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Improve Battery Life of E-Vehicle using Super Capacitor & Regenerative Braking System

Prof Mr. Yogesh.B. Mandake[1], Piyusha Hadke[2], Rishabh Kumar Tiwari[3], Sourabh Raj[4], Prince Kumar Singh[5]

[2,3,4,5]Student, Department of Electrical Engineering, Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, India
[1]Assistant Professor, Department of Electrical Engineering, Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, India

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Abstract - *Decrease in conventional resources has led to high reliability on renewable energy resources for generation of power for vehicles. The batteries are main source of storage for these power resources and the main investments in electrical vehicle are on battery storage. Thus, it is important to maintain them on proper grounds. Due to variable characteristics of renewable generation, the batteries utilized in renewable power grid undergoes many partial and irregular charge or discharge cycles. This has a detrimental effect on battery lifetime and thus replacement leads to increase in vehicle maintenance costs. This study imposes a method for improving battery lifetime in electronic vehicle by the use of battery supercapacitor storage system.*

Key Words: **Arduino UNO, LCD, ADXL, Super capacitor, Battery, E-vehicle, Regenerative braking system**

1. INTRODUCTION

Increasing natural gas prices and environmental concerns, battery propelled electric vehicles (BEVs) and hybrid electric vehicles (HEVs) have recently drawn more attention. In BEV and HEV configurations, the rechargeable energy storage system; is a key design issue. Thus, the system should be able to have good performances in terms of energy density and power capabilities during acceleration and braking phases. However, the thermal stability, charge capabilities, life cycle and price are often considered also as essential assessment parameters for RESS (Reliable Energy-Efficient Storage System). Presently batteries are used as energy storage devices in most applications. These batteries should be sized to satisfy the energy and power requirements of the vehicle. The batteries should have good life cycle performances. However, in many BEV applications the specified power is that the key factor for battery sizing, leading to an over-dimensioned battery pack and fewer optimal use of energy. These shortcomings might be solved by combination of battery system with supercapacitors. Hybridization topologies may result into enhancing the battery performances by increasing its life cycle, rated capacity, reducing the energy losses and limiting the temperature rising inside the battery.

2. LITERATURE

The literature search targeted primarily on topics associated with Electrical Vehicles (EV), Hybrid eElectrical Vehicles (HEV) and fuel cell electric vehicle (FCEV) we have a tendency to review the books associated with simulation, appraisal, and enquiry intimately using on the market software system. Additionally, a system supported energy sources has been tried to some extent. However, more emphasis is placed on literature associated with fuel savings objectives instead of on environmental savings on heating and studies undertaken to scale back the parts of harmful emissions. The foremost vital documents to say here, this paper details the requirements and potential advantages of infrastructure development, challenges and opportunities for the planning and preparation of emerging infrastructures related to Plug-in Electrical Vehicles (PEVs). From battery producing to communication and management between the vehicle and also the grid, the authors are able to maximize the advantages of the chance to scale back fuel consumption, which is crucial to provide safe, clean electricity.

Holms et al (2010) delineated the operation of an electrical vehicle and compared it with existing combustion engines and hybrid electrical vehicles. The report provided details of the benefits and downsides of electrical vehicles, beside future technological prospects.

Eberhard et al. (2005) tested a Tesla Roadster work unit with a lithium-ion battery for energy-efficient from well to wheel and emissions from the well to the wheel during a paper on the "21st century electrical vehicle". Compared to gas engines, chemical element fuel cells, diesel engines, gasoline engines and hybrid gas / electrical vehicles, the energy potency from the well to the wheel is high and also the Tollla Roadster work unit has terribly low emissions from the well to the wheel.

