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LOW POWER ELECTRIC TWO-WHEELER WITH INTELLIGENT COOLING TECHNOLOGY

Meenu Jose Thekkan
Assistant Professor
Department of Electrical and electronics engineering
Universal Engineering College, Thrissur, Kerala, India

Alkka PS, Ardra V S, Saji T M, AwinShajan
Department of Electrical and electronics engineering
Universal Engineering College, Thrissur, Kerala, India

***Abstract*—In the past decade, the electric two-wheelers have been popular in many of the southeast Asian countries for urban drives. Presence of electric two-wheeler is fastly growing in India too. Environmental problems promote the development of new generation EVs for transportation. Electric scooters are plug-in electric vehicles that runs on battery and can be recharged from any external sources of electricity. The important parts of electric scooter include a motor, battery pack, controller etc. Since electric scooters are not using an engine, it becomes an effective way of road transport as it does not cause any pollution. In future, electric two-wheelers maybe a replacement product for the engine driven vehicles, provided that safety, drive performance and cost issues are similar to that of actual engine EVs.**

In this paper, we have proposed a low power electric two-wheeler with an intelligent cooling technology. A custom build portable Li ion battery pack is developed which gives power to the electric scooter. An intelligent cooling technology is applied to the battery pack using a thermostat module to cool the battery while overheating. A gear mechanism is implemented to reduce gear strain on the motor. The advantage of the model is that it does not cause any pollution, more energy efficient, smooth operation and depends wholly on electricity.

***Keywords*—Battery management System (BMS), Permanent magnet DC Motor (PMDC), Electric Scooters (ESs), Electronic speed Controller (ESC).**

I. INTRODUCTION

The number of vehicles being brought to the road is increasing daily so it adds to the pollution problem. Internal combustion engines are to blame for the huge source of pollution that causes greenhouse gases leading to global warming. In addition, the growing environmental and economic crisis arising from oil dependence is likely to soon lead to a global crisis as global oil prices decline. Electric vehicles, fuel cell cars and hybrid electric vehicles have been extensively researched to improve fuel efficiency, gas emissions and vehicle performance. Car manufacturers want to upgrade electric vehicles to replace internal combustion engines. Electric cars have never been widely accepted in the market due to their natural limitations, which include high cost, limited acceleration ability, low climbing ability and insufficient driving distance. Hybrid electric vehicle that integrates fuel cell systems is becoming an attractive option. Hybrid electric vehicles usually have two or more sources, such as internal combustion engine, battery and fuel cell. Proton Exchange Membrane fuel cell vehicles are the most efficient use of motor vehicles due to the low operating temperature and fast start time. The development of fuel cell vehicles is a very difficult task with many technical problems. Therefore, fuel cell vehicle authentication with flexible vehicle performance indicators such as acceleration and acceleration capability are very important.

Electric two wheelers are increasingly needed as an alternative means of transportation for short distances. This practice is encouraged by increased awareness to avoid air pollution and harmful fumes from petrol and diesel engines. A two-wheeler is especially useful if traffic is heavy and parking is limited. Additionally, costs per grade are relatively low. Recently, improved battery packages and chargers have increased the range with each charge. Despite their advantages, however, some obstacles remain. Many such systems are designed for low speed only; driving efficiency, reliability and power density should be improved, while torque-to-weight ratio and value should be further reduced. Achieving these goals has been achieved through extensive research into vehicle construction.

In this paper, we have proposed a low power electric two-wheeler with an intelligent cooling technology. A custom build portable Li- ion battery pack is developed which gives power to the electric scooter. An intelligent cooling technology is applied to the battery pack using a thermostat module to cool the battery while overheating. A gear mechanism is implemented to reduce gear strain on the motor. The advantage of the model is that it does not cause any

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II. MODELLING OF ELECTRIC SCOOTER

Major Components of Electric Scooter are:

1. Li-ion Battery Pack
2. BMS Module
3. Battery Charger
4. PMDC Motor
5. Chassis
6. Motor Controller
7. Throttle
8. Electric Brake
9. Thermostat
10. BLDC cooler

1. Li-Ion Battery Pack

Li-ion battery is rechargeable battery made of li-ion cells. When we charge the battery, Li-ions move from cathode to anode. When the battery discharges, the anode releases Li-ions to the cathode, generating a flow of electrons from one side to the other. The Li-ion cell is made of graphite as anode and lithium oxide as cathode with lithium hexafluorophosphate as electrolyte.

