Journal of Physics: Conference Series

PAPER • **OPEN ACCESS**

IoT Based Control of Hybrid Energy Storage System for an Electric Vehicle using Super Capacitor and Battery

To cite this article: K Balachander *et al* 2021 *J. Phys.: Conf. Ser.* **1979** 012032

IoT Based Control of Hybrid Energy Storage System for an Electric Vehicle using Super Capacitor and Battery

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Abstract. This main objective of this project is to control the hybrid energy storage system in order to increase the lifetime and performance of an electric vehicle battery source. This can be achieved by utilizing the powerful super capacitors in order to satisfy the peak power demand in an electric vehicle. When there is sudden raise in acceleration the peak power demand raises and hence the battery life gets reduced when there is sudden peak in discharge. In order to overcome this drawback, the super capacitor based auxiliary energy storage system comes into the role. We have used ARDUINO as a brain of this operation and it smartly identifies the excess power demand, cruise and normal mode of acceleration and rapidly switches between the battery storage and super capacitor storage accordingly in order to increase battery life time.

1. Introduction to Hybrid Energy Storage System

Hybrid energy storage system is a system or a methodology to store two or more different source of energy resource in order to achieve the desired output power or performance of an electric vehicle. In this proposed work the hybrid energy resource like rechargeable battery and super capacitors are chosen. The main reason behind choosing the super capacitor as an auxiliary power source in the hybrid storage system is that the super capacitors will support sudden charge and discharge of operations. Additionally, the charge and discharge cycles of the super capacitor are more and it happens even faster when compared with the traditional storage devices like lithium-ion battery [1-5].

2. Existing System

The existing system of methodology the adaptive throttle difference is not calculated by sensing the vehicle previous time frame speed with the vehicle current speed at two different time frames. And if the acceleration is above zero condition exists the acceleration is identified by the flow chart which implies the system doesn't have any throttle difference to identify the throttle given by the user in previous time frame and the current time frame in order to activate the super capacitor at exact time frame [10-15]. Additionally, the excising system of methodology doesn't have remote monitoring technology and hence due to lack of scalability the vehicle manufacturer cannot be able to track the battery historical performance. Also, in the excising system of methodology the three exists the limitation of real time data acquisition while the vehicle is in running condition and hence only the simulation results were analysed [16, 17].

3. Proposed System

In the proposed methodology the continues monitoring of power consumption of the vehicle battery is handled by using Internet of Things concepts. By adopting fuzzy logic, the peak demand is identified by decision making algorithm and the super capacitor is activated in order to satisfy the peak power demand [18-22]. By this method the battery wear and tear is prevented and the battery life cycle is increased. Historical data of battery performance is also made possible with the help of internet of things. Also, the battery parameters can be monitored remotely with the help of TCP/IP protocol which periodically pumps the battery parameter to the remote server and hence the live data tracking is made possible which increases the scalability.

4. Proteus Design Suite
This work is implemented and simulated using Proteus Design Suite software tool. A proprietary software tool set used mainly for electronic design automation is the Proteus Design Suite. The software is primarily used for the production of printed circuit boards by computer design engineers and technicians to produce schematics and electronic prints.

5. Block Diagram
The fig. 1 represents the systematic block diagram of this project "IoT Based Control of Hybrid Energy Storage System or an Electric Vehicle Using Super Capacitor and Battery"