Santos et al (2006) studied power converters and controls for electrical traction, and mentioned solutions during this paper throughout development. Focus was on strategy and configuration problems with the facility device (controller), protection and management of the facility train. The study vehicle used eleven kilowatt - 48 V DC motor, as a result of this motor needs a high current worth of concerning 200A, it was important to think about stability problems within the projected design. DC-DC power converters are mentioned thoroughly to attain energy conservation and low power consumption in keeping with motor operation necessities in forward and reverse operation of the vehicle. This paper describes the explanation for the requirement / importance of the variable output current management of the device instead of the voltage management below the intuitive correlation of throttle management and force. ICE guarantees the protection and safety of motors, controllers, and several other electrical and mechanical elements. this management methodology, particularly the slippery mode management, was discussed.

Chetan Kumaar Maini (2005) recognized in his paper the potential would like for the planning and development of a globally competitive compact electrical thought vehicle for Asian nation and finished that EVs are the most effective resolution to cut back urban pollution and a major social and economic profit and can lead to the implementation of EVs and HEVs. The report additionally describes the role of governments and communities round the world in promoting and fast work unit programs.

Marinescu et al., (2010) FISITA F 2010 A-089 bestowed aspects of a diesel electrical hybrid thought automotive. The diesel powertrain is mounted during a classical position on the front facet and also the powertrain is mounted on the rear facet. Performance tests of epitome vehicles with electrical power units and diesel powertrain, a machine drive thought, haven't nevertheless been performed within the laboratory. The projected model-based integrated power transfer management for energy management and emission management for reduced hazardous pipe emissions and reduced operational emissions of hybrid electrical vehicles is bestowed during this paper.

Kessels et al. (2010) FISITA SF 2010 A-096 the value of the vehicle was thought of vital. This case study is bestowed for a heavy-duty hybrid electric vehicle equipped with SCR-deNOx, and till the time temperature of the system when treatment is low, the projected management system focuses on emissions management and also the future treatment system is hot enough Energy management can take the place of control. The results demonstrate a trade-off between in operation prices and emissions derived from the projected integrated powertrain control.

Carlson et al (2008) conducted dependence studies by evaluating variations in fuel averages for 2 models of hybrid electrical vehicles at antecedently outlined urban driving routes at wide close temperatures (-14° C to 31° C) at close temperature. given the fuel mileage provided by HEV, performance changes for low and extreme temperature effects on HEV operational potency have been investigated for roads in pre-defined cities on the road compared to existing vehicle technology. The results showed that battery power management limits and engine operation vary dramatically with temperature.

Chau et al. (2002) restrained varied aspects of the vehicle so as to derive most fuel economy, minimum emissions, minimum system value and glorious driving performance. In this paper author centered on power management ways for drive trains. Power flow management for varied HEVs is additionally detailed. Uzunoglu et al. (2007) in his paper describe the look and modelling of electrical cell / ultra-capacitor (FC / UC) primarily based hybrid vehicle power systems, additionally as a result of the event of power flow management ways that, simulation models. FC equipped basic power and UC provided any power throughout peak power demand or load shift. To develop a fairly correct model, to beat the FC connected difficulties, we have explored things, really advanced and dearly-won FC technology systems to boost system efficiency for vehicle applications victimization baryon exchange membrane fuel cells (PEMFCs). Times square measure created to develop model / possible selections which will provide power below transient operating

conditions like start-up, sudden load modification and acceleration.

Ahluwalia et al. (2005) noted that the standard U.S. drive cycle used for fuel consumption works at two hundredth of the rated output of the engine. He used the electrical cell is further economical at partial load than rated load. The authors square measure in operation to evaluate the usefulness of FCEV fuel economy improvement by direct substance compression FC system as degree energy conversion device and pairing of energy storage system (ESS) of Li particle battery pack and sedan vehicle in different drive pairing degree unit

3. BLOCK DIAGRAM AND DESCRIPTION

Regenerative braking is one in all the foremost necessary systems in electrical vehicles as a result of it will lay aside to eight to five of waste energy. Regenerative braking systems are increased with advanced power electronic parts like super capacitors, that facilitate improve the transient state of the automotive throughout embark, give a sander charging characteristic of the battery and improve the general performance of the electrical vehicle system.

