Power Saving System for Electrical Vehicles

Ch.Sujatha(Associate Professor),S.Rakesh Babu,Rabiya Basariya,P.Rushikesh,R.Bhaskar Rao.

ABSTRACT_ Though their mainstream acceptance is hampered by battery life, charging infrastructure, and consumer worries about range anxiety, electric vehicles (EVs) provide a sustainable substitute for fossil-fueled transportation. Current EV systems lack smart power optimisation, which causes ineffective energy use under important low-battery circumstances. Using an ATmega328P microcontroller, this project suggests a Power Saving System that dynamically optimises energy use in EVs. The system adjusts motor performance via an L293D motor driver to enhance driving range and automatically turns off non-essential components—such as lighting, fans, and infotainment systems. It also includes a manual activation function to allow power-saving mode preemptively. This design helps to more efficient EV operation by improving energy use and system dependability, therefore supporting more general adoption of electric mobility solutions.

1.INTRODUCTION

Offering no emissions, less environmental impact, and cheaper running costs, street electric vehicles (EVs) are fast becoming a popular sustainable substitute for internal combustion engine cars. Still, some pragmatic issues keep EV adoption limited even with these advantages. Among the most notable is the problem of battery limits—both in terms of driving range and energy efficiency. EV customers frequently suffer range anxiety, particularly in locations with limited charging infrastructure, hence it is imperative to handle power management inside these cars.

While the battery level is dangerously low, conventional EV systems concentrate mostly on issuing alerts; they do not take any action to maximise power use in reaction. Even when energy supplies are running low, this causes non-essential systems like air conditioning, entertainment, and lighting to keep running. As a result, energy that might otherwise prolong the driving range of the car is lost, and the likelihood of the car stopping before arriving at a charging station rises markedly.

The suggested project offers a power-saving mechanism that automatically controls energy use depending on battery condition to solve this problem. The system smartly detects important battery conditions and starts energy saving actions by including a microcontroller-based control unit. These cover changes in motor operation to lower power draw and the automatic shutdown of non-vital systems. Moreover, the system has a manual override function that lets drivers actively activate power-saving mode even before the battery runs low.

Because of its affordability and adaptability, the ATmega328P microcontroller, often found in Arduino platforms, forms the foundation of the system. Through interfaces like the L293D motor driver, it controls a DC motor (representing vehicle propulsion), fans, relays, LEDs, and other components. Real-time monitoring and dynamic control of energy-consuming components are made possible by this configuration, hence guaranteeing that the vehicle runs under diverse circumstances within optimal power parameters.

The suggested design also offers the driver utilising an LCD display and buzzer, respectively, useful visual and aural feedback. These indicators show active power-saving mode status, system alerts, and battery status. The solution not only increases vehicle efficiency but also empowers users with more control over their EV's performance by improving user awareness and enabling both automated and manual control of energy use. This research, therefore, intends to address one of the key obstacles in EV adoption by providing a reasonable, flexible, and practical approach for battery power control. By optimizing energy usage and increasing vehicle range during critical moments, the technology boosts the reliability of electric vehicles and contributes to the worldwide drive toward sustainable and efficient transportation systems

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

2.LITERATURE SURVEY

[1] Vinay Teja, P., Pradep, R., Prathiksh, S., & Karthika, V. (2019). Power Saving System for Electric Vehicles.

Abstract: This paper presents a novel power-saving system designed specifically for electric vehicles (EVs) to enhance energy efficiency and extend battery life. The proposed system utilizes a combination of regenerative braking, optimized power distribution, and intelligent load management to minimize power wastage during vehicle operation. By integrating microcontroller-based control logic, the system dynamically adjusts power output based on driving conditions and user input. Experimental results demonstrate significant energy savings and improved range performance, suggesting the approach as a viable solution for next-generation sustainable transport systems.

[2] Nagrale, S., Waghmare, A., Sahare, T., Nagwanshi, A., Sakhale, I., & Sathe, J. (2023). Arduino Based Battery Management System for Electric Vehicles.

