



SIMULATION OF ZnO BASED ELECTRIC VEHICLE WITH CONVENTIONAL CONTROLLERS

Author .1st – Dr. Dhanya J.S.

Assistant Professor , Department of Physics

Sabarmati University, Ahmedabad(INDIA)

Author .2nd – Patil Swati Shantaram

Research Scholar , Department of Physics

Sabarmati University, Ahmedabad(INDIA)

ABSTRACT

This paper proposes a solution to the problems listed above by including a ZnO capacitor into the electric vehicle's energy storage system alongside a battery bank. The energy needed to power an electric automobile, hybrid, or solar-powered vehicle is collected by the solar panel. An ideal efficiency model is suggested based on the analysis of the efficiency features of the electric motor, ZnO capacitors, and batteries in an electric vehicle. Major components of the suggested vehicle are energy storage devices since, as is well-known, they are necessary for storing production surplus and transmitting shortfall surplus. This paper proposes a method for making this happen by combining batteries with ZnO capacitors. Although lead acid batteries have a high energy storage capacity, their efficiency decreases with rapid load changes. To extend the life of the battery and offer energy on demand, a hybridized energy storage system that includes ZnO capacitors may work in tandem with the battery. Designing and managing various kinds of converters is part of the planned job. In order to improve the system's performance, the converters have been regulated using both traditional controllers like PI and PID and intelligent controllers like fuzzy controller. A comparison of the results has been done. In order to assist the batteries, maintain their charge as efficiently as possible, an Arduino-based power circuit has been developed to interface the battery pack with ZnO capacitors, which are known for their high performance in high terrains and low charge batteries.

Keywords: Ttraditional controllers like PI and PID , ZnO capacitors , electric vehicle's energy storage system.

1. INTRODUCTION

The tremendous advantages of renewable sources, such as their readily availableness and limitless consumption, have led to a rise in their utilization in recent years. The suggested electric car can use solar energy as its source for real-time implementation, among other renewable sources such as wind, biomass, tidal, etc. As the electric car relies on renewable energy sources for its functioning, the energy storage system is crucial to the electric vehicle industry. The energy storage technologies that have been selected are the lead acid battery and the ZnO capacitor. The lead acid battery has more advantages, such as bigger charge and discharge cycles and a longer lifespan, while the ZnO capacitor has the advantage of being able to operate during transient periods. The source voltage could be low, so a converter is needed to increase it. Traditional buck boost converters have a number of drawbacks, such as increased conduction losses, reduced voltage gain at higher duty cycles, and higher voltage stresses.

The block diagram for the electric vehicle is shown in figure 1.1.

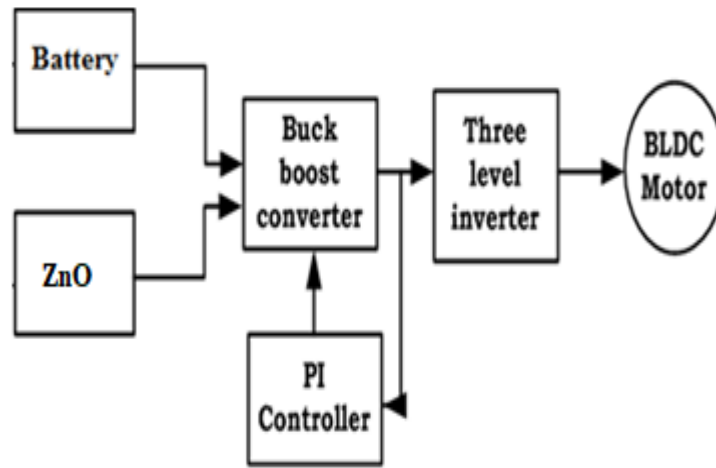


Figure 1. 1 Block diagram of proposed electric vehicle

The projected replica's block diagram is shown in Figure 1.1. Both the battery and the ZnO capacitor have been charged with the energy that the solar panels have produced. The buck boost converter will increase the output of the energy stored in the battery and ZnO capacitor before sending it to the inverter to be converted into AC output. Additionally, the system controls the BLDC motor.

