

New Battery Management System Prototype

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Abstract—The fuel existing vehicles produce air pollution, noise pollution and it produces many other effects on an environment like global warming, green-house effect etc. Due to these impacts, conventional fuel for vehicles is changing to battery. Hence there is increase in number of Electric Vehicle (EV) recently. In EV there is a major disadvantage that it could not travel more than few hundred kilometers. For solving this issue, if the battery capacity of EV increased, then weight and size also increase thus it is not possible. Hence there is a need for setting up the new battery management in the Electric Vehicle. This study provides a full overview as well as an in-depth investigation of this relatively novel and satisfying solution for battery problems in electric vehicles. We divide the battery in half with this innovative battery management technique. One half is for charging and the other half is for discharging. Solar panels and other renewable energy sources, regenerative braking, regenerative suspension is used to charge the vehicle. While one side is charging, the other is simultaneously discharging. We use the charged section of the battery when the other half is totally discharged, and the discharged portion is stored for charging. we don't need external charging because of this management, and the vehicle can charge itself. We're also not using two distinct batteries, so there won't be any space issues, this article will focus on the design and analysis of this battery management system, as well as its benefits and prospective applications. Its ability to solve the electric vehicle's inclination problem.

Index Terms— Battery Management System, Autonomous Vehicles, Battery, Electric Vehicles, EV, E-Vehicles.

I. INTRODUCTION

In today's world most of the electricity is generated using Fossil fuels, whereas only 9.8% of electricity that we use is from solar energy. India receives nine months of sunny climate thus the concept of using solar energy to commute from one place to another without having to stop anywhere is not only much needed in India but also other parts of the world.

By 2022, India will have surpassed China as the third biggest passenger vehicle market. The automotive industry in India currently accounts for more than 7% of the country's gross domestic product. Automotive Mission Plan 2016-2026 sets a goal of increasing the contribution to 12%. Given this potential growth and its importance as a component of India's industrial base, the automobile sector has the potential to make a substantial contribution to the country's sustainability goals.

These days, electric cars EV are gaining attention, and they do represent a substantial shift in how automotive products contribute to environmental issues. The switch to EVs is expected to happen over the next decade. Manufacturing, on the other hand, has an immediate opportunity to become more sustainable from a

sustainability standpoint. Given their commitment to source renewable energy, the majority of Indian firms are making progress to become more sustainable.

II. LITERATURE REVIEW

The government of every country around the world is enacting laws to reduce oil dependency, enhance air quality and reduce carbon gas emissions. EVs sales have steadily increased in recent years, Electric car sales peaked at 1 million units in September 2015, fast climbing to 4 million in January 2019.

A. Battery capacity is required to power electric vehicles in India

With a capacity of 2 megawatts (MW), One of Gujarat's largest rooftop solar installations is Tata Motors' Nano facility. Through this project, Tata Motors has been able to save almost Rs.3 million per year while also avoiding the emission of nearly 2,700 tonnes of CO₂.

The demand for electric vehicle components in India, especially battery cells, is highly dependent on overseas markets.

TABLE I. TYPICAL NET BATTERY CAPACITY VALUES AND ENERGY CONSUMPTION IN 2020 FOR DIFFERENT VEHICLE CATEGORIES

Vehicle category	Net battery capacity, kWh	Energy consumption, kWh/km
E-bike	1.2	0.016
2WLS	2.2	0.025
2WCS	3.0	0.030
E-rickshaw	3.7	0.043
Bus	124	0.840
Truck	125	0.750

TABLE II. EXISTING AND DESIRED DRIVING RANGE OF DIFFERENT EV CATEGORIES IN INDIA

Vehicle classification	Range in 2020, km	Estimated desired range, km
E-bike	73	100
2WLS	91	150
2WCS	93	200
E-rickshaw	81	150
Bus	166	300
Truck	229	300

B. Need for Battery Management System (BMS)

BMS ensures that the battery is secure and durable while also increasing senility without causing harm to it. To keep the battery in good condition, many monitoring techniques are used, including voltage, current, and ambient temperature.

