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"REVIEW OF IMPROVEMENT OF REGENERATIVE BREAKING BATTERY POWER STORAGE OF DYNAMIC ELECTRIC BIKE USING FUZZY LOGIC ALGORITHM"

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ABSTRACT

The most trending invention of this decade is electrical vehicles (EV) which are widely utilized around the world. The driving distance of the vehicle is strictly restricted up to energy storage of inbuilt battery. The important feature of EV is able to recover the energy during braking. The operation of brushless DC motor is to be controlled to generate enough amount of force during braking and this braking energy is being recovered as much as possible and finally, the energy can be stored in Super-capacitor or in batteries and then, it is being reused to increase the driving force, driving distance and system efficiency. Researches are being carried out in the field of batteries on the lines of: firstly, development of new energy efficient battery like Li-ion and secondly, with the help of energy sources like fuel cell, Super capacitor and high-power batteries, increase the level the energy density in batteries. Each complementary energy sources having its own advantages and drawbacks but among alternatives, Super capacitor will assist the vehicle battery during peak power demand effectively.

To achieve the overall Maximum efficiency in regenerative braking system, it needs to make a decision on the power split between the battery and the Super-capacitor/ Batteries. Therefore, the proposed a strategy will increase the characteristic of EV during regenerative braking and also verified experimentally.

Keywords *— Electrical Vehicles (EV), Brushless DC motor, Super-capacitor, Regenerative Braking*

I. INTRODUCTION

Non- conventional energy is perhaps the most relevant area of science and engineering, which is moving forward on a large scale; as the world runs out of oil reserves, as well as energy recovery solutions will become increasingly important, electric transportation is the apt solution. The government of India has taken many initiatives towards the research and development of electric vehicle and also increasing attention from industries and public due to increase in global warming, shortage of fuel like petrol and diesel and also passenger safety during driving of fuel and/or gas-based vehicle.

Electric vehicle has been catching more attention not just as a mode of transportation but it eliminates or reduces the gas emission and also for the passenger safety. By increasing the energy density of the battery, the driving distance is increased. During braking, the braking energy is wasted but EV may recover the braking energy by controlling the operation of the motor with the help of converter control and finally this braking energy will be stored in battery or in Super-capacitor which will be used when there is an energy demand. Many researchers have developed different control strategies in order to improve dynamic performance of the motor as well as the converter and efficiency of the overall system. Based on control theory, the suitable control strategy needs to be incorporated during regenerative braking on EV.

The power battery, motor, power converter and controller are the important parts of the EV. The motor may be of Permanent Magnet DC (PMDC) motor, Permanent magnet Synchronous motor (PMSM), Switched Reluctance Motor (SRM), or the Brushless DC (BLDC) motor. Among all the motors, BLDC motor has many advantages over PMDC motor and SRM. BLDC motor is simple in structure, offers high efficiency and starting torque, allows electronic commutation, and offers noiseless operation even at high speed. Due to simple control and high efficiency, BLDC motor has been widely used in EV than the other motors. The mechanical brake in conventional electric vehicle will increase the friction between the brake shoe and the wheel for deceleration purpose. Thus, the braking kinetic energy is wasted as heat. So, the battery powered electric vehicle is designed with regenerative braking for recovering the wasted energy. In addition, the super-capacitors are combined with the battery to enhance the driving distance, life time of the battery and to increase the starting torque on the motor. The capacitors are connected in parallel with the vehicle battery to achieve higher efficiency on the motor drive. The braking current during braking is higher in magnitude, so that, the batteries need to protect during regenerative braking.

The overall efficiency in regenerative braking system can be achieved by making decision on the power split or share between the battery and Super-capacitor. Therefore, the strategy by considering the characteristic of electric vehicle during regenerative braking is proposed. The control signals can be produce with the help of fuzzy controller and the results will be simulated with MATLAB/SIMULINK and experimentally tested.

II. LITERATURE REVIEW

1. Muhammad Nur Yuniarto, shifting the motorcycle to electric-driven based technology is inevitable. It is quite challenging as the residents prefer higher performance of the electric model which is unavailable in the market. Unluckily, the demand for higher performance models creates other problems, such as the requirement for a bigger battery. Therefore, there is a range of anxiety phenomena in-vehicle usage. However, the capability to accurately estimate the electric motorcycle's range does not exist. So, this paper mainly focuses on how to develop an electric vehicle (EV) model to simulate its performances, especially its range estimation. The modeling approach was actually the use of an electric scooter longitudinal model developed in MATLAB/ Simulink environment. Based on the dimensions and targeted performance, the developed model was simulated to determine its power and energy requirements. It is then validated using an experimental test mostly on a dynamometer and on-road conditions. Based on the experimental data analysis, it can be assumed the developed model is valid and can be used as a basis for the next development of any electric motorcycle.

