Review for Design and Development of Electric Bike

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Abstract— Electric Vehicles are emerging due to increasing concerns about global warming, greenhouse gas emissions, and the depletion of fossil fuels, the electric vehicles receive massive popularity due to their performances and efficiencies in recent years. EVs have already been widely accepted in the automotive industries considering the most promising replacements in reducing CO2 emissions and global environmental issues. So, battery and BLDC motor have huge attention in EVs due to their feature such as lightweight and high efficiency. In many urban cities there is problem of air pollution caused by the IC engine vehicles. India is a large manufacturer and consumer of two wheeler, due to which the emission of harmful gases such as CO, HC and Nox increases. The main objective of this paper is to identify problem of electric bike and to improve the life of battery, battery charging system and drive control system.

Key words: Electric Bike, BLDC Motor, Battery Management System (BMS), Battery Charging System, Motor Controller, Battery Thermal Management System

I. INTRODUCTION

The transport sector is one of the major contributors to global energy consumption and GHG (greenhouse gas) emissions [1]. At the time when problems, such as increasing GHG emissions and air pollutions, as well as growing dependency on energy import, related to the conventional passenger cars transport based on fossil fuels, are becoming more and more visible, the use of alternative, environmentally friendly fuels and power-trains seems to be a key strategy for heading towards a sustainable transport system. Especially in cities, where due to the urbanization trend transport developments are becoming even more important, there is need for action to cope with transport problems. Some of the problems related to urban areas such as local air pollution and noise, could be reduced by using zero-emission battery electric vehicles. It is estimated that 25% of the total cars across the world will run on electricity by 2025.

Other vehicles alternative fuel vehicle is a vehicle that runs on a fuel other than traditional petroleum fuels petrol or diesel fuel; and also refers to any technology of powering an engine that does not involve solely petroleum such as electric car, hybrid electric vehicles, and solar powered and hydrogen fuel. Because of a combination of factors, such as environmental concerns, high oil prices and the potential for peak oil, development of cleaner alternative fuels and advanced power systems for vehicles has become a high priority for many governments and vehicle manufacturers around the world. [2]

Solar car is an electric vehicle powered by solar energy obtained from solar panels on the car. Solar panels cannot currently be used to directly supply a car with a suitable amount of power at this time, but they can be used to extend the range of electric vehicles. These events are often sponsored by Government agencies of Energy keen to promote the development of alternative energy technology such as solar cells and electric vehicles. [3]

Electric vehicles (EVs) whose main energy storage is in the chemical energy of batteries. Batteries used in electric vehicles include lead-acid, Ni-Cd, nickel metal hydride, Li-ion, Li-poly and zinc-air batteries, the best battery among all is Li-poly but due to cost of it is not considered but Li-ion is better battery according to charge storage and weight consideration other than Li-poly battery.[2] Lithium-ion batteries have gained huge attention in automotive application due to their features such as lightweight, fast charging, high energy density, low self-discharge and long lifespan. During the lifespan of the battery, the State Of Charge (SOC) is an important parameter as it shows the remaining available energy in a battery that provides an idea about charging/discharging strategies and protect the battery from over charging/over discharging [4].The State Of Health (SOH) shows the ability of a battery to store and supply energy relative to its initial conditions, considering the energy and power requirements of the application. SOH reflects the current condition of the battery in terms of a percentage at its BOL (begin of life) & at EOL (end of life).At SOH < 80%, the battery is considered no longer usable by an electric vehicle and should be replaced [5].An effective BMS using the lithium-ion battery is compulsory so that battery can operate safely and reliably, prevent any physical damages, and handle thermal degradation and cell unbalancing. Different states of the battery such as the SOC, SOH can be assessed through an efficient battery management system. Further, A large amount of heat will be generated when the battery pack work, as these heat generated heat of battery cannot be ejected quickly the temperature of the battery will increase. These high temperature will damage the battery packs or even cause explosion of the system, to control these problems Battery Thermal Management System (BTMS) should be used [6].