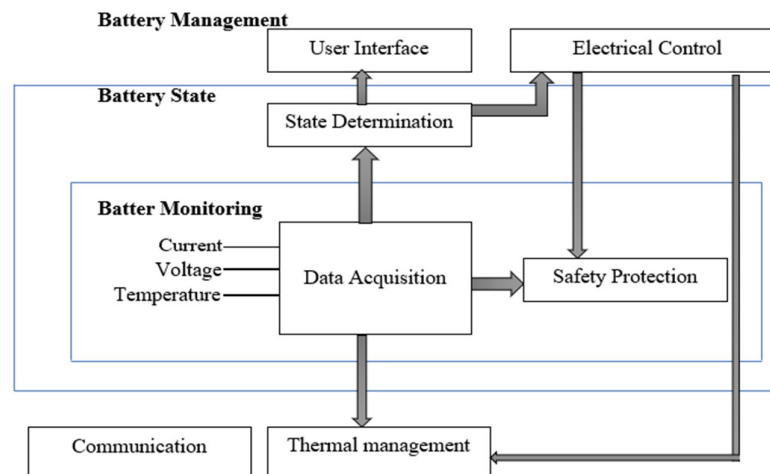


Figure 1. Battery Management System

C. Lithium-ion Battery

Lithium ion (Li-ion) battery is a type of advanced battery that uses lithium ion as a key element in electrochemistry. The lithium atoms in the anode ionize and lose their electrons during the discharge cycle. Lithium ions migrate from the positive electrode through the electrolyte to the negative electrode and combine with their electrons and become electrically neutral. Between the anode and the cathode, the lithium ions are small enough to pass through a fine permeation separator. Due to lithium's small size, Li-ion batteries are able to sustain very high voltages and store charge per unit mass and volume.

