Design of Battery Management System in Electric Vehicle

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Abstract *–Electric vehicles are used to overcome environmental issues like global warming and greenhouse effect in the automotive world. To promote electric vehicle, the central and state governments have launched incentives with some regulations and standards. In batteries, lithium ion has advantages like lightweight, fast charging, and low self-discharge and long lifespan as compared to Lead-acid battery so it is used widely. The performances of the EVs are affected by driving conditions braking energy recovery strategy. Brushless DC motors has features like speed versus torque characteristics compared to permanent magnet DC Motor , low maintenance, high efficiency and dynamic response, noiseless operation, higher speed ranges, long operating life compared to other motor. Drive controller and battery management system is used to control and operate the motor and battery smoothly for the long run. the above components which will make the electric vehicle which is better option to nonelectric vehicle in order to reduce environment issues. This paper deals with design and fabrication of battery management system of electric bike in which electrical power is used.*

Keywords: **Battery, Electric Vehicle(EV), Microcontroller, Battery Management System**

I.INTRODUCTION

Nowadays due to increasing emissions from the vehicles, increases the level of global warming, greenhouse gases and the mass use of fossil fuels, results electric vehicles came into picture as they deliver very good results in performances, safety and efficiencies mileage in recent years. An electric vehicle also called an EV, uses one or more electric motors and controller or traction motors for impulsion instead of fossil fuel. First electric carriage was coming into existence in 1830s and the first electric vehicle was built in United States in 1891.

The types of Electrical vehicle are battery electric vehicle hybrid electric vehicle plug-in hybrid electric vehicle fuel cell electric vehicle. Electric vehicles will play a very important role in changing the environment and also avoiding the pollution around in future. EVs provide fast acceleration and power instantly with smooth feel to the wheels by providing high torque at low speeds; they give a feel of smooth and quick responsiveness.

II.LITERATURE REVIEW

Mr Sai Krishna Vempalli gives physical modeling approach has been used for vehicle modeling to improve the modeling efficiency. Dynamic model of the electric vehicle is designed using Mat lab/Simulink and Sim Power System/Sim Driveline toolbar. Mr. Xiao Juan Liu intoduced the system that can simulate charging load of various types of vehicles, and versatile set of convenience, security and scalability in one. The physical system was established and the load characteristics of EV was modeled with the system, which verified the function of the system and at the same time offered a lot of experience to present for them. This paper[3] taking a electric vehicle motor drive system design as an example, power calculation, motor and drive system design, parameters selection procedures, to elaborate motor driver system.

III. DESIGNING OF ELECTRIC VEHICLE

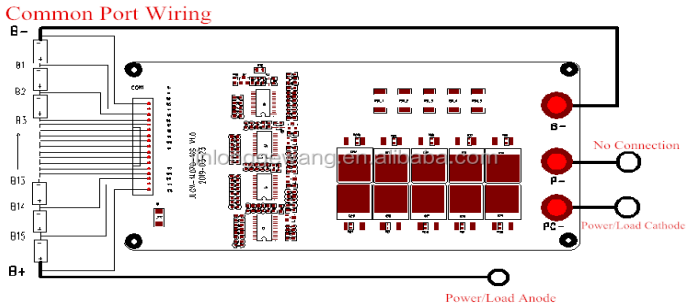
A. BATTERY MANAGEMENT SYSTEM (BMS)

Battery management system is used for observe the battery voltage, cell voltage, charge /discharge. It is used for short circuit protection and it allows cutting of max allocated voltage that is 2.55V each cell during the charging. During charging ,each cell reach up to 3.6V at that time BMS cuts the power supply from the charger. During the discharging will cut off allocated voltage. BMS is having N-channel MOSFET Basically is used for switching purpose.LM339 comparator is used for to cheek the voltage level of each cell. To keep away from short circuit protection, shunt resister is used. Temperature sensor is used for to measure cell temperature in series.

Table no: 1 BMS Specification

Model Name/Number	Life Po4 BMS 60v 19s 50Amp
Battery Capacity	50Amp
Voltage	60v
Battery Type	Lithium Phosphate
Usage/Application	Lithium Phosphate Battery
Capacity	50Amp
Continues Discharge	50 Amp
Peak Current	100 Amp

Low Cut-Off Voltage	48.5v
High Cut-Off Voltage	69.3v



B. BLDC MOTOR

These motors are very popular and technically versions of DC series motors. It is brushless motor in which permanent magnets are used. BLDCs motor is having high starting torque and efficiency and low maintenance. BLDCs are very popular these days either as the hub motor or mid-driven. The main disadvantage is the high cost due to permanent magnets. Overloading the motor beyond maximum value affects permanent magnets due to thermal conditions. BLDC motors can be constructed in different physical Layer. Depends on the stator windings, these can be used as 1 phase, 2 phase, or 3phase motors. 3-phase brushless DC motors with permanent magnet rotor are most used.

