STM JOURNALS

Journal of
Power Electronics & Power Systems

ISSN: 2249-863X (Online)
ISSN: 2321-4244 (Print)
Volume 15, Issue 3, 2025
September–December
DOI (Journal): 10.37591/JoPEPS

https://journals.stmjournals.com/jopeps

Research JoPEPS

Short Circuit Protection System for Electrical Vehicle (EV) Safety with GSM Module

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Abstract

The safety of electric vehicles' (EVs') vital components against overheating has become a top priority for both manufacturers and users as EVs continue to grow in popularity worldwide. Important parts like batteries, power electronics, and charging systems run the risk of overheating, which can have a number of detrimental effects, including thermal runaway, which presents major safety risks like fires or explosions. Overheating can also lead to decreased efficiency, deteriorated battery life, and possible system malfunctions, all of which can compromise the overall dependability and performance of electric vehicles. These issues highlight how crucial it is to create and put into place reliable thermal management systems in order to preserve safe operating conditions and extend the life of EVs. With an emphasis on the incorporation of real-time temperature monitoring systems, this study investigates the most recent developments in thermal management technology intended to avoid EV overheating. The use of GSM (Global System for Mobile Communications) modules, which allow for remote safety monitoring and alarms, is one of the major developments that are highlighted. When temperature abnormalities are identified, the system may instantly notify users or service centres thanks to the GSM module's smooth wireless connectivity. By ensuring fast communication, it is possible to intervene promptly, potentially averting catastrophic failures and maintaining the integrity of the vehicle's components. Advanced heat management systems and GSM-based monitoring are combined in this dual strategy to provide a complete solution for improving the overall performance, safety, and dependability of electric vehicles. In addition to offering proactive protection against overheating, the integration of these technologies promotes improved maintenance procedures and more economical resource utilization. In the end, these developments promote broader acceptance of electric vehicles as a dependable and secure substitute for traditional gasoline-powered automobiles by fostering more confidence in sustainable transportation technology.

Keywords: GSM (Global System for Mobile Communications), real time communication, artificial intelligence, electric vehicles (EVs), power supply

INTRODUCTION

With major advantages for the environment and the economy, electric vehicles (EVs) are leading the way in the shift to sustainable mobility. However, the global expansion of solar energy is accompanied by several challenges, particularly in ensuring the protection, efficiency, and reliability of its critical components. Key elements such as solar panels, inverters, and battery storage systems are essential for the proper functioning of solar power infrastructure [1]. These components are often subjected to prolonged use and exposed to harsh environmental conditions, including high temperatures, dust, and humidity. As a result, their long-term durability, consistent performance, and resistance to degradation are vital to ensure the stability, safety, and efficiency of solar energy

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Received Date: April 12, 2025
Accepted Date: June 15, 2025
Published Date: August 26, 2025

Citation: Payal Suryakant Dhamal, Sushant Dilip Sarak, Prerna Santosh Bathe, Yash Umesh Salunke. Short Circuit Protection System for Electrical Vehicle (EV) Safety with GSM Module. Journal of Power Electronics & Power Systems. 2025; 15(3): 18–22p.

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systems. Addressing these technical concerns is crucial for sustaining global solar energy adoption. Overheating in batteries, power electronics, and charging systems is a major protection concern, as it can lead to thermal runaway, performance degradation, or even catastrophic failures such as fires. Addressing this problem requires strong safety mechanisms and advanced monitoring technologies.

To enhance safety, the integration of Global System for Mobile Communications (GSM) modules in EVs offers a novel solution. GSM technology enables real-time monitoring and remote communication, allowing the vehicle to send alerts and notifications when overheating is detected. This not only secures rapid intervention but also provides an added layer of security by keeping users and service providers informed about the vehicle's thermal status [2].

This study explores the combined use of effective thermal management systems and GSM-based monitoring to address overheating risks in EVs. By leveraging advanced cooling techniques, temperature sensors, and wireless communication, the proposed solution aims to improve EV safety, reliability, and user confidence, ensuring a smoother transition to cleaner transportation technologies.

MARKET SURVEY

The objective of this market survey was to gather information about the current market demand and requirements for electrical vehicle safety systems, specifically those that prevent overheating and incorporate GSM modules. The survey targeted electrical vehicle manufacturers, owners, and enthusiasts, as well as automotive industry experts and safety professionals [3].

