Design Energy Efficient Mechanism For Electrical Vehicle Using Power Electronics: Review Paper

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ABSTRACT

An electric vehicle (EV), also called an electric drive vehicle, uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels or an electric generator to convert fuel to electricity. EVs include road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft.

EVs first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Modern internal combustion engines have been the dominant propulsion method for motor vehicles for almost 100 years, but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

In the 21st century, EVs saw a resurgence due to technological developments and an increased focus on renewable energy. Government incentives to increase adoptions were introduced, including in the India, United States and the European Union. In this paper we have reviewed various research reports in the developments of the components of the Electrical Vehicle in order to provide a solution wherein key developments have been integrated as well as DC/DC converter design and Separate Controller have been proposed to develop optimally efficient Electrical Vehicle.

Keywords:- *Electrical Vehicles, Energy Efficient Electrical Vehicles*

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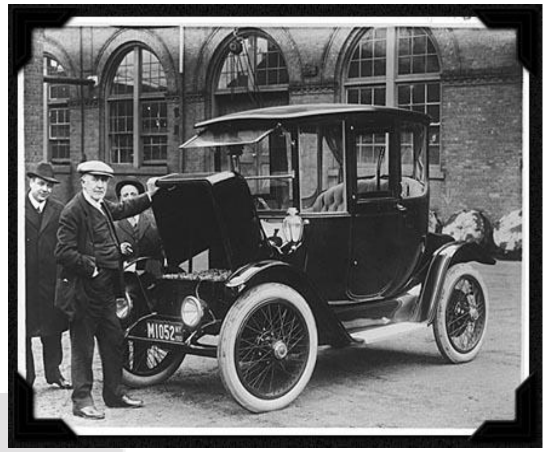
1. INTRODUCTION:

1.1 History of EVs



Electric motive power started in 1827, when Slovak-Hungarian priest Ányos Jedlik built the first crude but viable electric motor, provided with stator, rotor and commutator, and the year after he used it to power a tiny car. A few years later, in 1835, professor Sibrandus Stratingh of University of Groningen, the Netherlands, built a small scale electric car and a Robert Anderson of Scotland is reported to have made a crude electric carriage sometime between the years of 1832 and 1839. Around the same period, early experimental electrical cars were moving on rails, too. American blacksmith and inventor Thomas Davenport built a toy electric locomotive, powered by a primitive electric motor, in 1835. In 1838, a Scotsman named Robert Davidson built an electric locomotive that attained a speed of four miles per hour (6 km/h). In England a patent was granted in 1840 for the use of rails as conductors of electric current, and similar American patents were issued to Lilley and Colten in 1847.

The first mass produced electric vehicles appeared in America in the early 1900s. In 1902, "Studebaker Automobile Company" entered the automotive business with electric vehicles though it also entered the gasoline vehicles market in 1904. However, with the advent of cheap assembly line cars by Ford, electric cars fell to the wayside.

Image: 1: Edison and a 1914 Detroit Electric model 47

1.2 Reintroduction of EVs

A number of developments contributed to decline of electric cars. Improved road infrastructure required a greater range than that offered by electric cars, and the discovery of large reserves of petroleum in Texas, Oklahoma, and California led to the wide availability of affordable gasoline/petrol, making internal combustion powered cars cheaper to operate over long distances. Also internal combustion powered cars became ever easier to operate thanks to the invention of the electric starter by Charles Kettering in 1912, which eliminated the need of a hand crank for starting a gasoline engine, and the noise emitted by ICE cars became more bearable thanks to the use of the muffler, which Hiram Percy Maxim had invented in 1897. As roads were improved outside urban areas electric vehicle range could not compete with the ICE. Finally, the initiation of mass production of gasoline-powered vehicles by Henry Ford in 1913 reduced significantly the cost of gasoline cars as compared to electric cars.

1.3 Types of EVs

Just as there are a variety of technologies available in conventional vehicles, electric vehicles have different capabilities that can accommodate different drivers' needs. A major feature of EVs is that drivers can plug them in to charge from an off-board electric power source. This distinguishes them from hybrid electric vehicles, which supplement an internal combustion engine with battery power but cannot be plugged in.