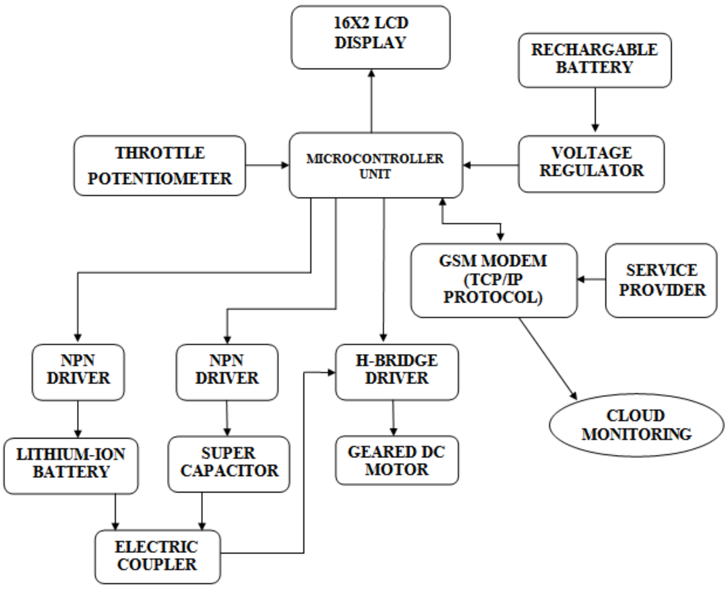

Figure 1 Block Diagram

In fig. 2 describes the microcontroller regulated operating power supply is obtained from the rechargeable battery and linier voltage regulator. And the overall project status is monitored over 16X2 LCD display locally. H-bridge motor driver block is used to control the speed of an electric vehicle using PWM pulse generated by the microcontroller unit based on the throttle applied by the user. Depending on the throttle applied, the duty cycle of the PWM pulse will be varied and hence the electric vehicle speed control has been established. The value of the throttle input given by the user will be recorded and the minimum threshold is set to 5 points. If the user is applying the constant speed throttle by slow variation, the throttle difference will not exceed above 5 points. And hence the overall vehicle power is drawn only from the rechargeable battery. Once the user has given the sudden variation in throttle whose throttle difference is more than that of predefined 5 points, the super capacitor is activated to boost the vehicle speed and to compensate the excess power demand applied by the electric vehicle user. The GSM modem block is used to establish the server connection through TCP/IP protocol and upload the battery parameter like SOC percentage to the cloud server. The server used here is Think speak server and the Think speak server channel frame is integrated to the static webpage and hosted with unique URL in order to monitor the battery performance from anywhere in the world.

6. Design Methodology

The below design diagram (Fig. 2) describes the entire circuit diagram of this project "IoT Based Control of Hybrid Energy Storage System for an Electric Vehicle Using Super Capacitor and Battery"

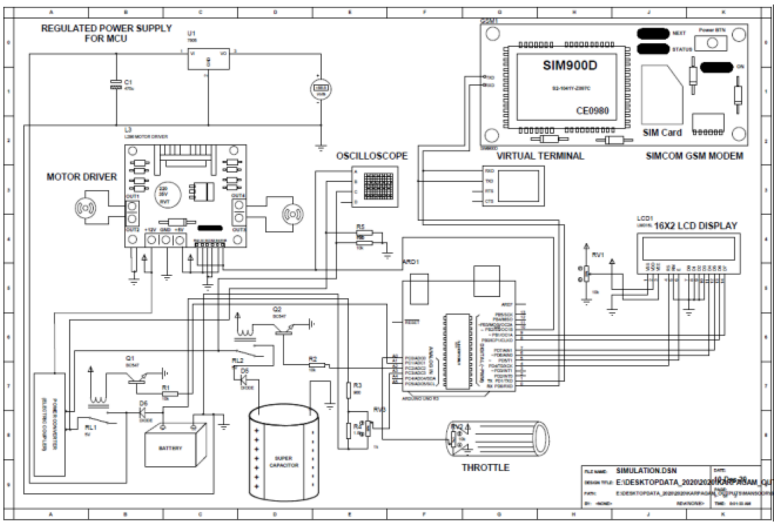

Figure 2 Circuit Diagram

7. Simulation Results

In this simulation results section, outputs of our research work are explained.

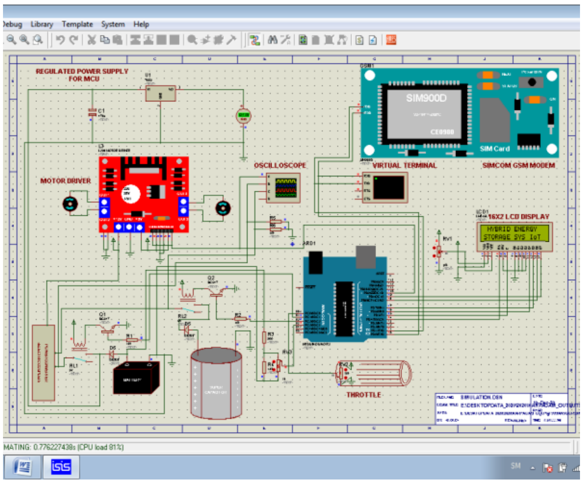

Figure 3 Simulation diagram of system initialization

The above figure 3 represents the system initialization in order to give hardware stabilization by providing on time delay by the microcontroller unit.

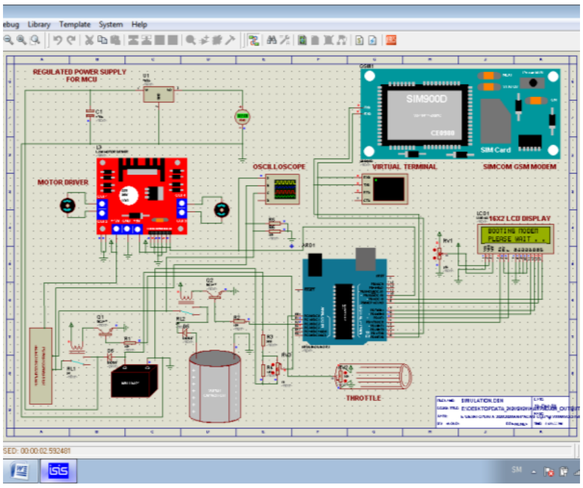

Figure 4 Simulation diagram of booting of modem

The above figure 4 represents the booting of modem in order to establish network connectivity.