Abstract: This study introduces an Arduino-based Battery Management System (BMS) aimed at monitoring and managing lithium-ion battery packs used in electric vehicles. The system is designed to track key battery parameters such as voltage, current, and temperature in real-time to ensure safe and efficient battery usage. The proposed BMS also includes overcharge, over-discharge, and short-circuit protection mechanisms. With a focus on affordability and simplicity, the Arduino microcontroller is employed as the core component, making the system suitable for educational and low-cost EV applications. The results confirm the BMS's effectiveness in enhancing battery safety and longevity.

[3] Dhavale, S. R., Mahajan, M., Mahajan, K., Chavan, A., & Sidwadkar, R. (2022). Smart Electrical Vehicle System.

Abstract: This paper discusses the development of a Smart Electric Vehicle (SEV) system integrating modern technologies to enhance driving experience, safety, and energy management. The system features GPS tracking, real-time battery monitoring, automated lighting, and IoT connectivity to provide users with better control and feedback. A microcontroller unit coordinates all sensor inputs and system operations. The SEV design emphasizes low cost and modularity, making it adaptable to various types of electric vehicles. The implementation results confirm the system's capability to optimize vehicle performance while ensuring safety and convenience for the user.

3.PROPOSED SYSTEM

When power levels are dangerously low, the suggested Power Saving System for Electric Vehicles is meant to maximise battery use and increase driving range. The system smartly controls energy use by automatically turning off non-essential parts like lights, fans, and infotainment systems and controlling motor speed using an L293D motor driver, all under ATmega328P microcontroller control. A manual activation switch also lets users turn on power-saving mode even if the battery is not dangerously low, therefore maximising efficiency. This approach increases energy use, lowers range anxiety, and increases general dependability of electric cars, hence enabling more practicality for longer travels.

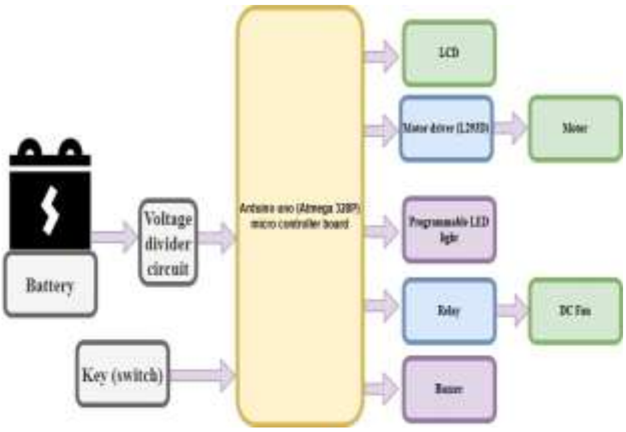

Fig 3.1 Block Diagram

The suggested Battery Power Saving System's workflow is a step-by-step process in which the microcontroller constantly monitors the battery status and dynamically controls the power distribution depending on real-time data. To maximise energy use in electric cars, the system runs via both automatic and human control systems.

© 2025, IJSREM

Starting and Tracking
The ATmega328P microprocessor initialises all components and begins monitoring the battery voltage using a voltage divider circuit linked to an analogue input pin when the system is powered on. It also monitors the manual activation switch's status.
Assessment of Battery Level
The microprocessor checks the real-time battery voltage against a specified critical threshold value. The system runs normally if the voltage stays over this threshold, so enabling all components (motor, fan, lighting, infotainment, etc.) to operate without limitations.

Automatic Power-Saving Activation
The microprocessor automatically turns on power-saving mode when the battery level drops below the crucial threshold. This activates the relay module to turn off non-essential parts such the DC fan, lights, and infotainment system. Motor speed is lowered at the same time by changing the PWM signal given to the L293D motor driver, therefore conserving more energy.
Manual Override Choice
The user can press the manual activation switch to activate power-saving mode at any time, even if the battery is not dangerously low. This gives the driver control over when to save energy, such as during extended travels or when approaching a charging station.
User Notifications and Feedback
An LCD display during the operation provides real-time battery voltage, system status (normal or power-saving mode), and any alerts. Keeping the driver informed and involved, a buzzer sounds alerts during mode changes or when the battery hits critical levels.
Back to Normal Mode
The system restores full operation once the battery voltage returns to a safe level or the user deactivates manual power-saving mode. Ensuring a smooth transition between modes, the relay reconnects non-essential components and the motor goes back to normal speed.