Other than battery, to power the vehicle, an electric motor, which is the most important in an electric vehicle. Motor such as brushed DC motor, AC motor, and last which is most reliable which brushless DC motor is. [3]

The charging sources of EV is Universal battery charging system and Stand-alone PV-EV battery charging system are two available battery charging system .The universal battery charging system shown in Fig. 1 is the conventional system in which, the battery is charged using the power from the utility grid. Renewable energy sources can also be used for charging the EV battery without utilizing the grid power [7]. PV stand-alone system shown in Fig. 2 is one of the off-board chargers used for charging the battery without utilizing the grid power. Due to the intermittent nature of solar irradiation, an additional storage battery bank is necessary in this configuration. Excess power of PV array gets stored in the additional battery and this power is utilized to charge the EV battery under low irradiations this system can also be used as

an on-board charger without the additional storage battery [7].

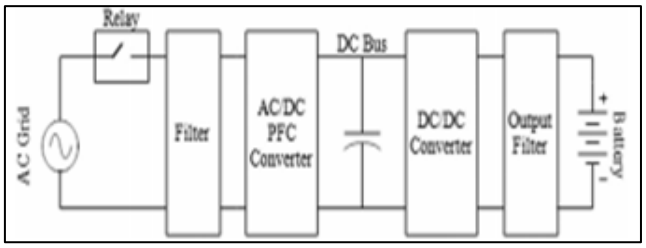

Fig. 1: Block diagram of the universal battery charger [7]

A battery -assisted charging system that was developed to improve the charging performance of a quick charger for electric vehicles. It mainly consists of an alternating current-to-direct current inverter, a direct current-to-direct current voltage converter, a stationary battery, and an electric vehicle charger. Performance in simultaneous charging of two EVs during winter with conventional QCs and BACS under a contracted power capacity of50 kW. Figure 2 shows the results of simultaneous charging of two EVs during summer with a conventional charging system and BACS [8]. Similar tendency to the case in winter can be observed.

II. LITERATURE REVIEW

A. Dissemination of Electric Vehicles in Urban Areas

Major factors for success: The most important recommendation for policy makers is that all monetary and non-monetary promotion measures implemented should depend on the environmental benignity of the electricity generation mix. From society's point of view the promotion of EVs make sense only if it is ensured that a major share of electricity they use is generated from renewable. Since the final goal is not just to increase the number of EVs but to reduce emissions. The fact that BEVs do not produce emissions at the point of use is an important feature for many cities and reason that most of them provide financial and other incentives for their purchase. However, EVs contribute to emission reduction but the corresponding cost benefit ratio is very high.

B. Design of Permanent Magnet Brushless Dc Motor Control System Based Dspic30f4012

This paper concludes that brushless DC motor consist of three major parts, motor body (the armature at the side of the stator, the permanent magnet at the side of the rotor), position sensors and electronic commutation circuit. The working principle is as with output signal of the position sensor which reflects the position of the rotor, electronic commutation circuit drives the corresponding power switching device with the armature winding connection, in turn makes the armature winding feed, thus generates jumping rotating magnetic field in the stator, and drives the permanent magnet rotor rotate. With the rotation of the rotor, position sensors (Hall sensor) constantly send signals, change the power state of armature windings, and make the conductor current direction remain unchanged under a pole. In the absence of mechanical contact body composed of commutator and brush body, the brushless DC motor has no commutation spark, while has a long life and reliable operation.

C. Design and Implementation of Brushless Dc Motor Drive and Control System

This paper concludes brushless DC motors (BLDC) have some advantages over conventional brushed DC motors which are mainly better speed versus torque characteristics, high efficiency, high dynamic response, long operating life, noiseless operation higher speed ranges, and low maintenance. The fine performance of BLDC obtains everybody's favor, but the control complexity and high cost of the dive hold back the widespread use of BLDC motors. Reduce cost controllers for BLDC motors are more in demand and many schemes and algorithms for reduced cost controllers have been reported in the literature [3]. One designs and implements a High power BLDC motor closed-loop control system and on the basis, one uses PID control.