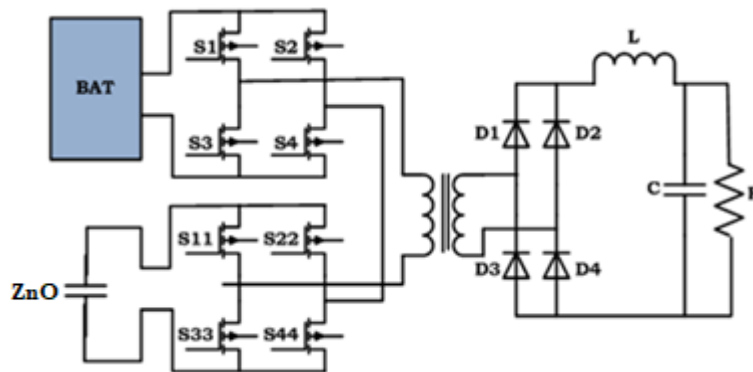


Figure 1. 2 Proposed model

The suggested vehicle's converter layout is shown in Figure 1.2. A complete bridge buck boost converter, a capacitor, a smoothing inductor, and a battery or ZnO capacitor serve as the converter's sources.

1.2 MODES OF OPERATION

1.2.1 LOW POWER MODE

Many electronic devices, especially portable ones like laptops, smartphones, and other similar devices, have a feature called Low Power Mode that helps to save battery life by minimizing energy consumption. To meet the increasing demand for devices with longer battery lives, manufacturers have introduced Low Power Modes. These modes allow customers to use their devices for extended periods of time without constantly charging them. This mode works by reducing processing power, improving the management of background operations, and limiting or eliminating certain non-essential functions. While each device and OS has its own unique Low Power Mode implementation, they all share a common objective: maximizing battery life through a compromise between performance and energy economy.

The vehicle can be operated in two distinct modes according to the amount of power needed. Figure 1.3 below shows the power mode, which is called lower power mode, when the needed power is less than or equal to the converter's power capability.

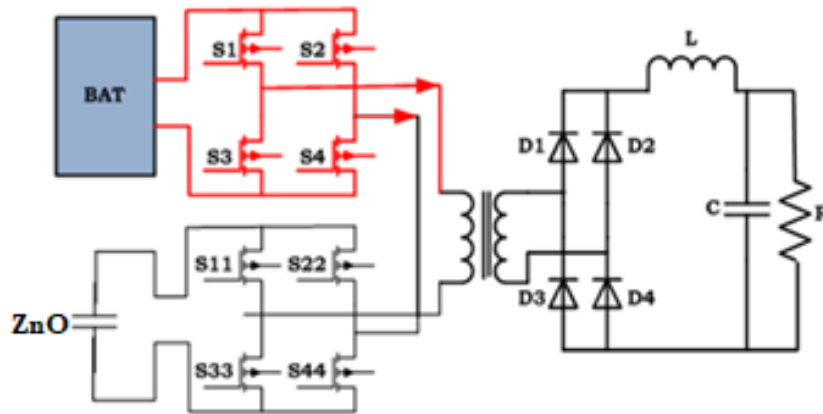


Figure 1. 3 Energy flow in Low power mode

1.2.2 HIGH POWER MODE

Smartphones, laptops, and desktops can all benefit from High Power Mode, which allows them to run at peak performance while typically increasing power consumption. Game playing, video editing, 3D rendering, and the execution of resource-intensive programs are just a few examples of the kinds of jobs that benefit greatly from this mode. Users may accomplish intensive tasks more rapidly and efficiently in High Power Mode because it prioritizes performance over energy efficiency and forces the device's components, including the CPU, GPU, and memory, to operate at their maximum capacity.

There will be a power disparity between the input and output of the converter when operating in the higher power mode. Because power diodes will be biased forward and the capacitor's voltage will not be able to be maintained. In order to supply electricity to the load, the converter must also be operational, and the battery must also be in the operational mode.

