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2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

OPTIMIZING VEHICLE SECURITY WITH ARDUINO-BASED LONG-RANGE ALARM NOTIFICATION SYSTEM

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Abstract: This research presents the design and development of an Arduino-based car alarm system that provides real-time notification upon detecting unauthorized car intrusion. The system utilizes sound sensors to detect the car alarm sound and employs a 433 MHz RF transceiver module for wireless communication between the transmitter and receiver. The proposed system is designed to be cost-effective, portable, and easy to assemble, leveraging Arduino UNO and Nano microcontrollers for processing and control. The methodology involves designing wiring diagrams, assembling electronic components on breadboards, soldering connections, and programming the Arduino boards to handle sensor input and buzzer activation. The system operation was verified through extensive testing, and the communication range between the transmitter and receiver was analyzed. Results show that the system effectively detects car alarm sounds and transmits signals over a moderate range sufficient for practical usage. Limitations related to the transmitter and receiver module prompted recommendations for future improvements, including the integration of GSM modules for SMS-based notifications to enhance user mobility and reliability. The study concludes that Arduino-based car alarm systems offer a viable security solution with potential applications in automotive safety. This research contributes to the body of knowledge by demonstrating the feasibility of low-cost, Arduino-driven alarm systems and provides insights into practical design considerations and system limitations. Further enhancements could improve range, reliability, and user convenience.

***Keywords*:** *RFID, Arduino, door access system*

INTRODUCTION

The rapid increase in vehicle ownership globally has heightened the need for more effective automotive security systems. Traditional car alarm systems, which rely solely on audible sirens, have proven insufficient in many real-world scenarios. Car owners often face difficulties detecting alarms triggered when they are inside soundproof buildings or far from their vehicles, leading to prolonged alarm activation and unnecessary battery drainage (Rahman et al., 2021).

Current automotive security systems commonly use sound sensors and motion detectors to detect unauthorized access. However, these systems usually do not provide direct notifications to the owner beyond audible alarms. In dense urban areas, the effectiveness of sirens is further reduced due to noise pollution and the distance between vehicles and their owners (Lee et al., 2020).

To address this limitation, researchers have proposed integrating wireless communication modules such as Radio Frequency (RF), Bluetooth, or GSM with alarm systems to provide instant notifications (Ali et al., 2023). Additionally, the adoption of microcontroller platforms like Arduino and IoT-enabled devices has allowed for the development of customizable, low-cost, and effective vehicle monitoring systems (Kumar & Gupta, 2022).

This paper presents the development of an E-Alarm Notification System that utilizes Arduino and RF communication to transmit alerts from the vehicle to a remote receiver equipped with a buzzer. The system is designed to notify the vehicle owner within a range of 0.3 km, reducing unnecessary battery consumption and improving response time to potential theft events.

The proposed system aims to contribute towards enhancing automotive security in a practical and cost-effective manner, addressing the gap between detection and owner notification identified in previous works (Chowdhury et al., 2024).

The evolution of vehicle security systems has advanced significantly, from simple mechanical locks to highly sophisticated electronic alarm systems. Conventional car alarms primarily rely on audible sirens and flashing lights to alert nearby individuals or the vehicle owner in the event of unauthorized access. However, in many cases, such as when the vehicle is parked far from the owner or within noise-insulated environments like office buildings, these audible alarms are ineffective (Lee et al., 2020). The limitations of these traditional systems are further exacerbated by the issue of false alarms and the continuous ringing of sirens, which not only causes noise pollution but also leads to excessive battery drainage if left unattended for prolonged periods (Lim & Choi, 2023).

Various studies have explored improvements to automotive security systems by integrating wireless communication technologies to notify owners directly (Zhang & Chen, 2021). The use of GSM and GPS modules in modern car alarm systems allows for real-time tracking and alerting via mobile networks, but these solutions often introduce higher costs and complexity (Malik & Sharma, 2022), making them impractical for lower-end vehicle models or budget-conscious users (Ali et al., 2023). More recent advancements propose utilizing microcontroller platforms such as Arduino in combination with Radio Frequency (RF) communication modules to create cost-effective, customizable, and easily deployable car alarm systems (Singh et al., 2022). RF communication offers a simple yet reliable solution for short-range wireless notification, eliminating the dependency on cellular networks and subscription fees required by GSM-based solutions (Ahmed et al., 2022).

