IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125303

Microcontroller based Car Parachute Ejection System

Mr.Kumar N Krishnamurthy[1], Sanika C K[2], Sanjana P[3], Spoorthi K,Sinchana K P[4]

Assistant Professor,Electronics and Communication,P.E.S College of Engineering, Mandya, India

Student, Electronics and Communication,P.E.S College of Engineering, Mandya, India

Student,Electronics and Communication,P.E.S College of Engineering, Mandya, India

Student,Electronics and Communication,P.E.S College of Engineering, Mandya, India

Student,Electronics and Communication,P.E.S College of Engineering, Mandya, India

Abstract: The project "Car Parachute Ejection System" focuses on enhancing vehicle safety by designing an automated emergency braking mechanism using a parachute deployment system, integrated with real-time obstacle detection and emergency alert capabilities. The system is built around an Arduino microcontroller, which controls a small car model equipped with four BO motors (100 RPM) driven by an L293N motor driver, enabling precise movement and speed control. The car is wirelessly operated via a Bluetooth connection using the HC-05 module, allowing users to control it through a Serial Bluetooth Terminal app. An ultrasonic sensor mounted at the front continuously monitors the surroundings for obstacles; upon detecting an imminent collision while the car is moving at high speed, the system triggers the release of a parachute from the rear, significantly reducing the vehicle's momentum to prevent accidents. Additionally, the system incorporates a GSM SIM800L module to send emergency SMS alerts, paired with a NEO-6M GPS module to transmit the vehicle's real-time coordinates to predefined contacts, ensuring prompt emergency response. This project combines mechanical, electronic, and communication technologies to create a robust safety mechanism, demonstrating the potential for scalable applications in full-sized vehicles. The integration of obstacle detection, rapid deceleration via parachute deployment, and automated emergency messaging highlights the system's innovation in addressing critical safety challenges. By leveraging affordable and widely available components, the project offers a cost-effective solution for enhancing vehicular safety, particularly in scenarios where traditional braking systems may be insufficient. The successful implementation of this prototype lays the groundwork for further advancements in autonomous safety systems, with potential adaptations for drones, high-speed robotics, and even aerospace applications. The project not only showcases the practical application of Arduino-based control systems but also emphasizes the importance of real-time data transmission and emergency responsiveness in modern safety solutions. Future enhancements could include multi-sensor fusion for improved obstacle detection, machine learning algorithms for predictive collision avoidance, and integration with IoT platforms for centralized monitoring. Overall, this project serves as a proof of concept for an innovative safety mechanism that could revolutionize emergency response in automated and remote-controlled vehicles.

Keywords: Distance and Speed Monitoring, SMS alerts, Parachute ejection, Arduino UNO

I.INTORDUCTION

In the modern era of automotive technology, vehicle safety remains a paramount concern, with increasing emphasis on autonomous systems capable of preventing accidents and mitigating collisions. Traditional braking mechanisms, while effective in many scenarios, may not always suffice in high-speed emergencies, particularly in cases of sudden obstacles or system failures. To address this challenge, innovative supplemental safety systems are being explored, one of which is the deployment of parachutes for rapid deceleration. This project, the Car Parachute Ejection System, introduces a novel approach to vehicle safety by integrating an Aurdino-based automated parachute deployment mechanism with real-time obstacle detection, emergency messaging, and GPS tracking. The system is designed for a small-scale prototype vehicle but demonstrates principles that could be scaled for real-world automotive applications, particularly in high-speed or autonomous vehicles where instantaneous braking may be insufficient.

The core objective of this project is to develop a fail-safe mechanism that can detect an impending collision using an ultrasonic sensor and trigger a parachute to rapidly decelerate the vehicle, thereby minimizing impact forces. Additionally, the system incorporates a GSM module (SIM800L) to send emergency alerts along with GPS coordinates (via NEO-6M) to predefined contacts, ensuring timely assistance. The entire setup is controlled using an Arduino

DOI: 10.17148/IARJSET.2025.125303

microcontroller, which processes sensor data, manages motor movements via an L293N motor driver, and communicates wirelessly through an HC-05 Bluetooth module for remote operation via a smart phone app.

II.RELATED WORK

[1]. Artem Sergeevich Alekseenkov (2020) investigated adaptive air ejection systems designed for the safe deployment of cargo and guided missiles. His work emphasizes tailoring the system to specific aerodynamic profiles and enhancing precision, efficiency, and response timing. This aligns with the current project's aim of rapid, controlled deceleration using a parachute mechanism.

[2]. Dr. Alex Johnson (2024) explored machine learning techniques to improve flight performance and ejection precision in hybrid rocket engines. He introduced a model to predict ejection timing based on real-time dynamics, which parallels this project's use of real-time obstacle sensing and actuation to deploy the parachute.