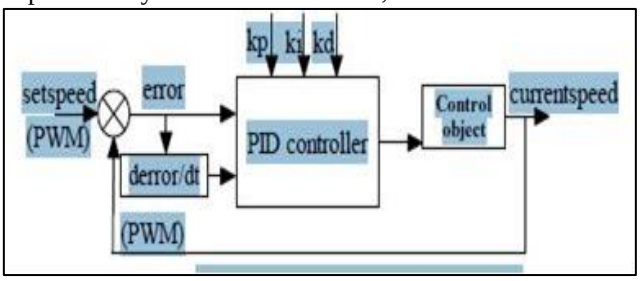

Fig. 2: PID Controller [3]

D. A Review of Lithium –Ion State of Charge Estimation and Management System in Electric Vehicle Application

The review shows many factors and challenges with possible recommendations for the development of BMS and estimation of SOC in automobile applications it also explains different existing methodologies and addressing the key issues and challenges for the estimation of SOC. The results obtain for further technological development are [4]: In achieving proper system functionality and market acceptance, safety, mobility, and durability issues of lithium-ion battery needs to be addressed. An efficient battery management system in terms of charge equalization, thermal control, fault detection, battery charging/ overcharging in obtaining SOC with high accuracy needs to be established. Further research on SOC estimation methods need to be investigated over conventional methods under the effect of aging, hysteresis, different discharge rate and temperature. An appropriate model needs to be developing for the estimation of SOC using an adaptive filter algorithm under various model uncertainties and disturbances in the system. An optimal number of neurons selections in the hidden layer of the intelligent network and parameters optimization model with less computational time using learning algorithm needs to be further researched. Designing an appropriate controller to enhance the robustness of nonlinear system and predictive analytical model to achieve a good accuracy of SOC estimation need to be investigated .A generalized validation and benchmark method for SOC estimation method is necessary. Further studies need to be conducting to improve the performance of wireless power transfer to charge a battery in terms of data security, reliability, and interference. These suggestions would be a remarkable contribution towards the accurate estimation of SOC.

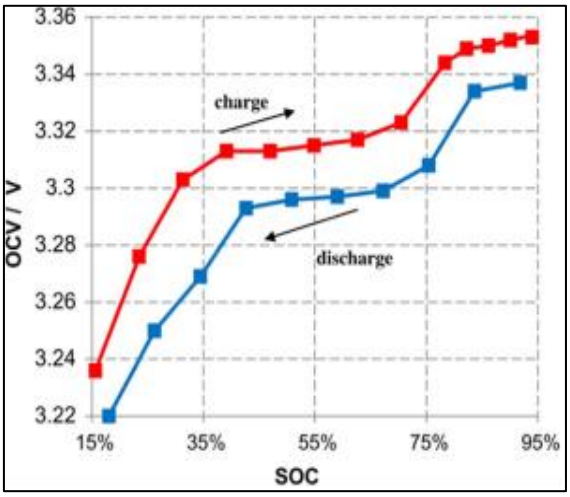

Fig. 3: OCV/V vs SOC charge and discharge profile of C/LiFePO4 battery tested under 25 °C, for 3 h [4].

E. State Of Health Estimation Algorithm of Life Po4battery Packs Based On Differential Voltage Curves for Battery Management System Application

This paper discusses an accurate method for estimating SOH in battery packs. The advantages of this methodology demonstrated in this paper can be summarized as the technique can be easily implemented in a BMS, making it possible for it to be used in real applications. It can detect the EOL of the cells, so an alarm can be programmed in order to warn the user of the aging situation. The method has been also validated at battery pack level, in which a module of 12 cells was tested. The application will always be available. In the event that the estimation program is running, but the application needs to be used, the SOH estimation will automatically stop, always giving priority to the user's needs. Because of the partial charging or discharging tests, there is no need to fully discharge the battery in order to obtain the estimate. For this reason, and in relation to the previous point, no matter when the technique is stopped, it will always have enough energy to continue with the operation.