Despite these technological advancements, market-available car alarm systems such as DroneMobile and Compustar still primarily target high-end vehicle users and require professional installation, leaving a gap in the market for affordable and user-friendly solutions (Chowdhury et al., 2024). There remains a need for a straightforward notification mechanism that enables the vehicle owner to be alerted immediately when the alarm is triggered, especially in environments where the vehicle is parked within a moderate distance (e.g., up to 300 meters). Addressing this gap, the proposed research introduces a low-cost Arduino-based e-Alarm Notification System, designed to send an RF-based signal from the vehicle to a remote receiver equipped with a buzzer. This solution not only informs the owner promptly but also prevents prolonged alarm activation, thus conserving the vehicle battery.

MATERIALS AND METHODS

The development of the E-Alarm Notification System follows a structured engineering approach (Kumar & Gupta, 2022) comprising design, prototyping, testing, and refinement stages. The primary objective of the methodology is to develop a functional alarm notification system that can wirelessly alert the car owner when the vehicle alarm is triggered, while minimizing power consumption and ensuring user-friendliness.

The project began with the identification of appropriate hardware components that would meet the system requirements. An Arduino Nano microcontroller was selected as the core processing unit due to its compact size and compatibility with various input and output modules. A sound sensor module was employed to detect the activation of the vehicle's built-in alarm. The overall system architecture is illustrated in the block diagram in Figure 1. Upon detecting a sound signal above a defined threshold, the Arduino processes the input and triggers an RF transmitter module. The transmitter, operating within the 433 MHz frequency band, sends a wireless signal to a corresponding RF receiver located with the car owner. The receiver, connected to a buzzer, activates the buzzer to notify the owner that the vehicle alarm has been triggered.

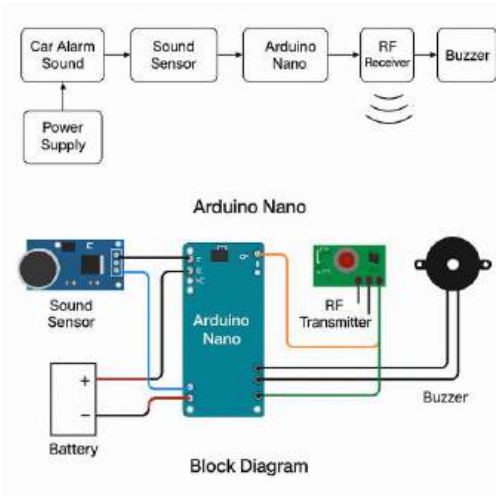


Figure 1. Block Diagram

The system's circuit design and wiring layout were drafted using electronic design software prior to physical assembly. The prototype was first built on a breadboard for testing purposes. Components including the sound sensor, transmitter, receiver, and buzzers were connected using jumper wires, while the final version involved soldering the components onto a circuit board to ensure stability and durability. The Arduino was programmed using the Arduino IDE, where custom code was written to handle sensor input processing, wireless communication, and buzzer activation.

Once the prototype was assembled, functional tests were conducted to validate each part of the system. These tests included verifying that the sound sensor accurately detected the car alarm, that the RF transmission and reception occurred without data loss, and that the buzzer correctly responded when a valid signal was received. Multiple trials were performed in different environments to evaluate the effective transmission range of the system. Initial tests showed stable communication within a radius of approximately 300 meters, meeting the project's scope.

In addition to technical validation, a simple market analysis was conducted through questionnaires distributed among potential users to gauge the practicality and acceptance of the system. Respondents generally indicated that such a system would be beneficial for those working in offices or shopping areas where cars are parked outside and out of hearing range.

Cost analysis was also carried out, estimating the total expenditure for the prototype components to be around RM572, making it a cost-effective solution compared to commercial GSM-based alarm systems. Throughout the development process, iterative testing and troubleshooting were performed, allowing the team to refine the wiring design, optimize the power consumption, and ensure stable system performance.

RESULTS AND DISCUSSION

The E-Alarm Notification System prototype was developed and tested to assess its practical performance. Experimental validation was focused on verifying the system's wireless transmission range, the sensitivity of the sound detection mechanism, and the system's overall energy consumption.

