BI-DIRECTIONAL POWER CONVERTER FOR ELECTRIC BIKE WITH CHARGING FEATURE

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Abstract

This paper proposes an effective method of energy regeneration for a brushless DC motor of electric vehicle (EV). In view of this, the paper discusses how to convert the mechanical energy into the electrical one that can be used to recharge the battery. We have chosen the two most important factors: Speed and brake strength as the control input variables. The motor which is used in this project is BLDC motor(Brushless DC motor). In a BLDC motor, the rotor position information is obtained from Hall Effect sensors and that information is sent to the microcontroller (i.e. Arduino). The motor is operating in Regenerative braking mode or in motoring mode. The microcontroller used is Arduino (ATmega 328).The main functions of the microcontroller includes taking inputs from the user controls and displaying proper values of battery level and motor mode on the LCD display.

1. INTRODUCTION

We have implemented Brushless dc (BLDC) motor technology in **Regenerative Braking** mode. BLDC are frequently used in electric vehicles due to their high efficiency and robustness. Regenerative braking is a better way for electric vehicle to expand their driving capabilities. The Regenerative braking plays an important role to maintain the vehicle's strength and getting better energy.

2. OBJECTIVE

To design and implement Bi-Directional Power Converter for electric bike with charging feature.

3. COMPONENTS REQUIRED

- Voltage Stepdown and Rectifier Circuit.
- Arduino Controlled 12V Battery Charger Circuit.
- Fixed Voltage Regulator.
- Display Unit i.e. LCD.

3.1. Voltage Stepdown and Rectifier Unit

The stepdown and rectifier is built around 220V AC primary to 15V-0-15V secondary transformer, two high power rectifier diode and a filter capacitor (2000 µF). This is basically a full wave rectifier with filter circuit. Transformer step down the AC input voltage to 30V AC which is rectified using two diodes and filtered using capacitor. This DC output contains ripple and the magnitude of DC volt is of about 28.5V.

3.2. ARDUINO CONTROLLED 12V BATTERY CHARGER CIRCUIT

The charger circuit is designed around adjustable voltage regulator IC LM338. Filtered DC voltage is given to the input pin of IC LM338. This IC can provide regulated voltage of about 1.2V to 32V at excess of 5A current. Transistors are to control the voltage at output i.e. when battery is fully charged then output is set to float charging state and when battery is in charging state then the output is set to bulk charging.

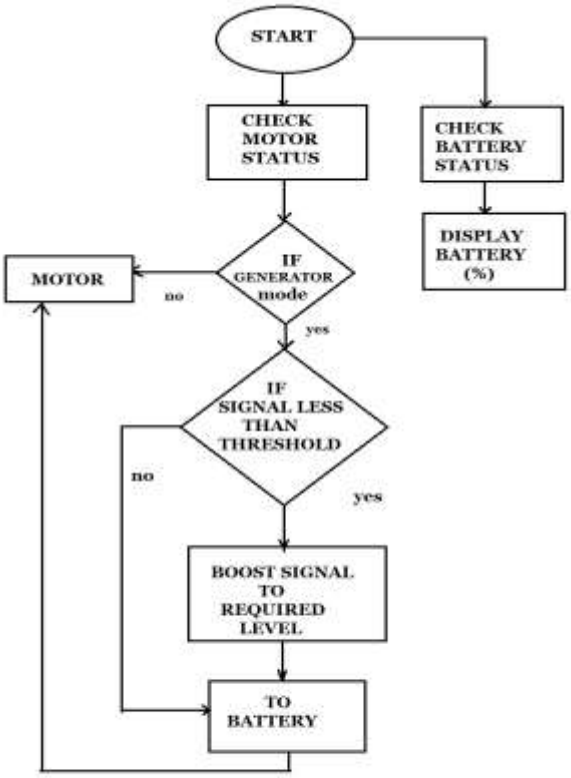
3.3. FIXED VOLTAGE REGULATOR

Fixed voltage regulator IC 7812 is used to power the arduino uno board. Diodes are used for protection. A voltage divider network is made using two resistors which is used to measure the voltage difference. One output between these two resistors is given to analog pin A1 of arduino uno board.

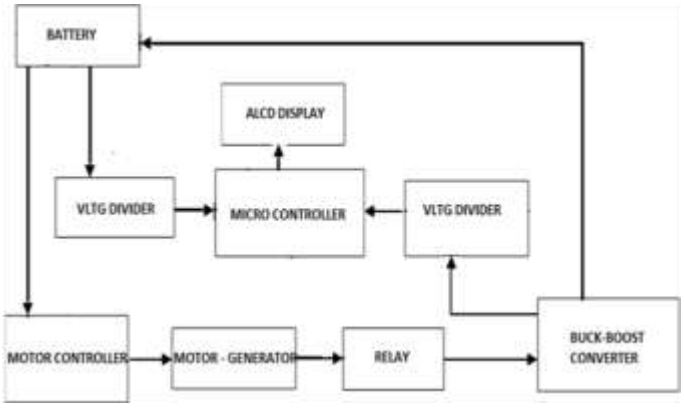
3.4. DISPLAY UNIT

Display unit is built around 16×2 LCD and arduino board. A fixed value resistor is connected to V_{DD} pin (pin 3) of LCD to ground. The higher data pin of LCD (D4, D5, D6 and D7) are connected to arduino uno digital pin (D5, D4, D3 and D2) respectively. Enable (E) and Reset/Set (RS) pin of LCD are connected to D6 and D7 respectively. LED+ and LED- (pin 15 and pin 16) of LCD is connected to +Vcc (5V of arduino) through current limiting resistor and GND respectively.

4. PROCESS FLOW



5. WORKING PRINCIPLE



The circuit comprises of a battery charger for standby charging and Regenerative Mode Charging circuit. When bike will start, the status of the motor will continuously monitored. It will be working in one of the following modes:

1. Motoring Mode
2. Generator Mode

In motoring mode the motor will run normally to drive the bike. In generator mode, motor will shift to regenerative braking mode. In regenerative mode, the mechanical energy is converted to electrical energy but, this electrical energy is not enough to charge the battery of 12V. Hence, it is then boosted to the required voltage level by the boost circuit and then applied to battery for charging.

The charging feature also works in three modes:

1. Fast charging
2. Float charging
3. Tackle charging

Fast charging takes place when battery is fully drained. It provides high current to charge the battery to 80%. The charging speed is high in this mode.

Tackle charging is done when battery charging reaches a predefined level. In this mode current flow is reduced and battery charges in tackle mode. This prevents battery from any damage and preserves battery life.

Float charging mode works when battery reaches 100% of the charging. Float charging maintains the battery voltage to full by supplying a low-value constant current, which is sufficient to maintain the full charge of battery or to restore the charge used due to internal resistance of the battery.

6. APPLICATIONS

1) For Industrial Purpose.
2) Electric Cars, Auto Rickshaws.
3) High Power Bikes.

7. FUTURE SCOPE

1) If same work is done at higher levels with more standard processes and using standard parts, efficiency and effectiveness of the system can be improved.
2) The regenerative braking system improves the advance technologies.

8. CONCLUSION

Hence, the power wasted is fully recovered using the regenerative braking system. Thus, the electrical power generated by motor, generator and battery is very useful and hence it should be used in electric vehicles.

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