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Electrical Vehicle with Regenerative Braking System by Using Super capacitors

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Abstract: **An electric vehicle is an automobile that is propelled by one or more motor using electric energy stored in batteries or another energy storage device .Generally major disadvantage with lithium-ion battery in electric vehicle is that the time required to recharge the batteries is approximately 1 to 3 hours. In this project we planned to reduce this defect by introducing a recharging technology by making use of a super capacitor and a regenerative braking system. It taken backs the wasting energy during braking to the capacitor or battery and reduces the energy. Nowadays the electric vehicle won't be a good choice for long trips, this can be solved by our regenerative charging system since it increases the distance travelled by 50%.The control strategy of regenerative braking plays an important role in maintaining the vehicle's stability and recovering energy Electric vehicles with regenerative braking can also perform Significant reduction in air pollution and optimum utilisation of energy.**

Keywords: **Regenerative braking, Electrical vehicle, Energy conservation, Super capacitor**.

I. INTRODUCTION

In recent years, electric vehicles (EVs) have received much attention as an alternative to traditional internal combustion engine (ICE) vehicles. The unprecedented focus is mainly attributable to environmental and economic concerns linked to the consumption of fossil-based oil which is used as fuel in ICE-powered vehicles. With the progress of battery and motor technology, the EVs become the most promising alternative to the ICE vehicles. Plug-in EVs use a battery system which can be recharged from standard power outlets. The invention of electric vehicle (EV) is a miracle, it also known as green vehicle as it produce zero emission to the air which means there are no toxic gasses release from the car that causes the ozone layer polluted. Nowadays, the population of EV starts increasing according to the demand in the market. Since the performance characteristics of EVs have become comparable to, if not better than, those of traditional ICE vehicles, EVs present a realistic alternative. Regenerative braking can be used in EVs as a process for recycling the brake energy, which is impossible in the conventional internal combustion vehicles. Regenerative braking is the process of feeding energy from the drive motor back into the battery during the braking process, when the vehicles inertia forces the motor into generator mode. In this mode, the battery is considered as a load, thereby providing a braking force to EVs. It is shown that the use of regenerative braking of EVs can increase the driving range up to 15% with respect to EVs without the regenerative braking system (RBS). However, regenerative braking does not operate when the battery is fully charged; braking needs to be erected by dissipating the energy in a resistive load. Therefore, the mechanical brake in the EV is still needed. A mechanical brake system is also very important for EVs safety and other operations. Coordination of EV mechanical braking and regenerative braking is achieved by a single foot pedal: The rest part of the foot pedal controls the regenerative braking, and the second part controls the mechanical brake. This is a seamless transition from regenerative braking to mechanical braking. It cannot be simply achieved by traditional ICE vehicles.

II. OBJECTIVES

- To develop an electric vehicle with higher efficiency and travel 10% more distance than conventional one
- To develop a low-cost, nature friendly or non-pollutant vehicle..

- Application in conventional vehicles for lighting and other electric application

III. EXPERIMENTAL SETUP

Generally the braking system for a conventional vehicle is based on hydraulic braking technology. However, this traditional braking methodology causes a lot of energy wastage since it produces unwanted heat during braking. Thus, the invention of regenerative braking in electric vehicle has overcome these disadvantages moreover it helps in save energy and provides higher efficiency for a vehicle. In regenerative mode, the motor act as a generator, it transfers the kinetic to electrical energy to restore the batteries or capacitors. Meanwhile, the brake controller monitors the speed of the wheels and calculates the torque required plus the excessive energy from the rotational force that can be converted into electricity and fed back into the batteries during regenerative mode. The merits of regenerative braking over traditional braking are energy conservation, wear reduction, fuel consumption and more efficient in braking. Nowadays, the brilliant technology in automotive industry towards regenerative braking is improving. By using a flywheel and super capacitors with DC-DC converter it had enhance the regenerative performance.

Super capacitors are a new technology that allows storing 20 times more energy than conventional electrolytic capacitors. Despite this important advance in energy storage, they are still far from being compared with electrochemical batteries. Even Lead-acid batteries can store at least ten times more energy than Super capacitors. However, they present a lot better performance in specific power than any battery, and can be charged and discharged thousands of times without performance deterioration. These very good characteristics can be used in combination with normal electrochemical batteries, to improve the transient performance of an electric vehicle, and to increase the useful life of the batteries. Fast and sudden battery discharge during acceleration, or fast charge during regenerative braking can be avoided with the help of Super capacitors. Besides, Super capacitors allow regenerative braking even with the batteries fully charged.

Here we are used radio frequency transmitter and receiver for braking instead of actual braking system.