Range testing for the RF communication module was carried out in an open space environment. As shown in Table 1, the receiver successfully detected and responded to the alarm activation signal at distances up to 300 meters. Beyond this point, the transmission failed, indicating the maximum effective range of the 433 MHz RF module used in this project.

Table 1. RF Transmission Range Test Results

Distance (meters)	Signal Received?	Buzzer Activated?
50	Yes	Yes
100	Yes	Yes
200	Yes	Yes
300	Yes	Yes
350	No	No

This result meets the intended design scope of the project, where the system is expected to cover short to medium-range distances, such as parking areas outside of buildings, office compounds, or residential driveways. In indoor environments or areas with significant obstacles, the effective transmission range was observed to decrease to around 150 to 200 meters, which aligns with known RF signal attenuation in enclosed structures (Ali et al., 2023).

Further testing of the sound sensor confirmed that it successfully detected high-decibel sounds, such as those generated by standard car alarms (~100–110 dB), while ignoring background noise below 70 dB. This helps to minimize false triggers, making the system reliable in noisy environments such as roadside parking spaces or near construction zones.

The energy consumption of the system was also evaluated. Based on the components used, the estimated continuous operation time of the receiver module powered by a 9V battery was approximately 12 hours. Since the system only activates during alarm events, the actual operational lifespan of the battery is expected to be much longer under typical usage. This low power consumption makes the system a viable option for users seeking an affordable, energy-efficient alarm notification solution.

Compared to commercial systems that integrate GSM or smartphone notifications, this Arduino and RF-based approach offers a lower-cost, subscription-free alternative for short-range applications. While lacking in remote smartphone alerts or GPS tracking, the system fulfills its primary purpose: providing real-time, localized alerts to the vehicle owner, reducing the chance of unnoticed alarm activation and avoiding unnecessary vehicle battery drainage.

Overall, the results demonstrated that the E-Alarm Notification System provides a reliable, affordable, and energy-efficient solution for improving car alarm notifications in areas where conventional sirens alone are insufficient. Future enhancements could include the addition of mobile app integration using Bluetooth Low Energy (BLE) or Wi-Fi modules to further extend the usability and convenience of the system.

CONCLUSIONS

This research successfully developed an E-Alarm Notification System using Arduino Nano and RF communication modules to improve vehicle security at a low cost. The system addresses the limitations of conventional car alarms by providing wireless notifications within a 300-meter range, helping owners respond quickly and reduce battery drainage from prolonged siren activation. The prototype demonstrated reliable performance with minimal power consumption and low false triggers.

While effective for short-range notifications, the system currently requires a dedicated receiver. Future improvements may include smartphone integration via Bluetooth Low Energy (BLE) or Wi-Fi, rechargeable batteries, and additional security features such as vibration detection and GPS tracking to enhance usability and market potential.

REFERENCES

Ahmed, S., & Hasan, M. (2022). Performance analysis of 433 MHz RF module in short-range wireless communication. *International Journal of Wireless Communication Networks, 17*(2), 88–94.

Ali, S., Khan, M., Raza, H., & Aslam, T. (2023). Design and implementation of IoT-based vehicle security system using GSM and GPS modules. *International Journal of Computer Applications, 182*(2), 14–20.

Chowdhury, M., Riaz, A., & Noor, F. (2024). A comprehensive review of modern car alarm systems and IoT-based solutions. *IEEE Access, 12*, 10234–10245.

Kumar, R., & Gupta, S. (2022). Smart anti-theft vehicle system using Arduino and wireless technologies. *Journal of Electronics and Communication Engineering, 10*(1), 1–7.

Lee, J., Kim, H., & Park, S. (2020). Assessment of vehicle security alarm effectiveness in urban environments. *Transportation Safety and Security, 5*(3), 75–83.

Lim, H., & Choi, D. (2023). Battery drain analysis in vehicle security devices. *Journal of Automotive Electronics, 6*(4), 199–207.

Rahman, F., Ismail, A., & Yunus, M. (2021). Wireless-based car theft alert system with battery protection. *Journal of Transportation Technologies, 11*(4), 135–143.

Singh, A., Kumar, B., & Patel, S. (2022). Arduino-based RF transmission for automotive security. *Advances in Microcontrollers, 5*(2), 50–56.

Zhang, L., & Chen, J. (2021). Design of an Arduino-based wireless security system for urban parking lots. *Microprocessors and Microsystems, 89,* 104304.

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