2. Shikha Parashar, in recent years, the concerns about the environmental effects of the traditional car (ICE-Internal Combustion Engine) have led to the improvement and growth of the electric vehicle (EV). The evolution of the regenerative braking system has led to the need to increase overall vehicle performance Regenerative Braking System whenever driver applied the brake the energy is completely loss in the form of kinetic energy due to the friction loss between wheels of vehicle and road. The use of regenerative braking allows this energy to be stored in the form of electrical energy in a battery so it increases the engine's efficiency. This paper discusses braking systems, types of braking systems, and regenerative braking systems, as well as the types of regenerative braking systems, the need for regenerative braking systems, and the applications of regenerative RBS, and how regenerative braking systems aid in increasing the efficiency of electric vehicles. There are a variety of cars that uses regenerative braking systems, and

many companies will be able to use this sort of regenerative braking system in the future to improve engine efficiency. This paper elaborates the applicability of the regenerative braking system and its applicability in various sectors to solve the existing problems.

3. K.W.E Cheng, describes the development and the comparison of different part of components. The major components in technology of battery, charger design, motor, steering and braking are examined. The paper finally shows some electric vehicle prototype as a conclusion of the papers.

4. Qingzheng Yang, Due to the increasing popularity of electric vehicles in recent years, the research and development requirements for electric vehicles are also increasingly high. This paper is usually based on Simulink modeling simulation as well as simulation debugging to get the impact of each parameter on the performance of the car. The content includes understanding the basic structure of pure electric vehicles and related performance requirements; Based on various data, summary data, battery, motor, and other models of the electric vehicle are designed. Learn MATLAB, Simulink related knowledge, and simulation modeling. This paper analyses the electric vehicles, the basic mechanism, performance characteristics, and key links of electric vehicles and other parts of the matching design. The design, modeling, simulation, and testing in the development process of automotive embedded systems can be essentially combined to form a relatively complete development mode. Through analysis, it is found that the simulation model of this design plays a vital role in improving development efficiency.

5. Rahul Raj, Automobiles are an integral part of our everyday lives. The world will eventually encounter a drastic energy crisis if we do not focus on alternative energy sources and transportation modes. So that the international community toward developing zero-emission (electric) and low emission (hybrid electric) vehicles to replace conventional internal combustion (IC) engine vehicles. Several auto industries have started marketing electric and hybrid electric vehicles. Also, the gradual replacement of the hydraulically driven actuators by electrically driven actuators. The Modelling and simulation of Electric Vehicle in MATLAB-Simulink are of great value in investigating the energy flow, performance and efficiency of the EV drivetrain. The design of the Electric Vehicle model presented in this paper, however, is indeed a basic model. There are many opportunities for augmentation to establish a good EV model which will form the foundation for further research and development. Modelling and simulation are significant for automotive designers to find the best energy control strategy and exact component size, also to minimize the use of energy because prototyping and testing are expensive and complicated operations. Good design leads to a reasonable compromise among flexibility, computational load and accurate representation of the components.

III. METHODOLOGY

Regenerative braking technology focuses on converting the reversal current during the deceleration of the vehicle back into electrical energy that can then be reused. In electric vehicle the actual motor can also be used as a generator, which is itself exploited in vehicle that use this principle to convert reversal energy back into electrical energy during deceleration and braking. The system as shown in figure 1 consists of an ultra-capacitor pack, converter, controller, hall sensor and the motor.

The motor used is Brushless Direct Current Motor (BLDC) as it has many advantages over other motors. The merits being, simple in structure, high efficiency and starting torque, allows electronic commutation, and offers noiseless operation even at high speed.The position of the rotor is determined by the hall sensor which is placed inside the motor. The sensor sends the digital signals to the controller to produce triggering gate pulse by sensing the position of the rotor poles.

Ultra capacitors are called as super capacitors and it is different from normal capacitors and ultra-capacitors will store greater charge. Therefore, the potential across the capacitor greater and the energy stored can be much higher. The ultra-capacitor used has 5.5V and 1V rating.

Gate signals for the inverter unit cannot be given directly so that gate drive should be added in between the controller and the inverter. MOSFET -P75NF75 of 6 numbers are used for inverter operation. During motoring condition, the MOSFET acts in inverter mode. And the current flows in the normal condition. When the brake is applied on the cycle, the freewheeling diode connected to the

MOSFET should start to conduct, that is the conduction should switch from inverter to converter mode. And the current will flow in reverse direction.

The controller which receives the digital signal from the hall sensor from where the rotor position of the motor is sensed and it decides the mode of conduction. The application specific 16-bit microcontroller is selected for the overall operation and it generates the gate pulses for the inverter and buck/boost converter circuit. Controller Unit The buck/ Boost converter shown figure 4 which boost the magnitude of voltage recovered during braking. To charge the ultra-capacitor in effective way, the voltage pulses are boosted.