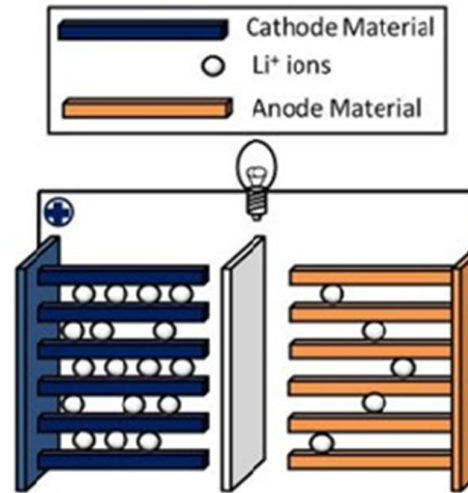


Figure 2. Lithium – ion Battery

III. DESIGN

A. Block Description

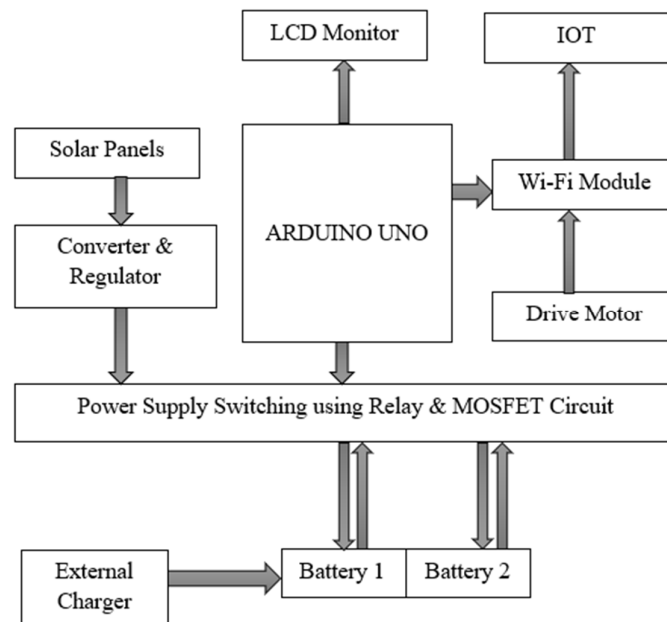


Figure 3. Block Diagram

- Arduino Uno: Pre-assembled Arduino boards contain a microcontroller that can be Programmed with Arduino programming language and Arduino development environment. This platform can be used to create and program electronic components.
- Solar Power: PV panels are attached to the vehicle's rooftop in solar power. We charge the battery by using the solar system.
- Battery: Two lithium-ion batteries are merged to make a single battery (Continuous charging and draining cycles are maintained automatically).
- Drive Motor: The majority of electric vehicles today use DC motors (4 kW and less power). A well-known form of AC motor is the induction motor. A huge number of high-power electric cars use induction motors (above 5kW). Torque and acceleration are often managed via a vector drive.
- Converters and Regulators: The bridge circuit is used to convert AC to DC. It is a bridge rectifier that is in use. For charging the battery, the regulator regulated the voltage and current up to a specific limit.
- Charging Port: IEC 60309 Industrial Blue connectors are used in Indian electric cars, and the Bharat EV requirements encourage utilising this plug. All global EVs use the IEC 62196 Type 2 connector. (Commonly referred to as Mennekes). The European Commission has recognised this connector as the official charging connector for the whole European Union. On our electric vehicles, this charging port is an optional feature

B. Calculations

1. Solar Panel:

Solar Voltage, $V_{\text{solar}} = 9.8$ Volts

Solar Current, $I_{\text{solar}} = 100\text{mA}$

Total Current output of Solar panel per hour = 1000mAH

2. Battery – SOC (State of Charge):

Battery Voltage, $V_B = 8.4$ Volts

Battery Current, $I_B = 3000$ mAH

Total time for Charging = Battery Current / Solar Current = 3000 in mAH/1000 in mAH = 3 hrs

3. Load Calculation:

Motor Voltage, $V_M = 8$ Volts

Motor Current, $I_M = 1$ Amps max.

Max. Power output = $V_M * I_M = 9 * 1 = 9$ Watts

Average Current consumption = 0.8A

Max. Voltage = 8.4V

Max. Power Consumption = Average Current consumption * Max. Voltage = 0.8A * 8.4V

Max. Power Consumption = 6.72 Watts

4. Other Electronic Components power consumption:

ARDUINO UNO, Relay & other – Operating Voltage = 5V

Operating Current = 2000 mA

Max. Power = 1 watts

C. MATLAB Simulation

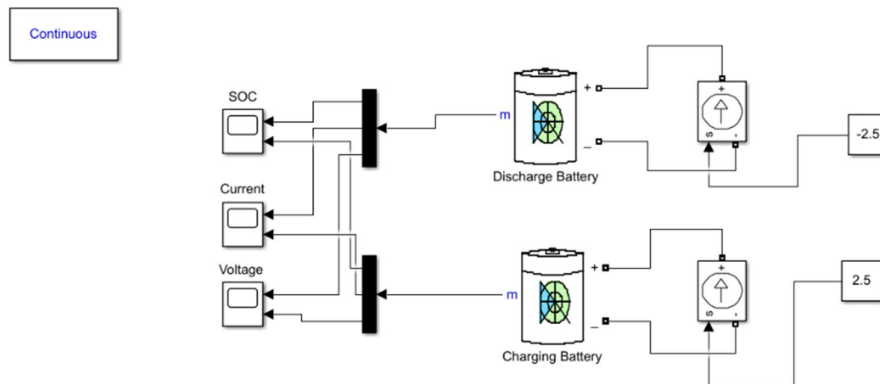


Figure 4. Matlab Simulation Snapshot

We utilized MATLAB to model the combination of two batteries using a new battery management system. We examined the State of Current (SOC), Voltage, and Current in this simulation