The survey revealed that overheating safety is a significant concern for electrical vehicle owners and manufacturers. Effective thermal management is crucial for the safe and efficient operation of solar energy systems. Features such as temperature monitoring, cooling systems, overheat protection, and real-time warning alerts play a vital role in preventing excessive heat buildup in critical components like solar panels, inverters, and batteries. These systems continuously track operating temperatures and activate protective measures, when necessary, thereby reducing the risk of damage or failure due to overheating [4]. Implementing advanced cooling technologies and automated safety responses not only enhances the overall performance and lifespan of solar equipment but also ensures consistent energy output and system reliability under varying environmental conditions. Additionally, the integration of GSM modules into the safety system is deemed important, with features such as real-time temperature monitoring, overheat alerts, vehicle tracking, and remote monitoring being highly desirable.

The survey also showed that answerers are ready to pay a premium for electrical vehicles with integrated GSM modules for safety. Furthermore, additional features such as fire detection and suppression, collision detection, and immediate action systems are also in demand. The execution of industry standards and regulations for electrical vehicle safety is also considered necessary [5].

In conclusion, the market survey highlights the want for effective electrical vehicle safety systems that prevent overheating and incorporate GSM modules. The need for these technologies derives from worries about convenience, safety, and legal compliance. The findings of this survey will inform the development of our electrical vehicle safety system, ensuring that it meets the needs and expectations of the market.

LITERATURE SURVEY

The safety of electrical vehicles from overheating and the integration of GSM modules is a critical area of research. Overheating is a significant concern in electrical vehicles, particularly in lithium-ion batteries. Advanced battery management systems, thermal management, and power electronics are key policy to ward off overheating. Monitoring the temperature, charge level, and overall health of batteries is a critical function of battery management systems. By controlling battery temperature, efficient thermal operating systems can lessen the chance of overheating. Advanced power electronics can optimize battery performance, reducing heat generation and the possibility of overheating [6].

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The combination of GSM modules enhances safety by enabling real-time monitoring of battery temperature, state of charge, and other critical parameters. This allows for prompt involvement in case of anomalies. GSM modules also facilitate remote diagnostics, enabling manufacturers to recognize and address aptitude matter before they become major problems. Furthermore, GSM modules can enable emergency response systems, alerting authorities and emergency services in case of an accident or other safety-critical event [7].

The creation of cutting-edge battery technologies, such as solid state and lithium-air batteries, which could offer enhanced performance and safety, is one area of future research. More efficient anomaly identification and predictive maintenance may be possible with the use of artificial intelligence (AI) and machine learning algorithms. Furthermore, quicker, more dependable, and more secure data processing and transmission may be made possible by the combination of 5G and edge computing technology. Figure 1 shows the block diagram of short circuit protection system.

RESEARCH METHOLOGY

This research points to investigate the protection of electrical vehicles from overheating and the effectiveness of integrating GSM modules to enhance safety. A mixed methods approach, which combines both qualitative and quantitative methodologies, is the research methodology used. To determine current research gaps and comprehend the present level of electrical vehicle safety, the study starts with a thorough literature review. This is followed by a survey of electrical vehicle manufacturers, owners, and experts to gather data on the current safety concerns and the potential benefits of integrating GSM modules [8].

To find patterns and trends, the survey data is subjected to thematic analysis and descriptive statistics. Additionally, a detailed case study was conducted on a leading electric vehicle (EV) manufacturer to gain comprehensive insights into the integration and application of GSM modules within their vehicle systems. The objective of this case study is to examine the technical and operational aspects of GSM module implementation, including their role in enabling real-time communication, vehicle tracking, remote diagnostics, and system updates. By analysing the manufacturer's approach, the study aims to understand the effectiveness of GSM technology in enhancing the overall performance, safety, and connectivity of electric vehicles. The findings contribute to a broader understanding of smart mobility solutions in the EV industry. The case study involves semi-structured interviews with key personnel and observations of the manufacturing process. Both content analysis and thematic analysis are used to examine the material gathered from the case study. To validate the findings, a prototype of an electrical vehicle safety system with GSM module is developed and tested. The prototype is tested under various scenarios to evaluate its performance and effectiveness in preventing overheating and enhancing safety.

