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Designing of Battery Charging and Controller Circuit for Battery Operated Electric Vehicle (2Wheeler)

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Abstract - This paper provide an overview of the charging circuit and controlling circuit that is used in the electric vehicle. The paper describes how each section from charging circuit to the controlling circuit functions. The paper finally shows some electric vehicle prototype in terms of designing as a conclusion of the papers.

Key Words: Electric Vehicle, Charging Circuit, Controller circuit.

1. INTRODUCTION

In this project we have designed two main circuits of Battery Based Electric Vehicle for 2 Wheeler. One is Battery charging circuit of 24V 20A and other is controller circuit to run the BLDC motor. In this project considering the Battery charging circuit it is designed by using various components like full wave bridge wave rectifier circuit, OP-Amp that is LH358, BC547 Transistor, and Relay to charge the Lithium ion battery. OP-Amps are used in Battery charging circuit because they converts differential signals to single ended signals as output and improves the dynamic range by applying a gain of 2V to the signals.

Whereas as considering the controller circuit in that circuit the main component is Microcontroller that is PIC16F887 Microcontroller which is used to generate PWM pulses to control the speed of the BLDC motor. For controlling the speed a potentiometer is placed at analog pin of microcontroller AN4 (which is PIN 7). Besides microcontroller there are also other components like chip IR2101 for controlling High and Low side of MOSFET at each phase. And third most important element of the controller circuit is MOSFET it is used for space limitation and high efficiency requirement demand for a device which can carry high power and switch at higher frequencies. Basically it works as switching device.

2. THE KEY COMPONENTS IN EV

The electric vehicle is rather simple in structure. The key components are the parts. Fig 1 shows the Block diagram.

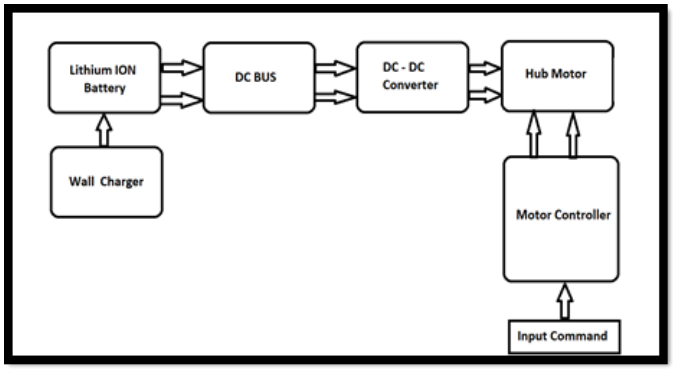

Fig -1: Block Diagram

The above figure aims to introduce the Design of Charging circuit and Controller circuit for Electric Vehicle (2 wheeler) with more user friendly and low cost features. Which consist of Power Supply which is use to provide 24V 20A to lithium Ion Battery, then through dc bus it gets transmitted to DC-DC Converter which converts 24v to 20v and gets passed to Hub Motor.

3. BLOCK DIAGRAM

1. Power Supply:-

We have used 30 V transformer to step down 230V 50Hz which is coming from main supply. It consist of bridge rectifier which convert AC current into DC current which get passed to the Regulator IC from where 30 V gets converted into 25 V then this voltage is passed to Lithium-ion Battery.

2. Lithium-ion Battery:-

Lithium-ion Battery is used to store current which is passed from power supply which is 24V 20A.

3. DC Bus:-

DC-BUS is technology for reliable and economical communication over noisy DC or AC power lines. The DC-BUS converts the digital input data into phase modulated signals, protected against errors generated by noise over the power.

4. DC-DC Converter:-

DC-DC Converter is used to convert 24V 20 A which is supplied from Lithium-ion Battery to 24V 20A which is required for BLDC Hub Motor.

5. Input Command:-

Input command as the name suggest it is the input which is given to the motor controller so that according to the input given to motor controller the motor speed is controlled.

6. Motor Controller:-

Motor Controller is a combination of Power electronics and embedded micro-computing elements which make the efficient conversion of energy stored in batteries of an electric vehicle to generate motion.