Stator of a BLDC motor made up of stacked steel laminations to carry the windings which are placed in slot cuts along the inner periphery of the stator. These windings can be arranged in star or delta connection. Most of the motors have three phase star connected stator. Each winding is constructed with interconnected coils; one or more coils are placed in each slot.

C. BATTERY

A battery is an electrochemical device which store power in the form of chemical energy. It works on to chemical reactions in which electrons flow through circuit when the external circuit is connected to the anode and cathode. Battery is used for to provide the power to motor to all application. Lithium phosphate type cell used in the battery. Major advantage of lithium cell is non explosive. Battery is used where we can store energy is required to be stored for future purposes. Emergency purpose batteries for backup. A portable device has a battery to use anywhere you want. An emergency device like an inverter, torch are used when there is no power. Low power devices like watches, ox meter and all other applications The mains supply is not appropriate for all situations. It will depend upon the devices requirement like how much power is needed or what device.

D. SPEEDOMETER

Speedometer will indicate the speed of the vehicle. A Hall sensor which detects the presence and magnitude of a magnetic field using the Hall effect. The output voltage of a hall sensor is directly proportional to the strength of magnetic field. Hall sensors is basically used for time the speed of wheels and shafts, such as for internal combustion engine ignition timing (ICE engine), tachometers and anti-lock braking systems. They are used in brushless DC electric motors to identify the arrangement of the permanent magnet.

E. HALL SENSORS

Hall sensor is used to gives supply to stator armature excitation with rotor position the commutation of BLDC motor is controlled electronically, the stator windings should be energized in order to rotate the motor. Before energizing a particular stator winding status of rotor position is essential. So the Hall Effect sensor senses the rotor position. BLDC motors three Hall sensors which are embedded into the stator. Whenever the rotor poles pass nearby it each and every sensor generates low and high signals. The commutation sequence to the stator winding can be based on the combination of three sensor's response or output of the three sensors.

F. MOTOR CONTROLLER

The motor controller takes power from the batteries and deliver it to the motor as per specification. The variable resistors, and these potentiometers provide the signal that tells the controller how much power is actual delivered. The controller can deliver zero power, full power or any power level in between which is easy to understand. Just take one example that the EV battery pack contains 3.3volt batteries(+B), wired in 19 series to create 62.7 volts. The controller takes in 5 volts DC, and delivers it to the motor . In an BLDC controller, there has bunch of 3 MOSFET connected in pair of 4 used to take feedback from hall sensor in the form of digital 0 and 1.Controller will decides to change the polarity of motor to change the direction of motor to move clockwise or anticlockwise. Controller is designed for electric motorcycles and electric scooters, equipped with powerful and intelligent microcontroller.

G.DC-DC STEP DOWN CONVERTER

Step-down converter is used to steps down voltage from its input to its DC output. It is type of SMPS typically containing two semiconductors and one energy storage element, inductor, a capacitor, combination of both. , Filters are used to reduce voltage ripple in which capacitors are used to convert 60V to 12V. It is called a step down because the voltage across the inductor opposes the supply voltage.

Dc –dc converter is used to provide high to low voltage application that why controllers less voltage application.

H. BLUETOOTH MODULE HC05

It is used for several applications like wireless headset, mouse, keyboard and many more consumer applications. It has range up to 100m which depends upon transmitter and receiver devices or module. Basically it used for serial communication to communicate with devices. Bluetooth has two pins used for transmitting and receiving purpose works on 5V. HC-05 is a Bluetooth is designed or it will allow to use for wireless communication. This module or devices can be used in a master or slave both the configuration. Send data from mobile terminal to HC-05 Bluetooth module and see this data on PC serial terminal and vice versa. To communicate mobile with HC-05 Bluetooth module, mobile requires Bluetooth for transmitting and receiving data. Without Bluetooth we are not able to send the data or signals etc. You will get Bluetooth terminal applications for android and windows in respective MIT App.