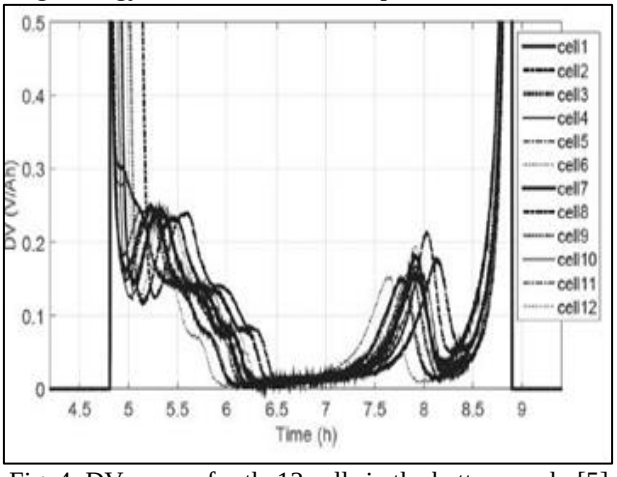

Fig. 4: DV curves for the12 cells in the battery pack. [5]

F. Structure Optimization of Parallel Air Cooled Battery Thermal Management System

This paper includes different cooling system or methods & their optimization. The cooling performance of the parallel air-cooled BTMS is improved through optimizing the structure of the system. The airflow distribution of the system is calculated through the flow resistance network model. Newton method is introduced to obtain the optimal plenum widths, with the target of minimizing the standard deviation of airflow velocities in the cooling channels [6].The airflows of the BTMSs before and after structure optimization are calculated through CFD method, respectively. The cooling performances of the two systems are compared[6].It can be concluded that Newton method combined with the flow resistance network model is an effective method to improve the cooling performance of the parallel air-cooling BTMS through optimizing the widths of the divergence plenum and the convergence plenum[6].

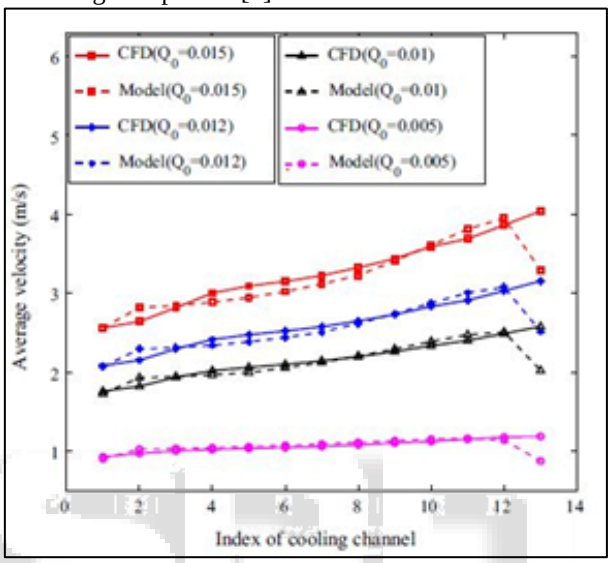

Fig. 5. Comparison of the results of flow resistance network model and CFD methods for the optimized BTMS for various inlet flow rates. [6]

G. RES Based EV Battery Charging System

This paper comprehensively reviews the current status and different methods for the deployment of EV with the latest technologies for the integration of EV with the PV array, also reviews the sources present for Electric vehicle charging system and the types of batteries used formerly and on the ease of development with the PV-EV charging system and WTG-EV charging system. It enables the individual to choose appropriate sources and methods of charging for the different electric vehicle charging system to meet the desired requirements.