7. BLDC Hub Motor:-

The BLDC motor has a permanent-magnet rotor surrounded by a wound stator. The winding in the stator get commutated electronically, instead of with brushes. This makes the BLDC motor:

- Simpler to maintain,
- More durable
- Smaller
- 85%–90% more efficient

4. SYSTEM SPECIFICATION

(i) Hardware Specification:-

- 1 Battery of 24 volt and 20 amp
- High speed configuration
- BLDC motor 500 watt & 20 volt
- PIC16F887 Microcontroller
- IR2101 Chip
- Mosfet IRF3205

(ii) Software Specifications:-

- MP Lab
- Proteus Software

(iii) Features:-

- No Fuel, Cheaper To Maintain.
- More Eco-Friendly
- Lower Carbon Footprint.
- Less Noise Pollution
- Smoother to Ride.
- Low Cost

(iv) Applications:-

- Automobile Industries

(v) Proposed platform:-

- Power Electronics & Embedded System
- Software – MPLab
- Hardware – Microcontroller

(vi) Tools-

- Simulation – Proteus 8 professional software
- Implementation – Microcontroller & Embedded System

(vii) Advantages:-

- Storage space
- Fuel savings
- Ecology and respect for the environment
- Lower maintenance cost among many other differences with gasoline engines
- Lower acoustic impact

(viii) Limitations:-

- Low speed
- The charging time
- Recharging points
- Laws

5. RESULT

(i) Simulation Results:-

Module wise simulation result –

a) Battery Charging Section:

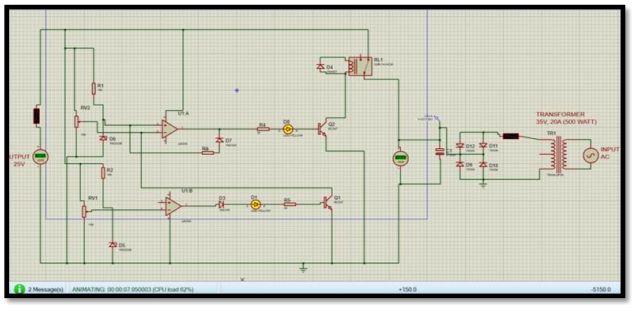

Fig -2: Circuit diagram of battery charging section

Fig.2 shows a circuit diagram of the proposed recharging system, compliant with an E-bike battery. From the right to the left, the following parts are shown: the Transformer, the bridge circuit to convert AC into DC, which supplies the final rechargeable battery. Now a days Li-Ion batteries are typically employed for E-bike supply. The proposed recharge system complies with a 24V 20Ah Li-Ion battery. The 24v the

battery voltage lies in the range 20V designed system envisions an about 500W recharge.

b) Controller Circuit Section:

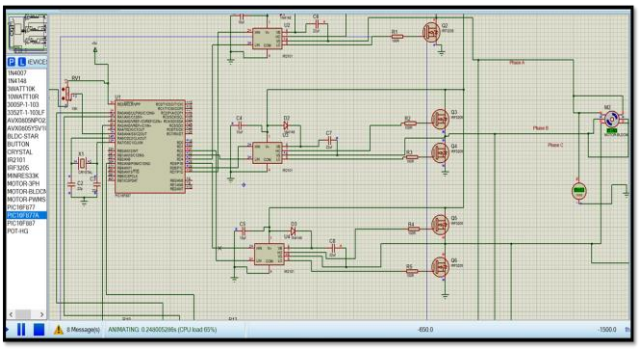

Fig -3: Circuit diagram of controller circuit section.

Considering Fig 3 the controller circuit in that circuit the main component is Microcontroller that is PIC16F887 Microcontroller which is used to generate PWM pulses to control the speed of the BLDC motor. For controlling the speed a potentiometer is placed at analog pin of microcontroller AN4 (which is PIN 7). Besides microcontroller there are also other components like chip IR2101 for controlling High and Low side of MOSFET at each phase. And third most important element of the controller circuit is MOSFET it is used for space limitation and high efficiency requirement demand for a device which can carry high power.