I. MICROCONTROLLER

A microcontroller is a small computer on a single metal-oxide-semiconductor board integrated circuit & chip.. We had used ATMega328P microcontroller.

Programs might me change depend upon application Microcontrollers are embedded inside devices to control the actions and features of a product. They can also be called as embedded controllers. There are multiple language for the coding Microcontrollers will take input from the device they control and retain control by sending the signals to different parts of the device.

J.MOSFET

MOSFET full form Metal Oxide Silicon Field Effect Transistor. This is also called as Insulated Gate Field Effect Transistor. The FET is operated in depletion and enhancement modes of operation. It works by electronically varying the width of a channel along which charge carriers (electrons or holes) flow. P channel MOSFET is used to switch the motor. MOSFET driver is used switching purpose.

K. OPTO-COUPLER

Opt couplers known as opto-isolators, are semiconductor devices that isolate unwanted signals by physically separating high-voltage circuit from low-voltage systems.

IV. WORKING PRINCIPLE

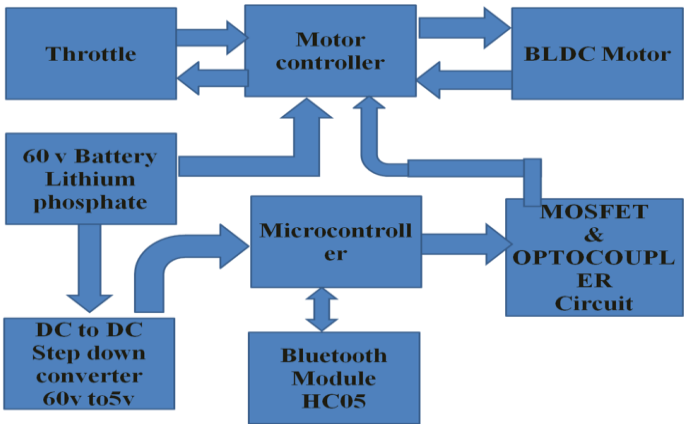


Figure 1: Block Diagram of Electric Vehicle

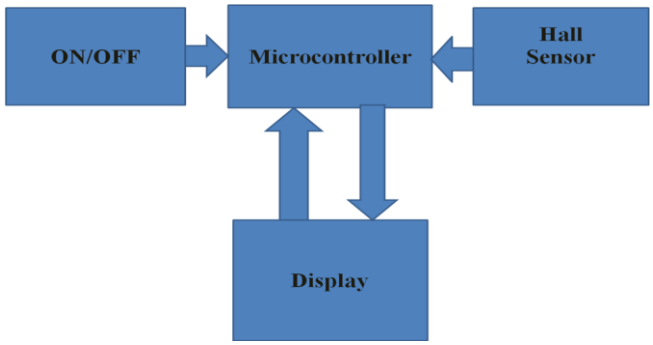


Figure 2: Block Diagram of Speedometer Electric Vehicle

Electrical vehicle will start the vehicle through remote on/off will be controlled through mobile app. Once if application is opened from mobile it will connect app to vehicle through Bluetooth. There are two buttons in the application to ON and OFF vehicle, throughout data will get through Bluetooth to microcontroller serially. Microcontroller will act as per the user input. P channel MOSFET driver is used switching purpose as it goes to positive terminal. BLDC motor is used in this project, it will control motor controller. BLDC motor will operate through enable signaled-dc converter is used for 62V to 12V conversion. IC7805 is used to converts the voltage 12V to 5V as 5V is required for Bluetooth, 16*4 LCD display ,microcontroller and throttle. Throttle is used for speed control. Speedometer is used for the speed indication purpose.

We can charge an electric vehicle by plugging it into a public charging station or into a home charger. There are number of charging stations around other countries but in India, we do not have enough charging stations so to get the best deal for home charging, it's important to get the right EV electricity tariff, so you can spend less money on charging . Depending on our motorcycle, it should take about a couple of hours to charge a battery to full using a Level 2

charger. Connector XT60 is used for high voltage and high current.

V. CONCLUSIONS

In this paper we described the design of BMS in electric vehicle. Batteries are used engineered to have a good life. An improved battery model was proposed in this work by considering the self discharging effect, torture effect the fading capacity effect observed in all batteries. Lithium Phosphate Battery is used of 50 amp current to run the bike.

The model is simulated by using the our design application "Key of electrical vehicle". Result will be observed though the design application. The charging percentage, speed, battery voltage and if any phone calls received will be displayed over 1682 display of design application which is connected to mobile.

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