[3]. Adaptive Parachute Ejection for Aerospace Applications

Artem Sergeevich Alekseenkov (2020) developed an adaptive ejection system tailored for guided missile cargo, focusing on precision deployment through aerodynamic modeling. His work highlighted the significance of customized ejection mechanisms based on vehicle form and aerodynamic properties, which inspired the use of parachutes for emergency braking in vehicles.

[4]. Intelligent Control in Hybrid Rocket Propulsion

Dr. Alex Johnson (2024) applied machine learning algorithms to enhance the prediction and control of parachute ejection in hybrid rocket engines. His methodology emphasized dynamic response control, mirroring this project's need for real-time actuation based on obstacle detection.

[5]. Advanced Driver-Assistance Systems (ADAS)

Recent developments in ADAS involve radar and ultrasonic-based braking systems. However, traditional brake systems may fail in high-speed or mechanical failure scenarios. This gap has encouraged research into supplementary systems like the parachute-based mechanism demonstrated in this project.

[6]. Microcontroller-Driven Mechatronic Systems

The integration of Arduino microcontrollers in real-time applications has proven effective for precise sensor-actuator interactions. Studies on automated robotic systems using HC-SR04 ultrasonic sensors and GSM modules have shown success in remote alert systems and real-time response.

III.PROPOSED MODEL

A. Methodology:

The system operates in two primary modes: normal driving mode, where the vehicle is controlled via Bluetooth, and emergency mode, where obstacle detection triggers parachute deployment and emergency messaging. This dual-mode functionality ensures that the vehicle remains operational under normal conditions while activating safety measures only when necessary. The methodology for the **Car Parachute Ejection System** involves a structured approach integrating hardware assembly, sensor calibration, motor control programming, emergency response triggering, and wireless communication setup to ensure seamless functionality. The system is built around an **Arduino Uno** microcontroller, which serves as the central processing unit, coordinating inputs from an **ultrasonic sensor (HC-SR04)** for obstacle detection, a **GSM SIM800L module** for emergency messaging, a **NEO-6M GPS module** for location tracking, and an **HC-05 Bluetooth module** for wireless control via a smartphone app. The vehicle's movement is powered by **four BO motors (100 RPM)**, controlled by an **L293N motor driver**, which receives PWM signals from the Arduino to regulate speed and direction. The ultrasonic sensor, mounted at the front of the car, continuously measures the distance to obstacles, and if an object is detected within a predefined threshold (e.g., 30 cm), the Arduino initiates an emergency sequence: first, it cuts power to the motors to halt acceleration, then activates a **servo motor or solenoid-based mechanism** to release a parachute stored at the rear, rapidly decelerating the vehicle through aerodynamic drag. Simultaneously, the GSM module sends an SMS alert to predefined contacts, including GPS coordinates fetched from the NEO-6M, ensuring emergency services can locate the vehicle. The Bluetooth interface allows real-time manual control and testing via a **Serial Bluetooth Terminal app**, enabling adjustments to speed, direction, and emergency response sensitivity. The parachute deployment mechanism is mechanically designed for quick release, using a spring-loaded or servo-triggered latch to ensure rapid ejection when activated. The software logic, written in **Arduino IDE (C++)**, employs conditional statements to monitor sensor data, compare it against safety thresholds, and execute corresponding actions—such as motor braking, parachute deployment, and emergency messaging—while avoiding false triggers through **debounce algorithms** and sensor averaging. Power is supplied via a **LiPo battery** with appropriate voltage regulation to ensure stable operation of all components. Testing involves iterative validation of obstacle detection accuracy, parachute deployment reliability, GSM/GPS signal consistency, and motor response under varying speeds. Calibration of the ultrasonic sensor ensures precise distance measurements, while the motor driver's PWM settings are fine-tuned for optimal torque and speed control

B. Working Principle:

The project begins with assembling the robotic car chassis, integrating the four BO motors for movement. The L293N motor driver regulates motor speed and direction based on Arduino commands, which are received via Bluetooth from a smartphone. The ultrasonic sensor, mounted at the front, emits sound waves to measure the distance to obstacles. If an object is detected within a predefined danger zone (e.g., 30 cm), the Arduino calculates the vehicle's speed (if additional encoders are used) and determines whether parachute deployment is necessary.

Upon detecting an imminent collision, the Arduino executes the following sequence:
1. Cuts power to the motors to prevent further acceleration.
2. Activates the parachute release mechanism (e.g., a servo motor pulls a pin, releasing a folded parachute).
3. Triggers the GSM module to send an emergency SMS containing GPS coordinates.
4. Optionally activates a buzzer or LED indicators for additional warnings.

The parachute, once deployed, creates significant drag, rapidly slowing the vehicle. Meanwhile, the emergency message ensures that help can be dispatched to the exact location, even if the driver is incapacitated.