Construction

For the construction of battery pack, we are using 56 Li-ion cells. All the cells are placed in a cell holder and are connected through spot welding. 7 cells are connected in series and 8 cells are connected in parallel by using Nickel strips of 8mm thickness to produce 24V, 20AH Li-ion battery pack. A BMS module of 24V, 7S, 20A is connected together with battery in order to ensure proper charging and discharging of each cell. Itaccts as a supervising system which prevent battery failure and ensure safety operation of battery pack.

BMS Module consist of one charging port, one common neutral point and a positive terminal. Since 7 cells are connected in series, we have 7 feedback wires coming out from BMS module. Each of these wires are connected to each individual series cells.

Now for intelligent cooling of the battery, a 12V, 1A thermostat temperature controller accompanied by a 12V,0.27A BLDC cooling fan is connected.

Working

When a Li-ion battery is plugged, the positively charged ions move from the anode to the cathode. Thus, cathode becomes more positively charged than the anode and in turn, attracts negatively charged electrons to the cathode. A separator in the cell promotes ion movement between them through electrolyte. Movement of ions through electrolyte causes electrons to move through the device, battery is plugged into. Li-ion battery is a rechargeable battery. While recharging, lithium ions moves but in opposite direction which restores the battery for additional use.

Cooling mechanism works according to the temperature variations. We are using a 12V, 1A thermostat with a bldc cooling fan. There is a provision to setup a desired temperature. When the real time temperature crosses the desired temperature, fan automatically turns on and when the temperature is lowered, it turns off.

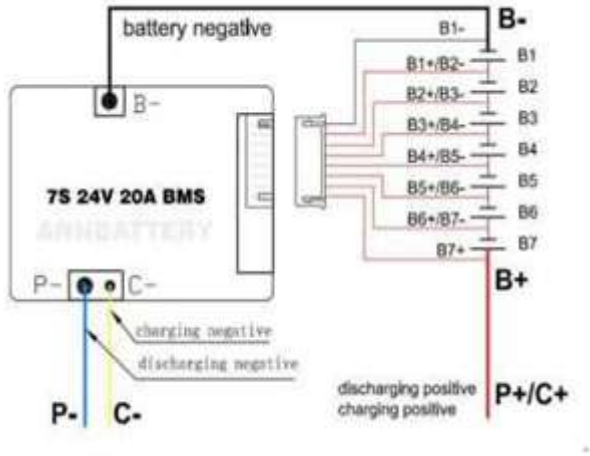

Fig.1. Connection of battery and BMS

2. Bms Module

Battery Management System is used in EVs to improve the quality of battery and its safe operation. It is a supervising system which ensures that batteries function properly in final application. The primary function of a BMS is to fulfill safety requirements, to prevent battery failure and to mitigate potential hazardous situation. It measures individual cell voltages, current, temperatures at different points as close as possible to battery and balance battery cells passively or actively.

Specification: 24V, 7S, 20A.

3. Battery Charger

We are using 29V, 3A battery charger. Battery charger is a device that stores energy in a battery by running an electric current through it. The charging protocol depends on the type and size of battery being charged. Charger consists of temperature or voltage sensing circuits and a microprocessor controller to determine state of charge and to safely adjust the charging voltage and current.

4. Pmdc Motor

PMDC Motors are those motors whose poles are made up of permanent magnets. The permanent magnets are mounted on inner periphery of cylindrical steel stator and are radially magnetized. Stator serves as return path for flux produced and rotor with commutator segments and brushes.

Model – MY1020

Specification: 500W, 24V, 2.5A – 27.4A, 2500rpm, 19Nm.

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Unloaded			Rated Loaded			
Volt	Speed	Current	Torque	Speed	Current	Efficiency
24V	3150	2.5A	1.90	2500	<=26.7A	>=78%

TABLE 1: MOTOR SPECIFICATIONS

5. Chassis
Chassis of a vehicle is the load bearing framework of the motor vehicle on which the body is mounted along with the running gear like wheel and transmission, drive shaft and sometimes even the driver's seat is included in it, thus forms a rolling chassis.

6. Motor Controller
Controller acts as the brain of the e-scooter. Motor controller is used to connect all the electrical components in an electrical scooter. It directs and regulates power from battery to motor and governs braking, riding modes and ultimate stopping.
Specification: 24V, 500W, YIYUN YK31C Brushed controller.

7. Throttle
It is the accessory of an electric scooter that is mounted directly to the handle bars in order to give riders the ability to easily control the speed of electric scooter.

8. Electic Brake
Electric brakes are devices which uses an electric current or magnetic actuating forces to slow or stop the motion of the rotating component. It provides both e-brake and mechanical brake for safer operation. Mechanical drum brake is used here.

9. Thermostat
Thermostat is a temperature control module which displays and controls temperature. It is mounted along with battery pack and is used to switch on and off an electrical circuit.
Specifications: 12V, 1A.

