

DESIGN AND DEVELOPMENT OF ELECTRIC CAR CONTROLLER

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Abstract - The **Brushless DC** motors are widely used in many industrial and traction applications because of their high efficiency, high torque, low maintenance, less noise and low volume. The BLDC motor can act as an alternative for traditional motors like Brushed DC motor, **induction motor**, switched reluctance motors etc. The performance of BLDC motor is analyzed using **Matlab** with motor on no load. The various performance parameters are analyzed by Matlab software. The torque characteristics of BLDC motor is very important factor in designing BLDC motor drive system. After development of simple mathematical model of three phase BLDC motor with trapezoidal wave forms of back **emf**, the motor is modelled by using **MATLAB/SIMULINK**.

INTRODUCTION

The issues of climate change or global warming have been rigorously discussed by many governments since the early 21st century. A great number of relevant reports have revealed the negative impact of climate changes dominantly driven by human activities[3]. With the globally increasing civilization and industrialization, a large number of fossil fuel burnings in industries have led to the acute problem of air pollution. Simultaneously, the exhaust emissions from automotive vehicles cannot be ignored. Vehicle emissions, which mainly include CO₂, CO, NO_x and particulate matters (PM₁₀ and PM_{2.5}), have been considered as the major contributors to the effect of greenhouse gases, also leading to the increase in different forms of cancers and other serious diseases.[6]

Electric vehicles (EV), as a promising way to reduce the greenhouse effect, have been researched extensively. With improvements in the areas of power electronics, energy storage and support, the plug-in hybrid electric vehicle (PHEV) provides competitive driving range and fuel economy compared to the internal combustion engine vehicle (ICEV). Operating with optimized control strategies or utilizing the concept of the energy management system (EMS), the efficiency of the PHEV could be significantly improved. Battery technology and super capacitor technology will also be discussed as a possibility to increase the energy capacity of PHEV[11].

Proper selection of the traction drive system to meet the requirements of an electric passenger vehicle is of prime importance. Choice may be made among alternating current, direct current or combined systems. Each approach can be implemented by utilizing various control techniques and power elements. For instance, an AC system may use an adjustable voltage inverter (AVI) or a pulse-width-modulated inverter (PWMI) for the power processor; and an induction motor or a synchronous motor for the rotating element. Similar alternatives exist for a DC system.[19]. The choice of a suitable manner of implementation must be based on information characterizing the various elements and tradeoffs matching them to the vehicle requirements. A review of characteristics relating to electric car requirements is made in an attempt to orient the designer and user with information necessary for selection of drives[13].

The ever rapidly growing transportation sector consumes about 49% of oil resources. Following the current trends of oil consumption and crude oil sources, the world's oil resources are predicted to be depleted by 2038. Therefore, replacing the non-renewable energy resources with renewable energy sources and use of suitable energy-saving technologies seems to be mandatory. Electric Vehicles (EVs) as a potential solution for alleviating the traffic-related environmental problems have been investigated and studied extensively. [18]

LITERATURE REVIEW

Electric vehicles (EV), those that use electric motors instead of gasoline motors, have become very popular. Those who strive to protect the environment and go green love electric vehicles.[1] But many would be surprised to learn that the EV isn't a new invention. While history is uncertain about who actually created the very first EV, what is certain is that there were electric motors in use as far back as the early 1800s. One known electric motor was created in 1828 by Anyos Jedlik. He made a small model car that could move on its own via a small electric motor. Sometime between 1832 and 1839, a larger electric motor created by Scottish inventor Robert Anderson was used to drive a carriage. Of course, while these EV didn't exactly gain widespread use, they did spark the imaginations of others. In 1835, two small-scale EVs were created, one in Holland and one in the United States by Thomas Davenport. Davenport and would later create the first electric car to run on batteries, although these batteries were non-rechargeable and were unable to give the car much range. Others, including French inventor Gaston Plante, worked on better batteries, but still fell short of a practical vehicle. In the early 1900s, American inventors return to the EV. Around this time, William Morrison created what many consider the first practical electric car, although it still lacked range. Hybrids were also created during this time to solve a number of issues with the EV. A wide part of subjects linked to EVs, such as the categories of these types of vehicles and their basic characteristics, fuel energy economization, Co2 emissions, and recent advancements. In fact, there are three principal categories of EVs: HEVs, PHEVs and BEVs, which were presented in details. The difference between these categories of vehicles is that the last two categories mentioned are recharged externally.[7]

Otherwise, BEV functions only on battery charge and therefore always use the charge-depleting mode of operation, demanding huge-power and high-energy battery packs. Furthermore, PHEVs provide the option of on-board battery charging and the possibility of charge depleting or charge sustaining modes of operation. Eventually, HEVs, which were the first category of EVs[9].

The braking of a vehicle in the past was based on mechanical systems such as disc brake. The braking method of an EV should be integrated with both mechanical and 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[15]The battery is the main energy storage in the electric vehicle. The battery in-fact governs the success of the electric vehicle. Recently there are massive works being reported in battery development. The battery such as Li-ion is now being used by new generation of electric vehicle. The danger of the instability of the battery has been studied by many reported. It seems that the LiFePO4 type is preferable because of its chemically stable and inherently safe. Other Li-ion such as LiCoO2, LiMn2O4 and Li (Ni1/3Mn1/3Co1/3) O2 may has the thermal and overcharge concern[5]

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].

A self-driving car, also known as an autonomous vehicle (AV), connected and autonomous vehicle (CAV), driverless car, robot-car, or robotic car, is a vehicle that is capable of sensing its environment and moving safely with little or no human input. Self-driving cars combine a variety of sensors to perceive their surroundings, such as radar, lidar, sonar, GPS, odometer and inertial measurement units. Advanced control systems interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage. Long distance trucks are seen as being in the forefront of adopting and implementing the technology[12]

Induction motor is a very popular AC motors. It also has a large market share in variable speed drive application such as air-conditioning, elevator or escalator. Many of the higher power electric vehicles, for more than 5kW, uses induction motor. Usually a vector drive is used to provide torque and speed

control. It is a classical motor and has been used in motor control for a long time. All the power involved in electromechanical conversion is transferred to the rotor through stationary brushes which are in rubbing contact with the copper segments of the commutator. It requires certain maintenance and has a shorter life time[8].

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. 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[16]

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For a low cost solution, the lead-acid battery is still a dominant part of the market. It is also referred to as BMS. The battery system is formed by a number of battery cells. They are connected in parallel or series that is according to the design. Each of the cells should be monitored and regulated.[12] 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). The SoC is like the oil tank meter that provides the battery charging condition.[11]

CONCLUSION:

From above literature survey we have seen that the proposed system using an BLDC motor instead of IC engine is best as compared to the existing systems. The system introduced is an innovative step to increase the mileage of electric bike. The cycle of charging and discharging continue, thus this helps in increasing the battery life. Due to extended battery life the vehicle battery can run more than that of the existing system.

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