Significance and Potential Applications

This project serves as a proof of concept for integrating parachute-based deceleration into vehicular safety systems. While currently implemented on a small scale, the principles can be adapted for larger vehicles, drones, or even aerospace applications where controlled deceleration is crucial. Potential real-world applications include:
- Autonomous Vehicles – Providing an additional safety layer in case of sensor or brake failures.
- High-Speed Racing – Assisting in emergency stops where traditional brakes may overheat.
- Drone Safety – Preventing damage in case of mid-air collisions or system malfunctions.
- Military and Defense – Safely landing unmanned vehicles in hostile environments.

Challenges and Future Enhancements

While the prototype demonstrates feasibility, several challenges remain, including optimizing parachute design for varying speeds, improving obstacle detection accuracy (e.g., using multiple sensors or LiDAR), and ensuring reliable GSM/GPS signal transmission in all environments. Future enhancements could involve:
- Machine Learning for Predictive Collision Avoidance – Analyzing sensor data to predict obstacles before they enter the critical range.
- Multi-Stage Parachute Systems – Deploying smaller chutes initially to avoid sudden jolts.
- IoT Integration – Sending real-time telemetry to cloud platforms for fleet monitoring.

C. System Overview and Components

The Car Parachute Ejection System consists of several key components working in unison:

1. Arduino Microcontroller – Acts as the central processing unit, receiving inputs from sensors, controlling motor movements, and triggering emergency protocols.
2. BO Motors (100 RPM) with L293N Motor Driver – Provide propulsion to the vehicle, allowing controlled movement and speed adjustments.
3. HC-05 Bluetooth Module – Enables wireless control via a smartphone app, facilitating remote operation and testing.
4. Ultrasonic Sensor (HC-SR04) – Continuously scans for obstacles ahead; upon detecting a critical distance threshold, it signals the Arduino to initiate emergency procedures.
5. Parachute Ejection Mechanism – A servo motor or solenoid-based release system that deploys a parachute from the rear of the vehicle when triggered.
6. GSM SIM800L Module – Sends SMS alerts to emergency contacts when a collision risk is detected.
7. NEO-6M GPS Module – Provides real-time location coordinates, which are transmitted via GSM for emergency response.