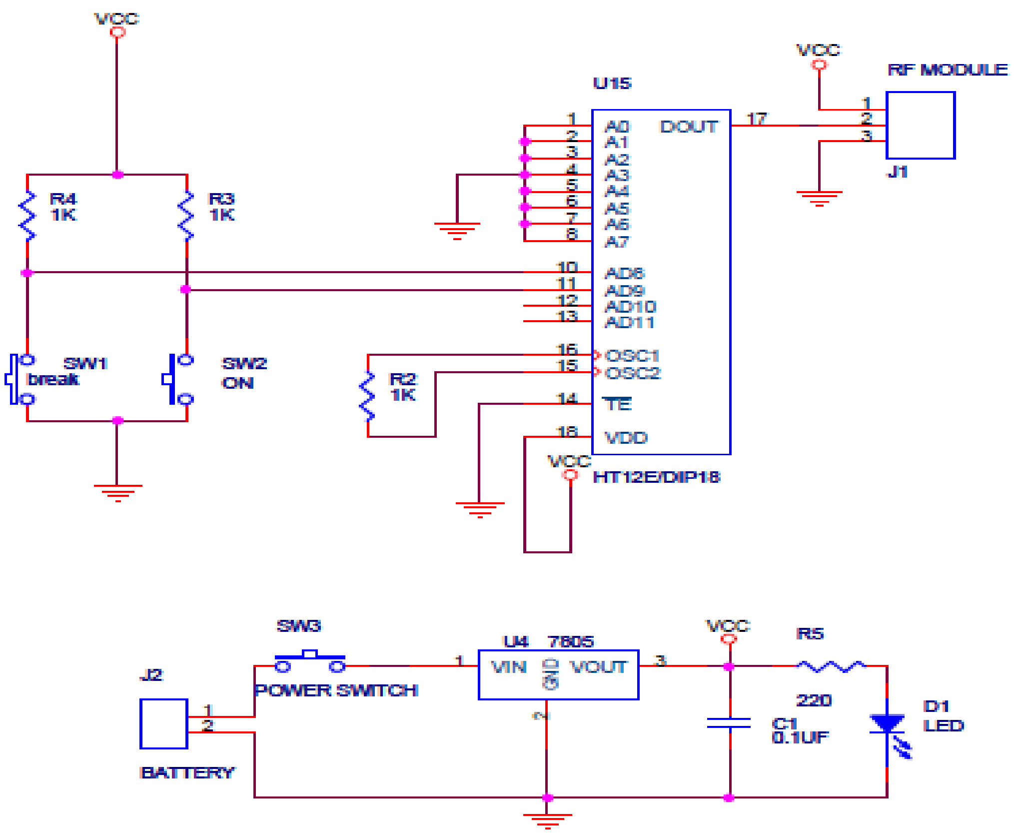

Figure 3.1: Circuit diagram for Transmitter Section.

The figure above given is the radio frequency transmitter; it is a two switch remote controller. The IC HT12e is the radio frequency encoder and RF module transmits it. For different operations (run and braking) different switches and corresponding signals are generated by the encoder and it transmitted through the antenna

The radio frequency receiver receives the corresponding signal and decodes it by using HT12D. The decoders receive data that are transmitted by an encoder and interpret the first N bits of code period as addresses and the last 12_N bits as data, where N is the address code number. A signal on the DIN pin activates the oscillator which in turn decodes the incoming address and data. The decoders will then check the received address three times continuously. If the received address codes all match the contents of the decoder's local address, the 12_N bits of data are decoded to activate the output pins and the VT pin is set high to indicate a valid transmission. This will last unless the address code is incorrect or no signal is received. The output of the VT pin is high only when the transmission is valid. Otherwise it is always low. The received signal is given to the microcontroller PIC16F877A. The core controller is a mid-range family having a built-in SPI master. 16F877A have enough I/O lines for current need. It is capable of initiating all intersystem communications. The master controller controls each functions of the system with a supporting device. Also responsible for reception of commands from the host and taking necessary actions.The microcontroller initialises the operation also initialise the relay section.

