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DC Fast Charger and Battery Management System for Electric Vehicle

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Abstract:

The idea of developing a DC fast charger for EV in order to reduce the cost of production by manufacturing within our country. The charging mechanism is done in such a way to minimize the charging time of electric vehicles. Increase in charging stations will make the people to believe in this type of electric vehicles and the importance of it towards environment. PIC microcontroller is used to control the charging and the voltage regulator is used to control the charging voltage. The lithium ion battery type is used. The BMS manage the output, charging and discharging and provide notifications on the status of the battery pack. The temperature sensor LM35 is used measure the battery temperature and if the temperature of the battery rises abnormally the led and buzzer will alert to disconnect the battery charging.

Keywords **— PIC microcontroller, Control the charging voltage, Lithium ion battery, Battery Management System, LM35 temperature sensor**

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I. INTRODUCTION

An Electric Vehicle (EV) is a vehicle propelled by an electric motor, rather than a traditional petrol or diesel engine. The electric motor is powered by rechargeable batteries that can be charged using household mains electricity via an EV charge point at home or at a more powerful EV charge station at work or in the street. There are a few types of EV technology, the most common are plug-in electric hybrid vehicles (PHEV), range extender electric vehicles (REEVs) and battery electric vehicles (BEVs). The BEVs are focused in this introduction.

Battery electric vehicles use electricity, which is stored in a battery pack to power an electric motor and turn the wheels. When depleted, the batteries are recharged using grid electricity from a dedicated charging unit. The EV is refueled by plugging it into the charging unit or charging station, like charging a mobile phone. The same technology exists in hybrid vehicles, alongside a small petrol or diesel engine that also connects to turn the wheels when the battery is depleted. This powers the car at cruising speed, and batteries either provide power until depleted or extra power when accelerating. Batteries can recharge themselves when the car is decelerating or when plugged in. Hybrid technology means less pollution from the exhaust pipe, and can save money if the battery is charged before each journey.

In the range extender vehicles, the petrol or diesel engine only comes in when the battery is depleted, and instead of supplying locomotion to the wheels it instead recharges the battery which drives the car forward through the electric motor. The combustion engine is designed to be used on the odd occasions that the journey is too far for the electric battery to satisfy, and helps to alleviate some concerns with range limitations of battery electric vehicles.

Due to their sustainability and cheaper running costs, electric vehicles are likely to be the way of the future. However, they require a slight change in the vehicles in general. Currently, the fuel in car when it runs out or if the fuel is getting low, arrive to a petrol station, fill it back up and drive off. However, electric vehicles aren't really designed for petrol station refills as they take a few hours to recharge. To put it simply, this is similar in the way how mobile phones and other gadgets will be charged before using it.

The most important thing is a charging station installed at your house, so that we can charge the vehicle at home. Likewise, charging stations will eventually be set up at destination points like car parks and work places so that we can recharge the vehicle while we are not using it, instead of sitting at a petrol station for 4 hours. In fact, governing bodies of the European Union have proposed that all new and refurbished buildings with parking space for more than 10 cars should have to have an electric vehicle charging point on the premises. There will still likely be charging points at petrol stations but these will be rapid charge units to give your electric vehicle a blast of power while having a travel break.

Electric vehicles are predicted to be the next disruptive market force for transportation and technology. They have the potential to revolutionize how energy is used, created and redirected. The advent of electric cars has called for an improvement in overall energy usage and generation. They have shown how important it is to find alternate sources of fuel and they can positively affect the environment and society as a whole. When these electric vehicles are started to implement in our country the situation will change. At a public parking facility, the electric vehicles (EVs) that are parked at dedicated parking spaces with charging points can enjoy charging services. Installing charging points at many places will be helpful to overcome this situational crisis.

This project proposes the idea of developing a DC fast charger for EV in order to reduce the cost of production by manufacturing within our country. The charging mechanism is done in such a way to minimize the charging time of electric vehicles. Increase in charging stations will make the people to believe in this type of electric vehicles and the importance of it towards environment.

Battery Management Systems are the brains behind battery packs. They manage the output, charging and discharging and provide notifications on the status of the battery pack. They also provide critical safeguards to protect the batteries from damage. The single most important function that a battery management system performs is cell protection. Lithium ion battery cells have two critical design issues, overcharging them can get damaged and cause overheating or even explode so it is important to have battery management system to provide over voltage protection. Lithium ion cells can also be damaged if they are discharged below a certain threshold, approximately 5 percent of total capacity. If the cells are discharged below this threshold their capacity can become permanently reduced.

In this module, we are closely observing the battery temperature using the temperature sensor which is placed on each individual cell and monitoring it. If the temperature rises above the threshold limit the buzzer will ON and led starts to glow which indicates a caution alert to shut down the charging kit. The lithium ion cell battery temperature, voltage and current values will be displayed by the serial monitor. PIC microcontroller are electronic circuits that can be programmed to carry out vast range of tasks. They are programmed to be timers or to control the production line and much more. The voltage regulators are used to control the supply voltage to the microcontroller at

a constant voltage and thereby the battery starts charging. The analog signals which is received from the sensors is converted into digital signal with the help of inbuilt ADC in the microcontroller.

II. BOCK DIAGRAM OF THE SYSTEM

The block diagram for DC fast charger for EV is shown in Fig 1.