There are two basic types of EVs:

- All-electric vehicles (AEVs)
- Plug-in hybrid electric vehicles (PHEVs)

AEVs include Battery Electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs). In addition to charging from the electrical grid, both types are charged in part by regenerative braking, which generates electricity from some of the energy normally lost when braking. Which type of vehicle will fit your lifestyle depends on your needs and driving habits. Find out which BEVs and PHEVs are available to suit your needs.

All-electric vehicles (AEVs) run only on electricity. Most have all-electric ranges of 80 to 100 miles, while a few luxury models have ranges up to 250 miles. When the battery is depleted, it can take from 30 minutes (with fast charging) up to nearly a full day (with Level 1 charging) to recharge it, depending on the type of charger and battery.

If this range is not sufficient, a plug-in electric vehicle (PHEV) may be a better choice. PHEVs run on electricity for shorter ranges (6 to 40 miles), then switch over to an internal combustion engine running on gasoline when the battery is depleted. The flexibility of PHEVs allows drivers to use electricity as often as possible while also being able to fuel up with gasoline if needed. Powering the vehicle with electricity from the grid reduces fuel costs, cuts petroleum consumption, and reduces tailpipe emissions compared with conventional vehicles. When driving distances are longer than the all-electric range, PHEVs act like hybrid electric vehicles, consuming less fuel and producing fewer emissions than similar conventional vehicles. Depending on the model, the internal combustion engine may also power the vehicle at other times, such as during rapid acceleration or when using heating or air conditioning. PHEVs could also use hydrogen in a fuel cell, biofuels, or other alternative fuels as a back-up instead of gasoline.

2. LITERATURE REVIEW:

2.1 Variable speed generating unit for vehicle on board applications

- In this paper [1] Fabio Crescimbini, Stefano Bifaretti, Marco Di Benedetto, Alessandro Lidozzi, Sabino Pipolo and Luca Solero proposes use of Variable Speed Diesel Electric Unit with Power Electronic Converter and PM Synchronous Generator instead of Fixed Speed Diesel Engine with Rotor Field Winding Synchronous Generator with results which shows that Variable Speed Systems are most applicable where the difference between Peak Power Generation capability and required average load is large. The proposed system is controlled by a combined ARM – MuP FPGA structure which regulates the output DC link voltage and the prime mover speed according to the DC link requested power.

2.2 High power inductive charging system for an electric taxi vehicle

- In this paper [2] Markus Henke and Tim-Hendrik Dietrich are applying Alternating Magnetic field in the primary coil system which leads to an Inducted voltage in the secondary coil. The output current of the secondary coil flows through specially designed serial compensation unit and is rectified to supply the DC link of the DC-DC converter. Contactors were used to disconnect the Induction Charging System.

2.3 Closed loop control of axial flux permanent magnet BLDC motor for electric vehicles

- In this paper [3] Anurag Khergade, S. B. Bodkhe and Ashwani Kumar Rana proposes the use of AFPM BLDC motor to avail high torque and wide speed range. The use of AFPM BLDC motor also reduces the overall size of the EV due to its compactness. To achieve accurate speed control, closed loop control using microcontroller is proposed in this paper. Microcontroller is used to drive the motor by sensing rotor position using Hall sensors. The effective braking scheme is also proposed.

2.4 E-bike electronic control unit

- In this paper [4] Florin Dumitrache, Marius Catalin Carp and Gheorghe Pana presents a way of designing and implementing an electronic module for an e-Bike. The paper shows how a low power, 8-bit microcontroller can be used to drive such a motor and also manage other useful functions on an e-Bike.

2.5 Development of Wireless Battery Monitoring for electric vehicle

- In this paper [5] Anif Jamaluddin, Fengky Adie Perdana, Agus Supriyanto, Agus Purwanto; Inayati, and M. Nizam presents a Wireless Battery Monitoring System (WBMS) for electric vehicle, developed for monitoring voltage, current and temperature of battery. Their proposed system consists of hardwares (sensors, a microcontroller, a bluetooth module, an Android smartphone) and software. It was designed on a low cost microcontroller ATMEGA 328 (Arduino UNO). Voltage, current and temperature data are transferred to microcontroller, then data of battery is transferred using bluetooth communication to display. In this research, data of battery monitoring are displayed on Personal Computer (PC) with LabVIEW programme and android smartphone. The monitoring system was able to show real-time data of voltage, current andtemperature and display data on android smartphone and PC simultaneously.