10. Bldc Cooling Fan
Temperature changes always impact performance of any electronic devices. A cooling fan is a vital component in any cooling system. It takes away all heat absorbed from the system and helps to get a stable temperature.
Specifications: 12V, 0.27A.

III. METHODOLOGY

Electric scooters are plug-in electric vehicles mainly with two or three wheels. They are very simple to ride and maintain and that's why they are so useful and fun. Since electric scooters are one of the modern transportation technologies, they are still not very complex in their way of work compared to other vehicles.

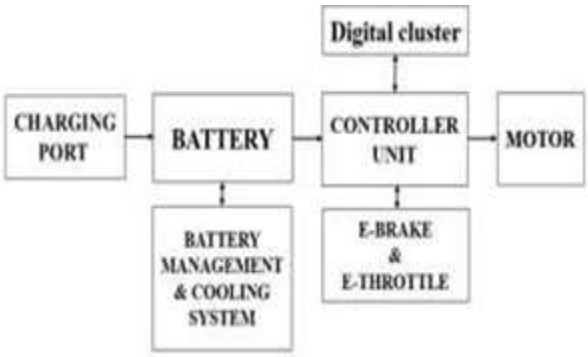

Fig.2. Block diagram of electric scooter

Electric scooters are made up of several components. Battery is the heart of the electric scooters. The most important features like overall performance, maximum distance it can run on a single charge depends upon the voltage, charge and energy storage capacity of battery. A BMS module is connected with battery to improve quality of battery and to ensure safe operation of battery pack. The motor has equal importance as that of battery. Quality and power of the motor will determine a lot about scooter performances like its speed, its torque, its range and its ability to climb hills. In our proposed system, we have placed PMDC motor over the deck provided with chains and gears to turn the wheel in order to increase the torque. Motor and battery are connected through electric wires and their performance is managed by rider through controller unit. Throttle control is provided on right side of the handlebar with an LED screen either placed at center or on the right handlebar. Both e brake and mechanical brakes (Drum) are provided. Wheels are an obvious part of the scooter. They are of two basic types - air filled and solid.

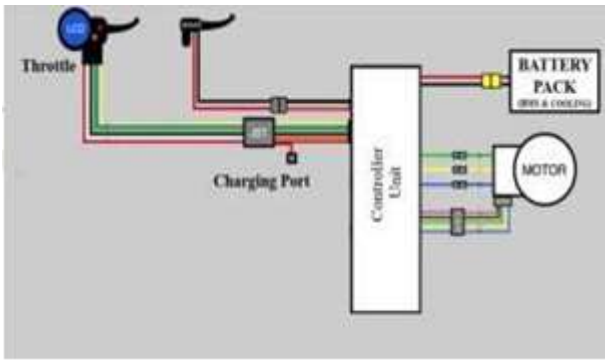

Fig.3. Circuit diagram of electric scooter

All these components are integrated tightly into a solid frame which is made up of aluminum alloy, or sometimes of carbon fiber. The frame can be divided into the stem, which is the front pipe-like part and the deck, which is the surface on which rider stands. In our proposed system, we have provided a seat with shock absorbers for comfortable drive and electronic components like one headlight, indicator one or more smaller lights in the rear to serve as brake lights too.

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When the rider presses the throttle, it sends a signal to the battery. The battery sends the power to the motor through wires. Motor thus rotates producing a movement of the wheel sand propel the scooter forward.

IV. RESULT ANALYSIS

Fig.4. Final image of Electric scooter

Fig. 5. Custom build Li-ion battery pack with intelligent cooling technology.

Fig. 6. Chain gear mechanism drawn in CAD

V. CONCLUSION

The paper presents the development of a low power electric two-wheeler with intelligent cooling technology. A custom build portable Li-ion battery pack is developed which gives power to the electric scooter. An intelligent cooling technology is applied to the battery pack using a thermostat module to cool the battery while overheating. A gear mechanism is implemented to reduce gear strain on the motor. We have used a PMDC motor and li-ion battery pack to run the scooter. When it starts to move, the front wheel generates electricity with the help of the rear wheel and energy is stored in the battery to power the horns, indicator etc. Motor is powered using a li-ion battery pack loaded with BMS module for security. All components are connected to the control unit where we get options to send signals to throttle, lcd display and braking. A charging port is provided for charging the battery pack. Nowadays the use of gasoline vehicles is increasing rapidly leading to more air pollution. To control this, the use of EV is appropriate because it has few advantages such as the electric scooter is an environmentally friendly product, very suitable for the city as it can avoid emissions of harmful gases and thus can reduce air pollution.

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