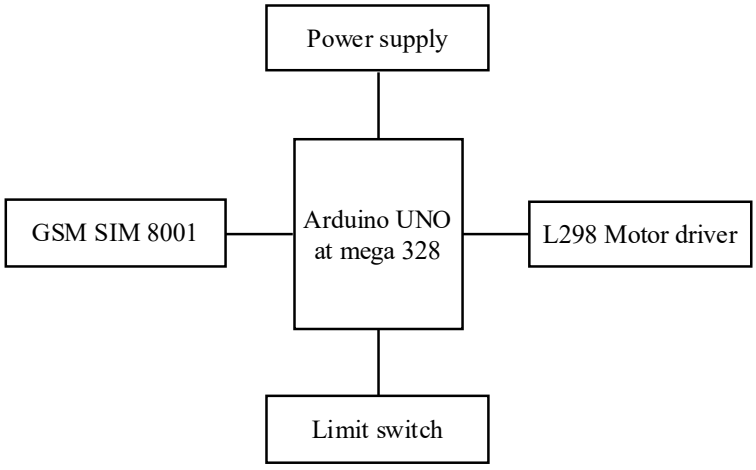

Figure 1. Block diagram of short circuit protection system.

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Numerical techniques, such as statistical analysis and data visualization, are used to analyse the test results. The outcome of the study provides valuable knowledge into the safety of electrical vehicles from overheating and the benefits of integrating GSM modules [9].

ADVANTAGES

- *Improved Safety:* Prevents overheating-related accidents and ensures the safety of passengers and bystanders.
- *Reduced Risk of Fire:* Minimizes the risk of electrical fires caused by overheating batteries or electrical components.
- *Increased Reliability:* Enhances the reliability of electrical vehicles by preventing overheating related component failures.
- *Extended Battery Life:* Helps to prolong the lifespan of batteries by preventing overheating, which can reduce battery capacity and overall lifespan.
- *Reduced Maintenance Costs:* reduces the need for replacements and repairs brought on by overheating, thereby lowering maintenance expenses.
- *Real-time Monitoring:* Enables real-time monitoring of vehicle performance, battery temperature, and other critical parameters.
- *Remote Diagnostics:* reduces the need for in-person inspections and downtime by enabling remote diagnostics and troubleshooting.
- *Emergency Response:* Enables emergency response systems to alert authorities and emergency services in case of an accident or other safety-critical event.
- *Improved Vehicle Security:* provides real-time location tracking and alarms for tampering or unauthorized entry, improving vehicle security.
- *Enhanced Driver Experience:* gives drivers notifications and information in real time, improving their entire driving experience and encouraging safe driving techniques.
- *Reduced Insurance Costs:* May lead to reduced insurance costs by demonstrating a commitment to safety and reducing the risk of accidents.
- *Increased Resale Value:* Can increase the resale value of electrical vehicles by providing a proven safety record and demonstrating a commitment to safety.

FUTURE SCOPE

The future of electrical vehicle safety from overheating and with GSM module holds tremendous potential. Advancements in thermal management systems, smart battery management, and multi-sensor fusion will enable more logical and effective protection systems. Combining machine learning techniques with artificial intelligence (AI) will improve battery performance, anticipate overheating, and avert mishaps. Furthermore, the growth of autonomous exigency response systems will enable vehicles to detect overheating and take corrective action, such as shutting down the vehicle or activating fire suppression systems.

Additionally, the combination of GSM modules will remain essential for improving the safety of electrical vehicles. The assumption of 5G networks and edge computing will enable faster, more reliable, and more secure data transmission and processing. Artificial intelligence-powered predictive maintenance systems will predict overheating and other safety-critical events, enabling proactive maintenance and minimizing downtime [10]. Additionally, vehicle-to-everything (V2X) communication, which allows cars to talk to other cars, bases, and pedestrians, will become more and more significant. Emerging trends and technologies, such as the (IoT) Internet of Things, blockchain, augmented reality, and quantum computing, will also shape the future of electrical vehicle safety. IoT technologies will enable real-time monitoring and control of electrical vehicles, while blockchain-based systems will provide secure data storage and transmission. Augmented actuality technologies will give drivers with real-time information and alerts, enhancing their overall driving experience. Quantum computing-based systems will enable advanced predictive maintenance and safety analysis, further enhancing electrical vehicle safety. Figure 2 shows the final model of electric vehicle.