2.6 Prototype building of VIDYUT battery electric vehicle for energy efficiency

- In this paper [6] Vatsal Shah, Vipin Shukla, and Amit Sant presents the design methodology and performance analysis of a single passenger prototype battery electric vehicle (EV), named Vidyut. The main objective of this paper is to demonstrate the performance of a Lynch motor based propulsion system for a prototype EV. Lynch motor is an axial gap permanent magnet (PM) brushed dc motor which offers the merits of higher torque to weight ratio, higher power density, and lower cost as compared to the PM brushless dc motors. This results in elimination of dc-ac conversion system, and consequently reduces power and signal electronics, related losses, cost. On the other hand, the overall reliability, energy savings and compactness are positively impacted. The prototype consists of a 24 V lithium ion battery storage system, MOSFET based synchronous buck dc-dc converter, and an ARM microcontroller for implementing the control algorithm.

3. COMPARATIVE TABLE:

Table -1: Comparative Table

Paper Title	Technique	Advantages	Limitation
Variable speed generating unit for vehicle on board applications	A newly conceived variable speed generating unit to be used in on-board vehicle applications. A complete current limiting strategy is described and tested under different load conditions	Simplifying the overall control configuration and fast compensation of load unbalances.	Variable speed operation has been proposed in literature as a solution to efficiency and pollution problems for diesel generating units as well to improve efficiency and power conversion in rotating systems for renewable energy sources.
High power inductive charging system for an electric taxi vehicle	Design and integration of a high power inductive charging system. A high efficient DC-DC converter and a magnetic design for the inductive coil	Common used public charging infrastructure	
Closed loop control of Axial Flux Permanent Magnet (AFPM) BLDC motor for electric vehicles	A slotless AFPM BLDC motor is proposed. It has single side configuration with 24 stator poles and 36 permanent magnets of rotor disc. To achieve accurate speed control, closed loop control using microcontroller is proposed. Microcontroller is used to drive the motor by sensing rotor position using hall sensors. The effective braking scheme is also proposed. To verify the performance of the proposed BLDC motor, simulation is carried out and results are presented.	High torque and wide speed. Steady and accurate operation. Effective braking control of motor.	AF BLDC motor is also very much suited for application like elevator because of their disc shape. Performance of the motor after reduction in the stator coils can also be tested. Further torque control loop can be added and the performance of drive can be tested under the different torque conditions.

E-bike electronic control unit	A way of designing and implementing an electronic module for an e-bike. The paper shows how a low power, 8-bit microcontroller can be used to drive such a motor and also manage other useful functions on an e-bike.	A higher power-autonomy ratio. The hardware improvements. A simple yet effective software yield a low cost and reliable product.	
Development of wireless battery monitoring for electric vehicle	It was designed on a low cost microcontroller ATMEGA 328. Voltage, current and temperature data are transferred to microcontroller, then data of battery is transferred using Bluetooth communication to display. In this research, data of battery monitoring are displayed on PC with Labview programme and Android smartphone.	Monitoring voltage, current and temperature of battery. The monitoring system was able to show real-time data of voltage, current and temp. and display on Android and PC.	
Prototype building of vidyut battery electric vehicle for energy efficiency	The main objective of this paper is to demonstrate the performance of a Lynch motor based propulsion system for a prototype EV. The prototype consists of a 24 V Li-ion battery storage system, MOSFET based synchronous BUCK DC-DC converter and an ARM microcontroller for implementing the current algorithm.	High torque to weight ratio. High power density and Low cost compare to PM BLDC motor. Elimination of a DC-DC conversion system. Reduced power and signal electronics related losses. Energy savings. Compactness. System efficiency of 76% can be achieved under steady state operation.	

4. CONCLUSION:

Increasing level of pollution is the key issue of the moment for almost every country in theworld and with increasing population of fossil fuel powered transportation mediums, the issueis rising rapidly as it accounts for the major percentage of overall pollution.However, we saw a gap between the individual research on the EV components and integrationof the same into one complete system with few modification/development to make them moreefficient.

This research is our humble try to fill this gap and we would like it to be appreciated. Althoughthere is still fair amount of development scope available in this field, we have touched fewimportant technical development scope during our research tenure which we felt needs to beaddressed immediately.

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5. REFERENCES:

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