ADXL detector is employed for the position of car thanks to that controller will acknowledge the vehicle is on the slope or plane surface. Once vehicle is on slope it needs additional energy boosting than once it's on plane surface.

The Arduino program has been written for the relay dominant circuit. The Arduino program can manage the relay circuit that successively controls the complete circuit to change the ability to load.

Relay circuit is employed to switch the availability from battery to supercapacitor. it's additionally accustomed charge the battery and super electrical condenser that is connected in parallel. once each reaches the total charge it's mechanically stops from the availability.

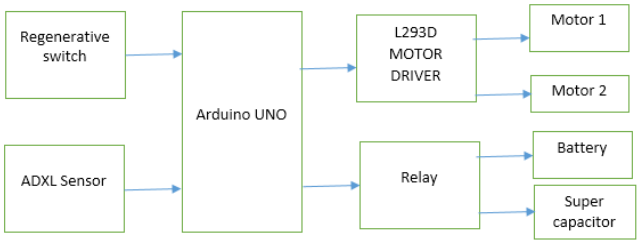

Fig -1: Block Diagram of Circuit

4. HARDWARE REQUIREMENTS

For building prototype module, we need following components.

4.1 Super capacitor

Super electrical condenser is an excellent electrical condenser (SC) (also electrical double layer electrical condenser (EDLC), additionally known as super cap, ultra-capacitor or Gold cap) could be a high- capability electrical condenser with capacitance values a lot of beyond different capacitors (but lower voltage limits) that bridge the gap between electrolytic capacitors and reversible batteries. They usually store ten to a hundred times additional energy per unit volume or mass than electrolytic capacitors, will settle for and deliver charge a lot of quicker than batteries, and tolerate more charge and discharge cycles than reversible batteries.

Super capacitors square measure employed in applications requiring several speedy charge/discharge cycles instead of long run compact energy storage: inside cars, buses, trains, cranes and elevators, wherever they're used for regenerative braking, short-term energy storage or burst-mode power delivery. In operation super capacitors below the rated voltage improves the long-time behavior of the electrical parameters. Capacitance values and internal resistance throughout sport square measure additional stable and lifelong and charge/discharge cycles is also extended. Super capacitors occupy the gap between high power/low energy electrolytic capacitors and low power/high energy rechargeable batteries.

Fig-2 : Super Capacitor

There are four application classes, according to discharge current levels:

1. Memory backup.
2. Energy storage, mainly used for driving motors requires a short time operation.

3. Power, higher power demand for a long-time operation.

4. Instantaneous power, for applications that requires relatively high current units or peak currents ranging up to several hundreds of amperes even with a short operating time.

4.2 Arduino

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. In this project we used it to sense and control the relay circuit.

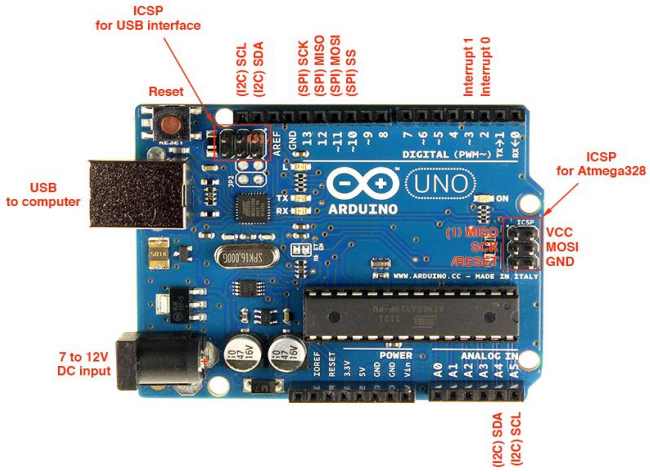

Fig-3 : Arduino Circuit

4.3 BATTERY

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work.