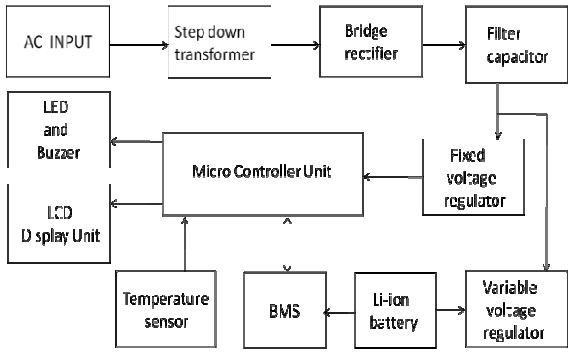

Fig 1. DC fast charger for EV

III. WORKING

A 230V AC supply is given to the step-down transformer. In the step-down transformer, the AC voltage is reduced from 230V to 12V.The bridge rectifier is an Alternating Current(AC) to Direct Current(DC) converter that rectifies mains AC input to DC output. This rectifier circuit are widely used in power supplies that provide necessary DC voltage for the electronic devices. The filter capacitor is a device that allows passing the dc component of the rectifier output. Thus, the output of the filter circuit will be a steady DC voltage. A voltage regulator is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. Two voltage regulators are used for various purposes. A fixed voltage regulator produces a fixed DC output voltage, which is either positive or negative.

In other words, some fixed voltage regulators produce positive fixed DC voltage values, while others produce negative fixed DC voltage values. An Adjustable/Variable Voltage Regulator regulates the output voltage within a desired range and can be adjustable within that range. Depending on the range of voltage to be adjusted, there are many types of adjustable voltage regulators. The two IC's used are LM317T and LM7085.PIC microcontroller is used here to carry out the vast range of tasks and calibrate the obtained values with the programmed values which are feed into IC through coding. The series of three lithium ion cells are used to produce the output voltage of 12V.A printed circuit board (PCB) is an electronic circuit used in devices to provide mechanical support and a pathway to its electronic components. The temperature sensor LM35 is used for measuring the lithium ion battery temperature while charging. The buzzer is used to indicate the abnormal rise in battery temperature which alerts to safeguard the charging kit. The led glows incase of any technical malfunction in the kit. The serial 2x16 LCD is used to display the battery temperature, voltage and current values.

IV. HARDWARE MODULES

Microcontroller(PIC16F877A)

The microcontroller PIC16F877A is one of the most renowned microcontrollers in the industry. It has a total number of 40 pins and there are 33 pins for input and output. It has a smaller 35 instructions set. The operating voltage is between 4.2 volts to 5.5 volts and it can operate up to 20MHz frequency.

Step down transformer

The step down transformer is designed to reduce the voltage from the primary winding to the secondary winding. As a step-down unit, the transformer converts high-voltage, low-current power into low-voltage, high-current power. The transformer will step down the power supply voltage from 230V to 12V. Then the secondary of the potential transformer will be connected to the precision rectifier. The advantages of using precision rectifier is to give peak voltage output as DC, rest of the circuits will give only RMS output.

Rectifier

A rectifier is an electrical device comprises of one or more diodes which allow the flow of current only in one direction. It basically converts alternating current into direct current. The rectifier which is used here is 1N4007G SOD57.

Fixed voltage regulator

The voltage regulator is used to regulate voltage level. When a steady, reliable voltage is needed, then voltage regulator is the preferred device. It generates a fixed output voltage that remains constant for any changes in an input voltage or load conditions. It acts as a buffer for protecting components from damages. The voltage regulator which is used here is LM7805.

Variable voltage regulator

Variable Voltage Regulator regulates the output voltage within a desired range and can be adjustable within that range. Depending on the range of voltage to be adjusted, there are many types of adjustable voltage regulators. The adjustable voltage regulator which is used here is LM317T.

Temperature sensor

LM35 is a temperature measuring device having an analog output voltage proportional to the temperature. It provides output voltage in Celsius. It does not require any external calibration circuitry. The sensitivity of LM35 is 10 mV/degree Celsius.

Liquid Crystal Display

LCD stands for Liquid Crystal Display which is wide spread use replacing LEDs. A model used here is low cost LCD which can display messages in two lines with 16 characters each. It can also display the alphabets, Greek letters, punctuation marks, mathematical symbols and also the user defined symbols.

V. CONCLUSIONS

The proposed DC fast charger will ensure the knowledge regarding electric vehicle battery management system. Electric vehicle industry has seen in recent years is not only extremely welcomed, but highly necessary in light of the increasing global greenhouse gas levels. Due to the economic, social, and environmental causes, the benefits of electric vehicles far surpass the costs. Moreover, the cost of the electric vehicle is relatively high now when compared with the normal gasoline powered vehicles. The only way to overcome this problem is manufacturing the electronic components related to electric vehicle industry in India and marketing its reliability. This will reduce the cost of the electric vehicles. Also making incentivized and empowered to drive an electric-powered vehicle will rise to better change.

REFERENCES

[1] R. S. Morris, B. G. Dixon, T. Gennett, R. Raffaelle, M. J. Heben, “High-energy fast rechargeable Li-ion battery” Power Sources, vol. 138, pp. 277-280, 2018.

[2] M. Fukino, N. Irie, H. Ito, Development of an electric vehicle with fast charging system, pp. 25-32, 2017.

[3] Luca Buccolini, Adrianna Ricci, Cristiano Scavongelli, Giuseppe DeMaso-Gentile, Simone Orcioni, Massimo “Battery Management System”, pp. 1-6, 2016.

[4] Huang Shaofang, "Electric vehicle charger (station) of harmonic" in Jiaotong University, Beijing, vol. 2, pp. 56-58, 2008.