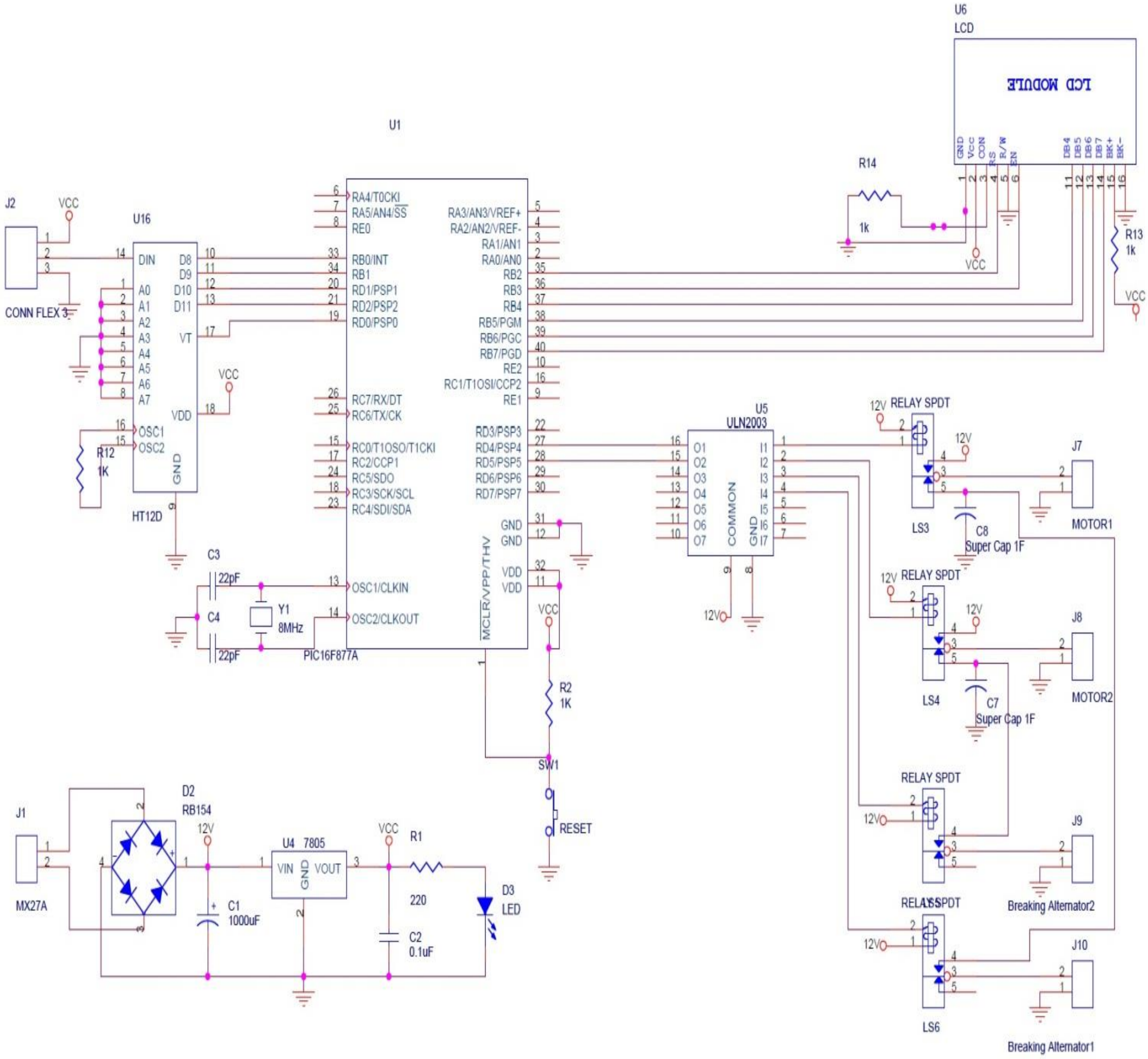

Figure 3.2: Circuit diagram for Receiver Section.

The relay is used for the controlling motor generator operations as per the logic loaded to the microcontroller. The relay driver is necessary to drive the relay because of high current required to operate the relay and microcontroller can't supply that much current so IC ULN2003 is used. The ULN2003A is a high-voltage, high-current Darlington transistor array. It consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode fly back diodes for switching inductive loads. The drivers can be paralleled for higher current capability, even stacking one chip on top of another, both electrically and physically has been done. The DC motor is used for the experimental setup and for the practical application bldc motor is more preferable. Storing of charge and sourcing it is done by supercapacitor and a rechargeable battery. The supercapacitor, also known as *ultracapacitor* or *double-layer capacitor*, differs from a regular capacitor in that it has a very high capacitance. A capacitor stores energy by means of a static charge as opposed to an electrochemical reaction. Applying a voltage differential on the positive and negative plates charges the capacitor. This is similar to the build-up of electrical charge when walking on a carpet. Touching an object releases the energy through the finger. *Supercapacitor*, rated in farads, which is thousands of times higher than the electrolytic capacitor. The supercapacitor is ideal for energy storage that undergoes frequent charge and discharge cycles at high current and short duration. Brake is applied for the short duration, so super capacitor with parallel to the battery is more suitable.

The RF receiver receives the signal and HT12D decode it and given to the PIC16F877A and gives signal to the relay driver IC ULN2003 .it amplify the signal and actuate corresponding relays. For normal run two motor relays are actuated for the regenerative breaking mode two motor supply is cut off and two generator are actuated. The generator output is connected to the supercapacitor and battery which enable fast charging and increase the battery life. There is another mode which is added to avoid accidents and speed controlling. It enables automatically when the speed is more than a predefined value. In this case motor supply cut off and generator comes in action.

IV. CONCLUSION

Conventional braking systems convert kinetic energy into heat, usually via friction. Regenerative braking systems reclaim and storing the kinetic energy in a reusable manner so many modern electric drive vehicles including electric locomotives and hybrid electric vehicles have regenerative braking systems. Regenerative braking is an effective method of improving vehicle efficiency and longevity. The technology to do it exists and is often well worth it mostly dependent on the wider adoption of EVs or further development of hydraulic regeneration systems.

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