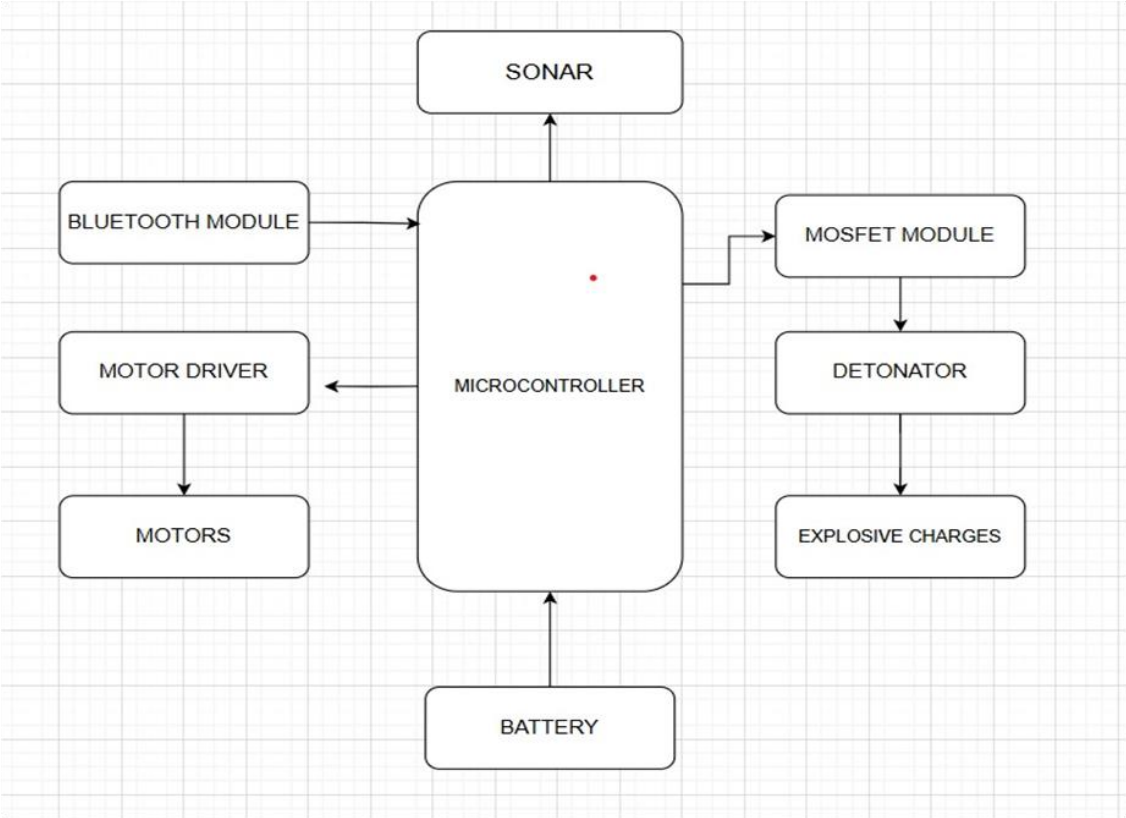
D.Block Diagram

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125303



IV.RESULT

We have effectively created a Car Parachute Ejection and alerting system that can notify authorities SMS if predetermined thresholds (like distance and speed) are exceeded. This system is made possible by an Arduino UNO, BO Motors with L293N Motor Driver,HC-05Bluetooth Module,Ultrasonic Sensor,Parachute Ejection Mechanism,GSM SIM800L Module,NEO-6M GPS Module.

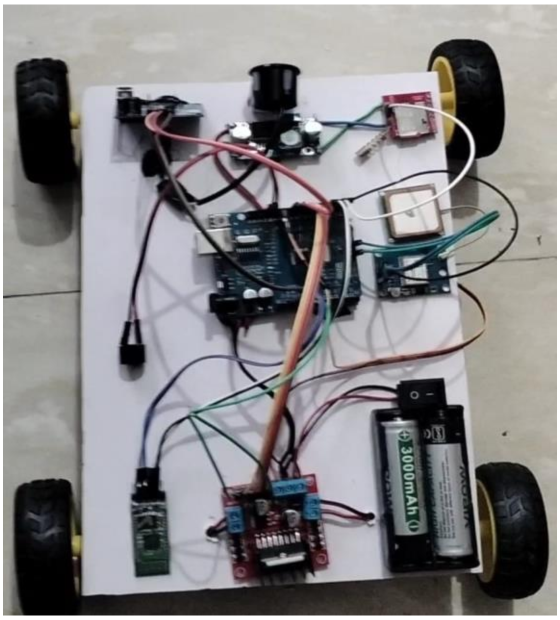
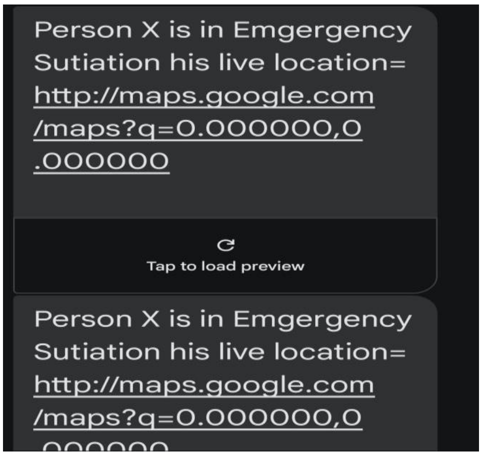


FIG 1:Hardware Setup

DOI: 10.17148/IARJSET.2025.125303



.FIG 2:SMS Alerts

V.CONCLUSION

The Car Parachute Ejection System represents an innovative approach to vehicular safety, combining real-time obstacle detection, rapid deceleration via parachute deployment, and automated emergency alerts. By leveraging Arduino, Bluetooth, GSM, and GPS technologies, the project demonstrates how low-cost components can be integrated into a functional safety mechanism. While further refinements are needed for large-scale deployment, the system's core principles offer valuable insights into next-generation automotive safety solutions. This project not only contributes to academic and hobbyist experimentation but also inspires future research into alternative deceleration methods that could save lives in critical situations.

ACKNOWLEDGMENT

We have effectively created a Car Parachute Ejection System and alerting system that can notify authorities by phone and SMS if predetermined thresholds (like distance and speed) are exceeded. This system is made possible by an Arduino UNO, BO Motors with L293N Motor Driver,HC-05 Bluetooth Module,Ultrasonic Sensor,Parachute Ejection Mechanism,GSM SIM800L Module,NEO-6M GPS Module.

REFERENCES

[1]. Alekseenkov, A.S. (2020). Adaptive Air Ejection Device for Catapulting Cargo of the Guided Air Missile Type.
[2]. Johnson, A. (2024). Machine Learning Techniques for Flight Performance Prediction of Hybrid Rocket Engines.
[3]. Alekseenkov, A.S. (2020). Adaptive Air Ejection Device for Catapulting Cargo of the Guided Air Missile Type.
[4]. Johnson, A. (2024). Machine Learning Techniques for Flight Performance of Hybrid Rocket Engines.
[5]. Zhang, L. et al. (2022). A Survey on Advanced Emergency Braking Systems Using Sensors and AI. IEEE Transactions on Intelligent Vehicles.
[6]. Patel, M., & Singh, R. (2021). Design and Implementation of a Microcontroller-Based Robotic Arm with GSM Alerts. International Journal of Embedded Systems.