4.HARDWARE REQUIREMENTS

4.1 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduno, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards

The **ATmega328** is one kind of single-chip microcontroller formed with Atmel within the **megaAVR family**. The architecture of this Arduino Uno is a customized Harvard architecture with 8 bit **RISC processor** core. **Uno** include Arduino Pro Mini, Arduino Nano, Arduino Due, Arduino Mega, and Arduino Leonardo.

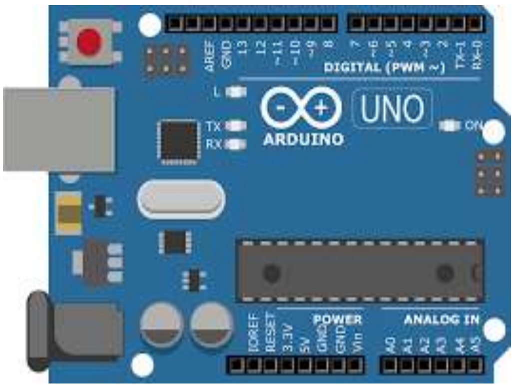

Fig 4.1 Arduino uno

4.2 Power Supply

The **Arduino Uno power supply** can be done with the help of a USB cable or an external power supply. The external power supplies mainly include AC to DC adapter otherwise a battery. The adapter can be connected to the Arduino Uno by plugging into the power jack of the Arduino board. Similarly, **the battery** leads can be connected to the Vin pin and the GND pin of the POWER connector. The suggested voltage range will be 7 volts to 12 volts.

4.3 L293D Motor Driver

A motor driver is an essential component in controlling the movement of motors within electronic systems, especially in projects involving robotics, electric vehicles, and automation. It acts as an interface between the low-power control signals (from microcontrollers or other logic circuits) and the high-power requirements of motors. The motor driver amplifies the control signal, allowing it to manage larger currents needed to drive motors effectively. Without a motor driver, the microcontroller would not be able to supply the necessary power for motor operation, as microcontrollers typically output low current (milliampere range), while motors require much higher currents (amperes) to function.

4.2 L293D Motor Driver

4.4 LED matrix

The WS281B is a popular type of addressable RGB LED, often used in programmable LED matrices, strips, and displays. These LEDs are highly versatile because each individual LED can be independently controlled, allowing for a wide range of color displays and effects. The WS281B LED uses a 3-wire protocol (data, power, and ground), making it relatively easy to interface with microcontrollers like Arduino, Raspberry Pi, or ESP32. The data pin transmits control information to each LED, which then adjusts the color and brightness according to the input signal.

Fig 4.4 WS2812B 16-Bit LED Matrix

4.5 Relay Module

A relay module is an electrically operated switch that allows a low-power circuit to control a high-power circuit. It is widely used in automation, IoT, and embedded systems to control electrical devices such as lights, fans, motors, and appliances.

Fig 4.5 Relay module

4.6 Jumping wires

Jumper wires are insulated conductors used to connect different components on a breadboard**,** circuit board**, or** microcontroller without the need for soldering. They are essential for prototyping and testing electronic circuits.

Fig 4.6 Jumper wires

4.7 LCD display

This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Please take care not to exceed 5V, as this will cause damage to the device. The 5V is best generated from the E-blocks Multi programmer or a 5V fixed regulated power supply.