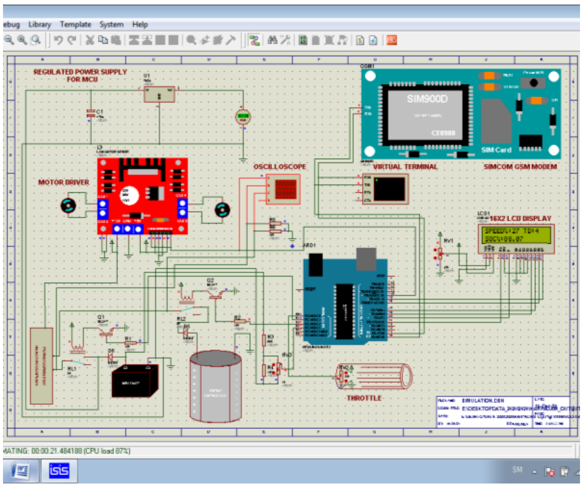

Figure 5 Simulation of vehicle parameters

The above figure 5 represents the RPM of electric vehicle in terms of speed, the throttle difference level and the battery state of charge percentage level of the electric vehicle. The throttle difference level is nothing but a variable defined to identify the difference in throttle with previous state and current state.

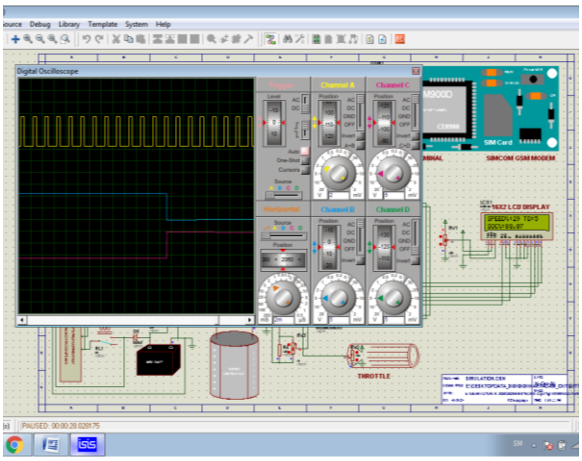

Figure 6 Simulation Result of PWM wave form at 29%

The fig. 6 represents the PWM wave form of the speed of the vehicle which indicates the duty cycle of the PWM wave when the speed is 29 percentage and when the throttle difference is more than that of predefined range the super capacitor is energized in order to compensate the load demand.

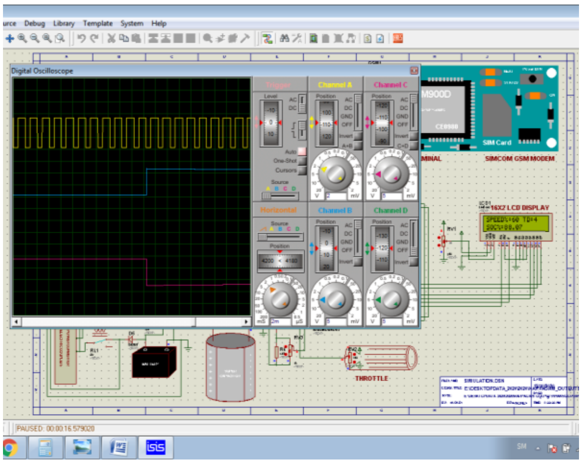

Figure 7 Simulation Result of PWM wave form at 60%

Fig. 7 represents the PWM wave form of the speed of the vehicle which indicates the duty cycle of the PWM wave when the speed is 60 percentage and other waveforms represents the deactivation of super capacitor when the throttle difference is back to normal and hence the battery source is connected by disabling the super capacitor line.