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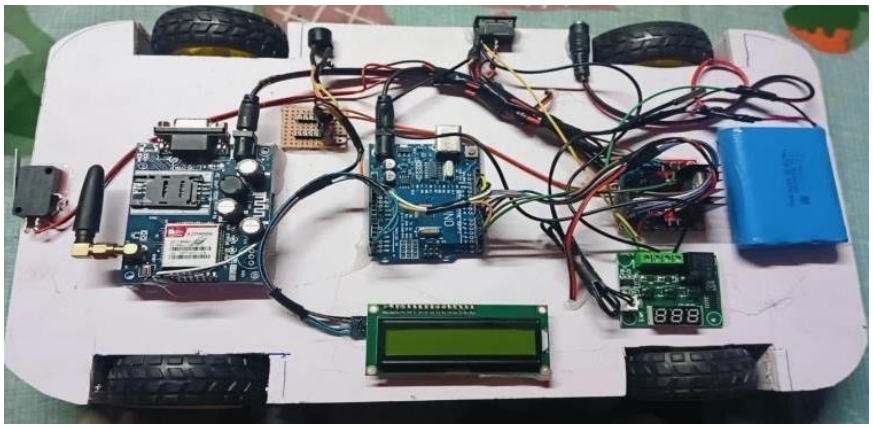

Figure 2. Final model of electric vehicle.

CONCLUSION

The growth of electrical vehicle safety systems that prevent overheating and integrate GSM modules is vital for ensuring the safety and dependability of electrical vehicles. This research has highlighted the importance of addressing overheating issues in electrical vehicles and demonstrated the potential advantage of integrating GSM modules for real-time monitoring and emergency response. The suggested technique provides a thorough approach to improving electrical vehicle safety and avoiding overheating. Safety and dependability must be given top priority as the use of electric vehicles grows. The findings of this research provide to the development of more efficient and effective electrical vehicle safety systems, ultimately promoting a safer and more sustainable transportation ecosystem.

REFERENCES

1. Marhoon HM, Alanssari AI, Basil N. Design and implementation of an intelligent safety and security system for vehicles based on GSM communication and IoT network for real-time tracking. Journal of Robotics and Control (JRC). 2023 Oct 12; 4(5): 708–18.
2. Hakim KA, Hasan MM, Akter S. Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS Module. B. Sc. Project. Dhaka, Bangladesh: City University; 2019 Spring.
3. Hossain I, Islam MS, Sultana R, Latif MA. Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS Module. Int J Res Appl Sci Eng Technol. 2023 Sep; 11(9): 1166–75.
4. Liu Z, Tao W, Jiang L, Zhu C. Design and application on electric vehicle real-time condition monitoring system by Internet of things technology. In 2014 IEEE 5th International Conference on Software Engineering and Service Science. 2014 Jun 27; 744–747.
5. Alsayaydeh JA, bin Yusof MF, Abdillah MA, bin Al-Gburi AJ, Herawan SG, Oliinyk A. Enhancing Vehicle Safety: A Comprehensive Accident Detection and Alert System. Int J Adv Comput Sci Appl. 2023 Nov 1; 14(11): 28–41.
6. Łebkowski A. Electric vehicle fire extinguishing system. Prz Elektrotech. 2017 Jan 1; 93(1): 329–32.
7. Abinaya M, Devi RU. Intelligent vehicle control using wireless embedded system in transportation system based on GSM and GPS technology. International Journal of Computer Science and Mobile Computing (IJCSMC). 2014 Sep; 3(9): 244–58.
8. Bhutani M, Sudha K, Banerjee S, Sharma S, Singh B, Gupta S, Katoch R. An Enhanced Alert System for Accidents Involving Electric Vehicles. Library of Progress-Library Science, Information Technology & Computer. 2024 Jul 15; 44(3): 17720–17735.
9. Santhoshkumar R, Jabez I, Kannan SB, Kumar K. Intelligent Monitoring and Learning System for Electric Vehicle Charging Stations. In Proceedings of 4th International Conference on Artificial Intelligence and Smart Energy: ICAIS 2024. Cham: Springer Nature; 2024; 2: 198.
10. Suresh S, Purushothaman A, Jeswin Vincent Raj R, Sakthimurugan M. Modelling and Analysis of EV Communication System for Road Safety Applications. In 2023 7th IEEE International Conference on Electronics, Communication and Aerospace Technology (ICECA). 2023 Nov 22; 1643–1648.

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