IV. SIMULATION RESULTS

A. State of Charging (SOC)

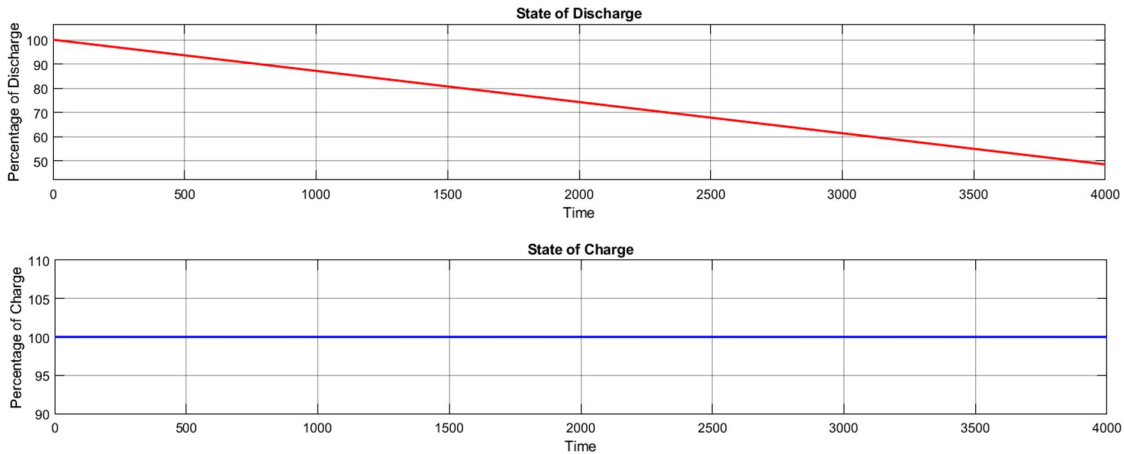


Figure 5. State Of Charging Snapshot

In an electric vehicle's battery management system, the terms SOC (State of Charge), current, and voltage are all crucial. The state of charge (SOC) of a battery is determined by the charging and discharging rates.

In the figure 5., the SOC for battery discharge drops from 100 percent to 0 percent, while the SOC for battery charge rises from 0 percent to 100 percent. The charging and discharging rates of the batteries are constant over time, as shown in the graph above.

B. Current

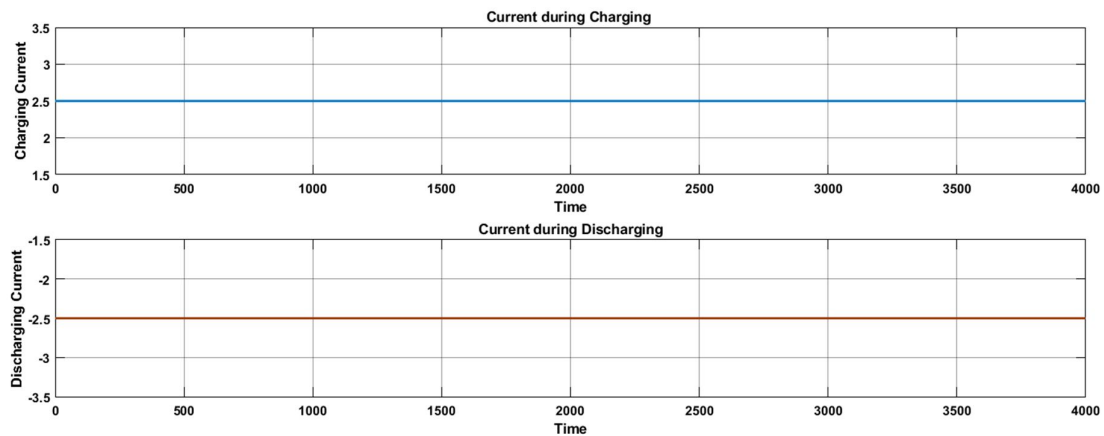


Figure 6. State of Current during Charging & discharging snapshot

The upper graph in the current diagram depicts the charging current, while the lower graph depicts the discharging current. We can deduce from this diagram that the current utilised to charge and drain the battery is identical.

C. Voltage

The upper graph indicates the voltage when the battery is charging, and the lower graph shows the voltage after the battery is depleted, according to the voltage graph. As can be seen from the graph, the voltage is the same for both.

