors are sinusoidal-fed PM brushless motors, because of their sinusoidal AC current and brushless configuration. These motors can run from a sinusoidal or pulsed waveform modulation supply (PWM supply) without electronic commutation.

PLUG-IN HYBRID ELECTRIC VEHICLE

PHEV is a hybrid electric vehicle whose battery can be recharged by plugging it into an external source of electric power, as well by its on-board engine and generator.

Fig. 4 shows an electric vehicle being charged at charging station such as petrol pump for IC engine vehicle.

Fig. 4. Charging Station

CONCLUSION

EVs will become more affordable than ICEs if the cost of batteries goes down. Combined with the lower costs of EV maintenance and repair, and assuming the cost of electricity.

REFERENCES

[1] W. Hui, W. Fushuan and X. Jianbo, "Charging and discharging characteristics of electric vehicles as well as their impacts on distribution systems", *Journal of North China Electric Power University*, Vol. 5, pp. 17-24, 2011.

[2] X. Zhou, L. Zou, Y. Ma and Z. Gao, "Research on impacts of the electric vehicles charging and discharging on power grid," *29th Chinese Control And Decision Conference (CCDC)*, Chongqing, pp. 1398-1402, 2017.