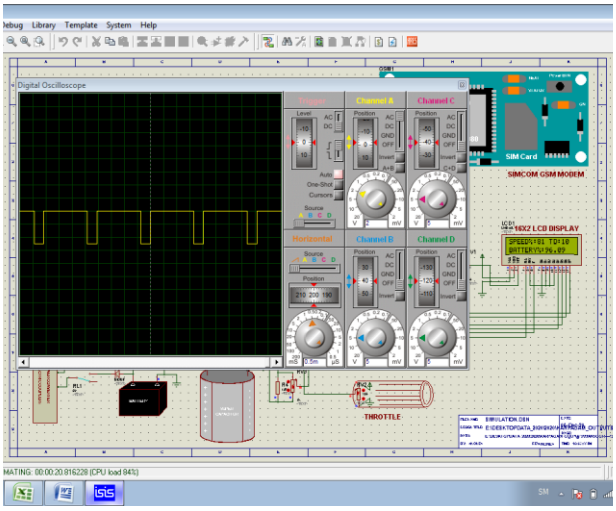

Figure 8 Simulation diagram of PWM at 81%

The fig. 8 represents the PWM wave form of the speed of the vehicle which indicates the duty cycle of the PWM wave when the speed is 81%.

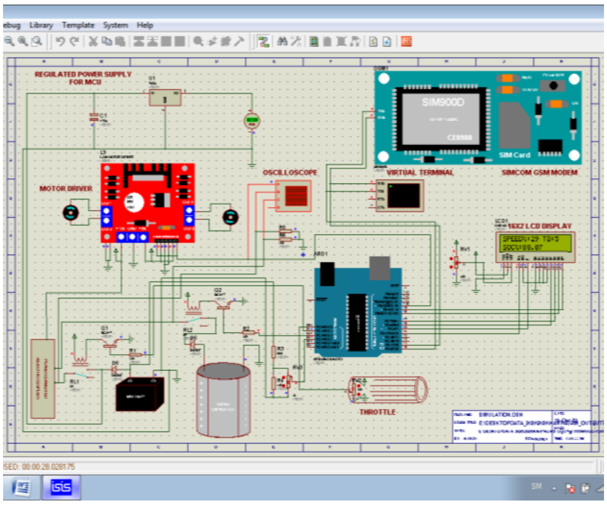

Figure 9 Simulation Result of throttle difference (more than 2 points)

The above figure 9 represents when there is a throttle difference more than that of 2 points, the super capacitor is activated in order to satisfy the load demand.

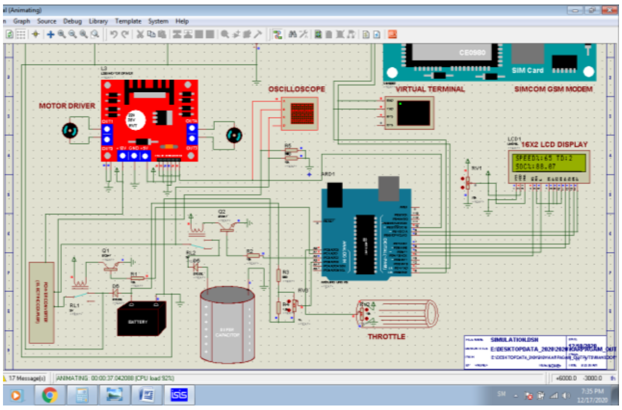

Figure 10 Simulation Result of throttle difference (less than 2 points)

The above figure represents when there is a throttle difference less than that of 4 points, the super capacitor is deactivated and the constant increase in load is driven only from the battery resource.

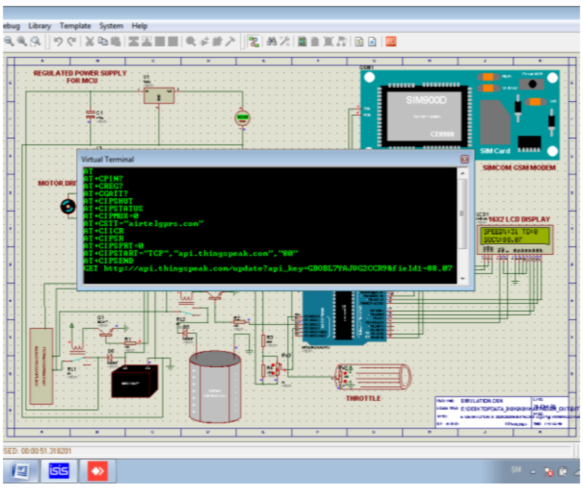

Figure 11 Simulation Result of GSM modem updating the power parameters values

The above figure represents the TCP/IP commands from the GSM modem updating the power parameters values to the live cloud server in order to increase the scalability.

Conclusion

By using this project Dual switch over of power source between super capacitors and battery is enabled to enhance the electric vehicle battery performance and life cycle and to satisfy the excess power demand when required by the user. IoT based monitoring of Electric vehicle battery is enabled to increase the scalability. Battery live power consumption and state of charge percentage level graphical representation is implemented in IoT platform and made available in the unique URL for live tracking of battery performance.

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