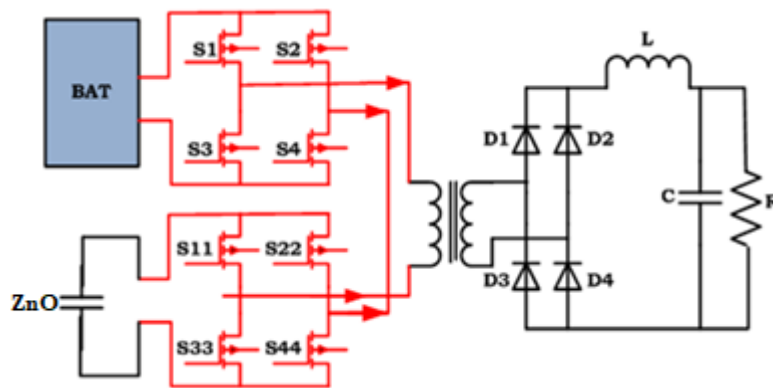


Figure 1. 4 Energy flow in High power mode

1.2.3 ACCELERATING MODE

There are a number of electronic gadgets and systems that include an Accelerating Mode that is meant to improve performance by making operations faster and more efficient. Data processing, high-performance computing, and gaming are just a few examples of situations where this mode shines. Tasks can be finished more quickly in Accelerating Mode compared to normal operating settings because it optimizes resource allocation and boosts the speed of the central processor unit (CPU) or graphics processing unit (GPU).

1.2.4 DECELERATING MODE

When turned on, Decelerating Mode reduces the overall performance and power consumption of an electronic gadget, making it more energy efficient. This mode, when turned on, reduces the speed of the system's processes, usually by decreasing the clock speed of the CPU and limiting background activity. Portable electronics, like as smartphones and laptops, benefit greatly from this performance drop because it allows users to store power for longer periods of time or when they won't be able to charge their devices soon.

Decelerating Mode can also lessen the load on hardware components, which means less heat is generated and the cooling systems, like fans, aren't working as hard, which means the operation is quieter. This mode guarantees that necessary operations can still be completed without consuming excessive power, albeit at the cost of speed and responsiveness. When users aren't doing anything particularly resource-intensive, like playing games or editing videos, this trade-off works well.

Longer battery life, quieter operation, and sufficient capability for day-to-day tasks are all benefits of Decelerating Mode, which offers a balanced approach for energy savings. In low-power scenarios, it is very helpful for increasing device longevity. Energy is transferred from the battery to the ZnO capacitor during deceleration

mode. When activated, the switch transfers energy from the battery to the ZnO capacitor for storage. The stored energy is transmitted into the load when the switch is turned off.

1.3 CONCLUSION

One exciting step toward improving electric vehicle (EV) energy storage systems for maximum performance and longevity is the use of zinc oxide (ZnO) capacitors into battery banks. Combining the high energy density and extended discharge durations of batteries with the quick charge/discharge capabilities of capacitors, this unique technique utilizes the particular benefits of both types of batteries. When compared to traditional electric vehicle (EV) energy storage options, this hybrid system performs better in a variety of situations and uses less energy overall.

A number of promising uses have been identified for zinc oxide (ZnO) capacitors due to its high capacitance, excellent electrical characteristics, and energy storage capabilities. Utilizing their integration with battery banks, they assist in overcoming the drawbacks of conventional batteries, such their inefficient charging and quick discharging cycles. An improved energy storage system that enhances EV performance is possible because to the synergistic properties of ZnO capacitors and batteries. To improve the vehicle's operating efficiency and range, ZnO capacitors are used to manage peak power demands, such acceleration or regenerative braking, so that the battery bank can concentrate on supplying steady power for extended periods of time.

One revolutionary way to improve the efficiency of EVs is to combine ZnO capacitors with battery banks. Fast energy storage and release, greater energy recovery, and an extended battery life are all advantages of this hybrid system that overcome the drawbacks of conventional batteries. These kinds of advancements are going to be crucial in meeting the rising demand for electric cars, making them more efficient, less harmful to the environment, and helping the world move towards more sustainable modes of transportation. An exciting development in the realm of electric vehicle energy storage is the incorporation of ZnO capacitors into battery systems. This will allow electric mobility to reach its maximum potential.

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