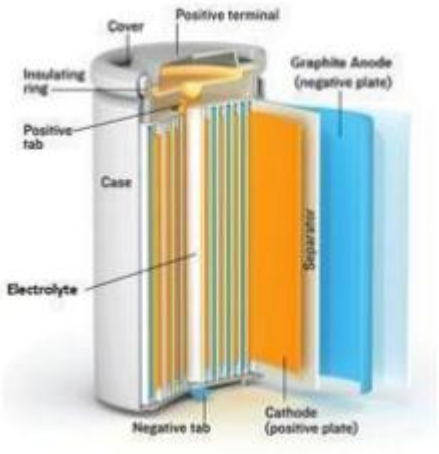

Fig-4 : Opeartion of Battery

A battery's capability is that the quantity of electrical charge it will deliver at the rated voltage. There are lot of conductor material contained within the cell the larger its capability. A tiny low cell has less capability than a bigger cell with constant chemistry, though they develop constant open-circuit voltage. Capability is measured in units like amp-hour (A-h). The rated capability of a battery is typically expressed because the product of twenty hours increased by this that a replacement battery will systematically offer for twenty hours at 68°F (20 °C), whereas remaining higher than a nominal terminal voltage per cell unit. As an example, a battery rated at 100 A-h will deliver five a over a 20-hour amount at temperature. The fraction of the keep charge that a battery will deliver depends on multiple factors, as well as battery chemistry, the speed at that the charge is delivered (current), the desired terminal voltage, the storage amount, close temperature and alternative factors.

Battery life may be extended by storing the batteries at an occasional temperature, as in a very white goods or deep freezer, that slows the aspect reactions. Such storage will extend the lifetime of alkalescent batteries by concerning 5%; reversible batteries will hold their charge for much longer, relying upon kind. To succeed in their most voltage, batteries should be coming to space temperature; discharging associate degree alkalescent battery at 250 mA at 0 °C is just 0.5 as economical as at 20°C.

4.4 ADXL Sensor

It's a three-axis analogy measuring system IC, that reads off the X, Y and Z acceleration as analogy voltages. By measuring the quantity of acceleration, thanks to gravity, associate degree measuring system

will work out the angle it's atilt at with relevancy the world. By sensing the quantity of dynamic acceleration, the measuring system will resolve how briskly and in what direction the device is moving.

Accelerometers with associate degree analog interface show accelerations through variable voltage levels. These values usually fluctuate between ground and therefore the offer voltage levels. ADC on a microcontroller will then be wont to browse this worth. ADXL335 is 3- axis measuring system with on board transformer IC and signal conditioned Analog voltage output. The module is formed of ADXL335 from Analog Devices. It measures acceleration with a minimum complete vary of ±3 g. It will live the static acceleration of gravity in tilt-sensing applications, moreover as dynamic acceleration ensuing from motion, shock, or vibration.

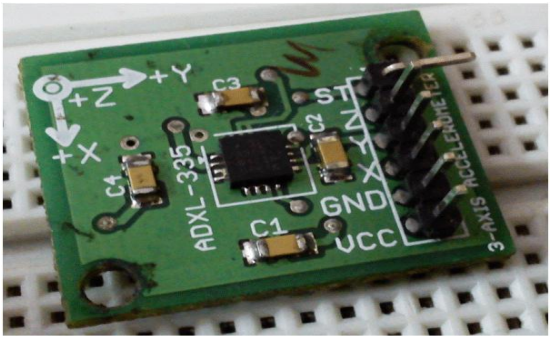

Fig- 5 : ADXL Sensor

5. CONCLUSIONS

Developing this system is one amongst the foremost convenient and effective answer for manufacturing electric vehicle. It is not only less costly but also it does not cause any harm to the environment. Several energy devices are on the market nowadays, among these energy storage devices super capacitors show some necessary benefits because of their high-power density, reduced size and weight.

The parallel connection of battery and super capacitor was planned and evaluated. The utilization of a battery-super capacitor connection tested to be helpful for run-time extension, that is achieved because of the reduction within the battery losses. This loss reduction accompanied in improvement within the power delivering capability. In future the batteries can altogether get replaced by super capacitors.

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