Fig 4.7. 16x2 LCD

5.RESULTS AND DISCUSSION

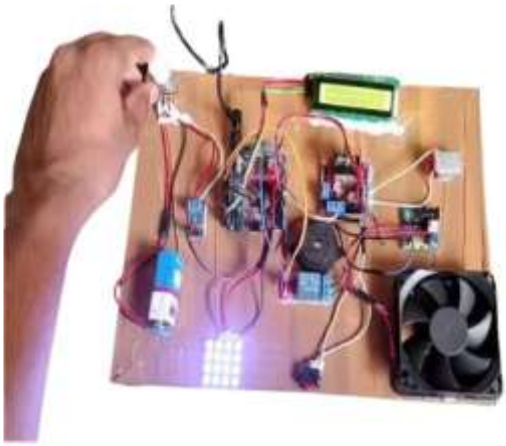

Fig 5.1

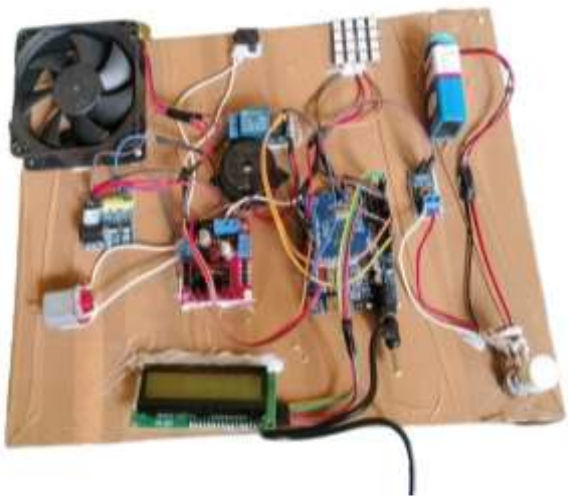

Fig 5.2

6. CONCLUSION

In conclusion, the proposed Power Saving System for Electric Vehicles effectively enhances energy efficiency and extends driving range by intelligently managing the vehicle's electrical components. Key elements such as the ATmega328P microcontroller, L293D motor driver, manual on/off switch, buzzer, DC fan, and battery monitoring work together to optimize power consumption, especially during critical battery conditions. By automatically disabling non-essential systems like fans, lights, and infotainment units, and by regulating motor speed, the system ensures that available energy is used wisely and efficiently.

The inclusion of a manual power-saving switch empowers users to engage the mode proactively, reducing unnecessary energy usage even before reaching low battery levels. Components like the buzzer provide real-time alerts, while smart fan control ensures essential cooling without excessive power draw. The use of a programmable LED matrix or indicator system could also be explored to provide visual feedback, further improving user interaction.

FUTURE WORK

Future work for the proposed Power Saving System can focus on integrating IoT and mobile app support for real-time monitoring and remote control, enabling users to track battery usage and activate power-saving features conveniently. Incorporating artificial intelligence could allow the system to learn from driving patterns and environmental conditions to dynamically optimize energy consumption. Additionally, support for solar charging, an enhanced user interface using LED matrices or touchscreens, and a modular design adaptable to various types of electric vehicles can further increase the system's efficiency, usability, and applicability across a wide range of EV platforms.

REFERENCES

[1] Vinay Teja, P., Pradep, R., Prathiksh, S., & Karthika, V. (2019). Power Saving System for Electric Vehicles. International Journal of Innovative Research in Science, Engineering and Technology, 8(3), 2450-2455.

[2] Nagrale, S., Waghmare, A., Sahare, T., Nagwanshi, A., Sakhale, I., & Sathe, J. (2023). Arduino Based Battery Management System for Electric Vehicles. International Journal of Advanced Research in Innovative Ideas in Education, 9(2), 2248-2251.

[3] LinkDhavale, S. R., Mahajan, M., Mahajan, K., Chavan, A., & Sidwadkar, R. (2022). Smart Electrical Vehicle System. International Journal of Research Publication and Reviews, 3(5), 3465-3473.

[4] Arduino Forum. (2019). ATMEGA328P Power Saving.

[5] Instructables. (2013). How to Use the L293D Motor Driver - Arduino Tut

orial.