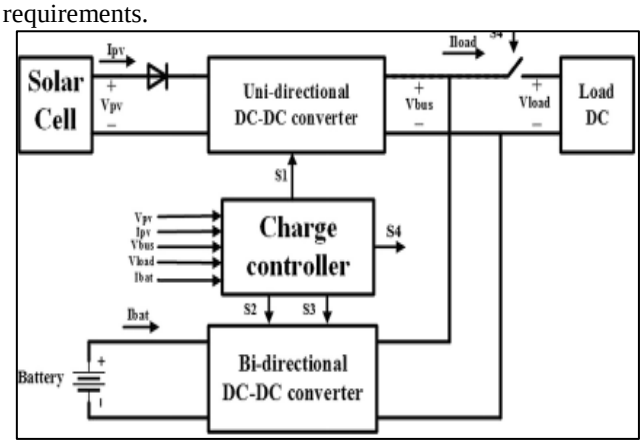

Fig. 6. The structure of PV/battery hybrid system [7]

H. Battery Assisted Charging System for Simultaneous Charging Of Electric Vehicles

This paper reviews battery assisted charging system was developed and its performance in simultaneous charging was evaluated. Charging behavior of Electric vehicle in different season's winter and summer was clarified in terms of the influence of temperature on the charging rate. It is believed that battery temperature strongly influences the charging behavior of a battery, and ambient temperature influences the battery temperature. It was clarified that the charging rate during summer is higher than that during winter. In the simultaneous charging experiment, the Battery assisted charging system clearly improved the performance of EV chargers. Charging was performed in a shorter time, while maintaining the contracted power capacity. In future, as the demand for EVs charging increases, grid stress due to charging demand and its fluctuations would increase accordingly. The adoption of BACS would minimize this stress and maintain the quality of grid electricity.

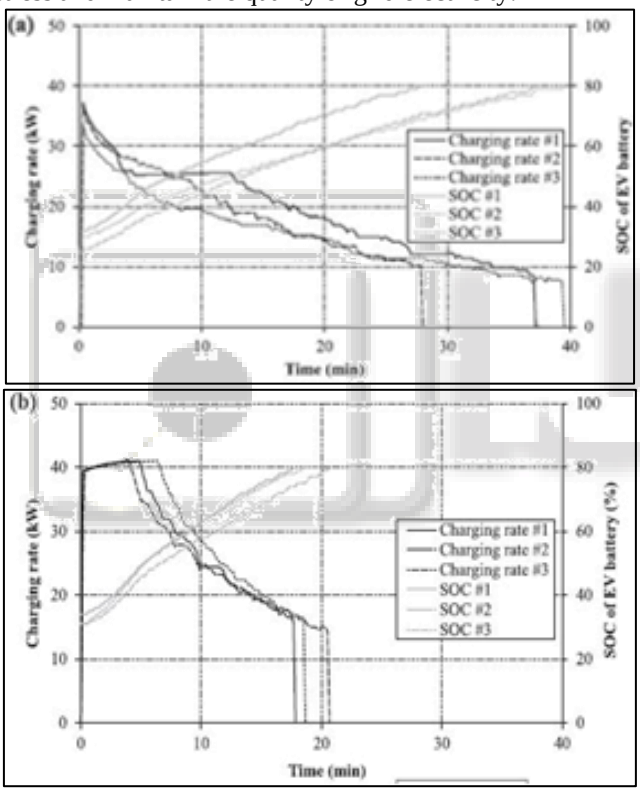

Fig. 7: Relationship among charging rate, charging time, and SOC of EV battery: (a) winter (b) summer. [8]

Fig. 8. Developed BACS used for the experimental study: EV quick charger [8]

III. OBSERVATION

We concluded that Environmental and Economic is the reason are making the Electric Vehicles a reality nowadays. Electric bike would be the better option for conventional motorbike in urban area to reduce the pollution in some extent and one of the cheapest mode of travel. Electric bike is more convent to travel for point to point. BLDC motor reduces the contract power capacity. To extent the battery life i.e. state of health and to maintain the state of charge the battery management system should be used (BMS) and also to maintain the temperature of battery to extend the life of battery. Obtain information related to state of charge and state of health helps in optimizing the battery performance. The main energy storage element used in electric vehicle is battery, battery need to be charged and for this battery assisted charging system is required save battery for being over charge.

IV. FUTURE-SCOPE

- Electric Vehicle is the future of Transportation.
- To develop lithium-polymer battery pack with low cost.
- Regenerative is way to increase range of distance travel.
- To work on battery management system to increase the battery cycle life.

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