3.1 BLOCK DIAGRAM

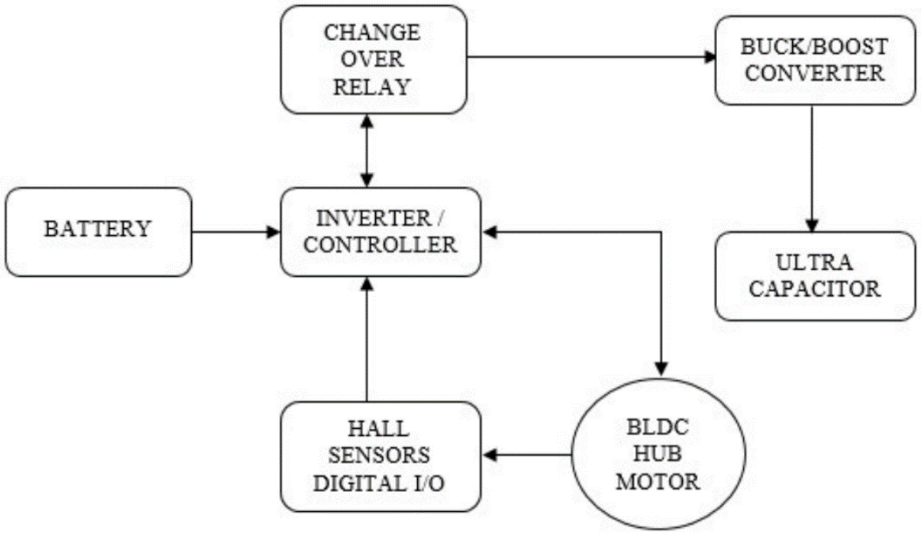

Figure 1: - Block diagram of proposed model

3.2 SYSTEM ANALYSIS

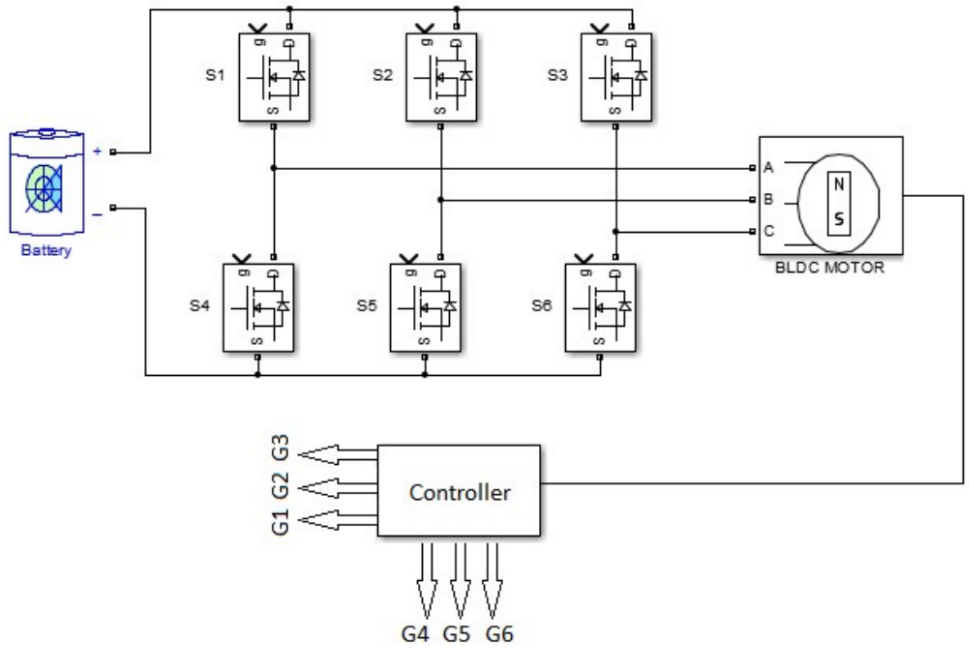

Figure 6: Schematic of Power Circuit

The schematic diagram of the inverter is shown in figure 6. Inverter is designed with P75NF75 MOSFET, which are conducted based on the gate pulses given from the controller depends on the hall sensor signals. Based on the rotor position, hall sensor sends the signal to the controller and gate pulses are provided for respective MOSFETs. During motoring action, both upper and lower arm MOSFETs are conducts. But during regenerative braking, the upper arm MOSFETs are kept low and only lower arm MOSFETs are started conduct one at a time.

IV. SYSTEM REQUIRMENT

4.1 SOFTWARE REQUIRMENT

MATLAB Software

V. CONCLUSION

It has been demonstrated that the proposed model is effectively recovered the braking energy and stored in the banks of ultra-capacitor. The proposed system is used to allow the vehicle to operate in higher acceleration and deceleration with less energy loss and will 98 reduce the degradation of the vehicle battery. The vehicle is tested with different loading condition and therefore, the electric vehicle powered by battery along with the stored energy in ultra-capacitor and it can obtain higher energy regeneration in a short time. This proposed concept may also easily be implemented in hybrid electric vehicles.

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