c) PCB Layout:-

(i) Battery Charging Circuit

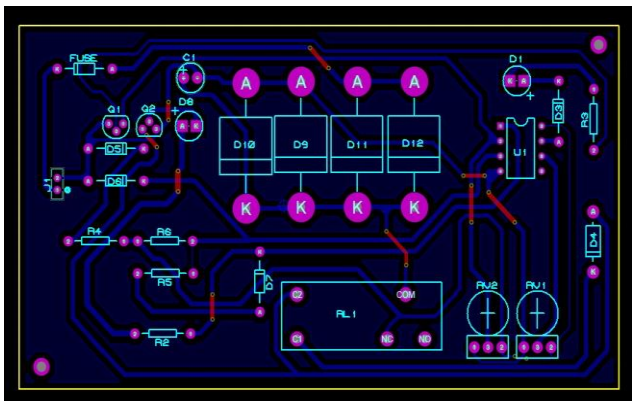

Fig -4: PCB layout of Battery Charging Circuit

(ii) Controller Circuit

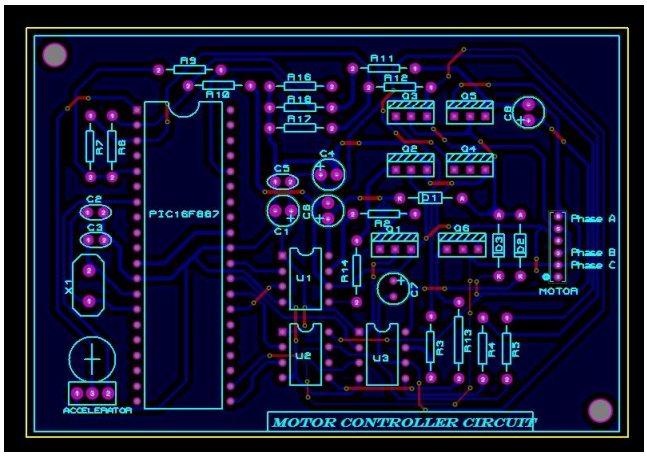

Fig -5: PCB Layout of Controller Circuit

d) 3-D Figure

(i) Battery Circuit

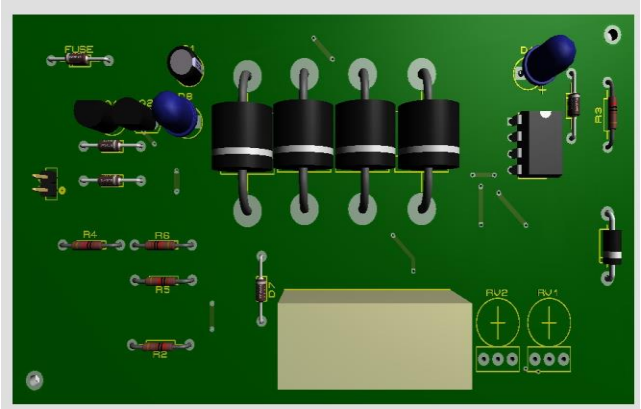

Fig -6: 3-D figure of Battery Charging Circuit

(ii) Controller Circuit

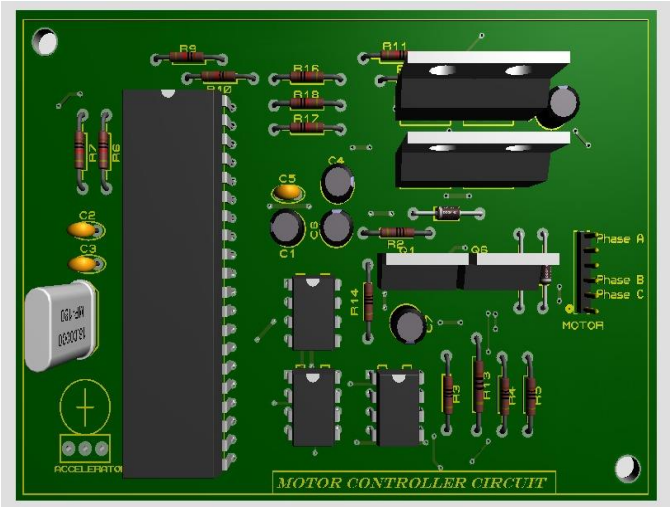

Fig -7: 3-D Figure of Controller Circuit

6. CONCLUSION

Electric Vehicles differ from traditional petrol or diesel-powered vehicles as they operate on electricity which can be obtained from renewable and non – renewable energy sources unlike the latter ones which can only be powered by non – renewable energy sources. Hence, we can drastically reduce the carbon footprints by using renewable energy sources for electricity generation such as solar, wind, water, etc. Here we have designed electric vehicle that is battery operated. In this project our main motive was to design a battery charging circuit and Controller circuit for battery based electric vehicle. And we have successfully designed these two circuits and tested its results on Proteus simulation by using Proteus 8 Professional simulation software. In this semester we have successfully completed the simulation and designing part of our Final year project.

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