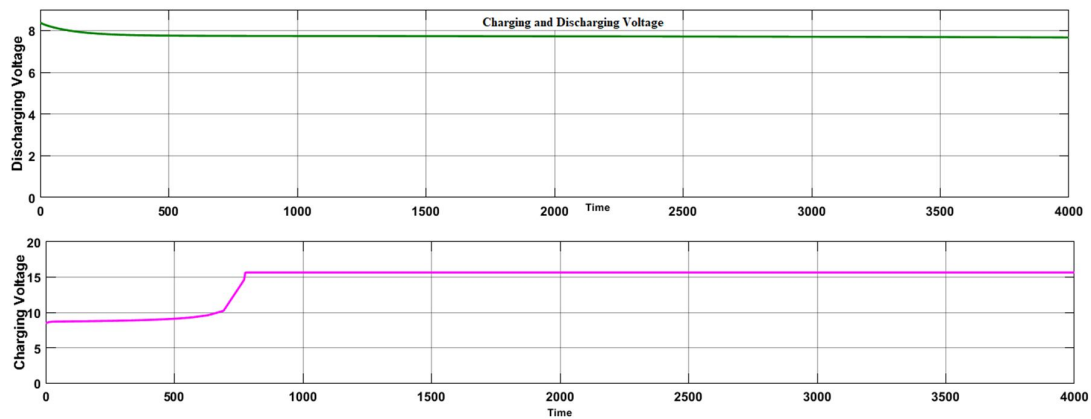
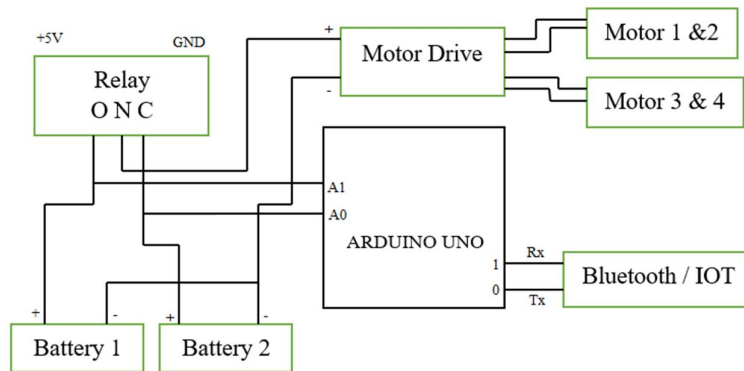


Figure 7. State of Voltage during Charging & discharging snapshot

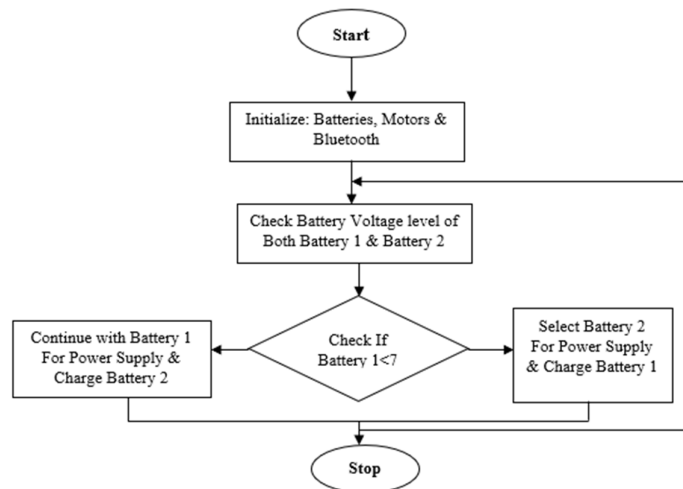
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V. METHODOLOGY

A. Circuit Diagram



B. Flow Chart



Battery Switch Over: Conditions

1. Battery 1 and 2 voltage is be measured using analog pin of Arduino
2. If default battery (battery no. 1) voltage goes below 7V then battery power will be switched to battery no 2 and battery 1 will start charging
3. If battery 2 volt goes below 7v then it will be switched to battery 1 and battery 2 starts charging.

VI. RESULTS AND DISCUSSION

Electric vehicles are pollution-free and require little maintenance compared to other types of vehicles. We can improve the battery's efficiency with a battery management system. We integrate two batteries into one new battery using our battery management technology.

An improved battery management system can significantly increase the performance of electric vehicles. Battery management systems assure battery safety, efficiency, and reliability. They are critical components of electric vehicles. Additionally, they offer solutions for Torque, power, and heating issues for electric vehicle

VII. BENEFITS OF BATTERY MANAGEMENT SYSTEM

1. Efficient power transmission throughout the system
2. The most effective method for dealing with inclination issues
3. Allows the vehicle to be totally self-contained.
4. It saves a lot of money on charging stations.
5. There are no additional charges for billing purposes.
6. This is a system that will stand the test of time.

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