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Intelligent Vehicle Safety and Driver Monitoring System Using IOT and Multi-Sensor Technology

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Abstract— The development of an IoT-enabled smart vehicle safety system aims to improve vehicle safety through intelligent obstacle detection, alcohol monitoring, and real-time vehicle supervision. The proposed system uses an Arduino UNO controller integrated with an ultrasonic sensor, infrared (IR) sensors, an MQ-3 alcohol sensor, a motor driver, DC motors, an LCD display, and a buzzer. The ultrasonic sensor detects obstacles in front of the vehicle, while IR sensors identify nearby objects on the left, right, and rear sides. Based on sensor inputs, the Arduino generates warnings and controls motor operation to reduce collision risks. The alcohol sensor detects alcohol presence and can restrict vehicle movement when the calibrated threshold is exceeded. An LCD displays sensor information and warning messages, while the buzzer provides audible alerts during unsafe conditions. An ESP8266 or ESP32 module enables wireless communication with a cloud server for remote monitoring of vehicle status and safety events. The system is designed as a low-cost prototype for demonstrating intelligent driving assistance using embedded technology and the Internet of Things. Its effectiveness can be evaluated through obstacle detection accuracy, motor response, alcohol sensor performance, warning reliability, and successful cloud data transmission under different testing conditions.

Keywords— Internet of Things (IoT), Arduino UNO, Collision Avoidance, Alcohol Detection, Intelligent Driving Assistance. etc.

I. INTRODUCTION

The increasing number of road accidents has created a significant need for intelligent vehicle safety technologies that can improve driver awareness and reduce collision risks. Accidents may occur due to driver negligence, excessive speed, alcohol consumption, limited visibility, and delayed responses to unexpected obstacles. Conventional vehicles often depend on the driver's ability to recognize hazards and take immediate action. Therefore, integrating embedded systems, sensors, and wireless communication technologies can provide additional safety measures through real-time monitoring, obstacle detection, and automated warnings [1], [2].

The Internet of Things (IoT) has emerged as an important technology for connecting physical devices, collecting sensor information, and transmitting data to remote platforms. In intelligent transportation applications, IoT enables vehicle monitoring, safety-event reporting, and remote access to operating conditions. When combined with microcontrollers and sensing devices, it can support affordable safety prototypes for educational, research, and small-scale transportation applications [3], [4]. These systems can improve access to vehicle safety monitoring without requiring complex automotive infrastructure.

The proposed project, "Development of an IoT-Enabled Smart Vehicle Safety System Using Ultrasonic Sensors for Collision Avoidance and Intelligent Driving Assistance," focuses on integrating multiple sensors with an Arduino UNO controller. An ultrasonic sensor measures the distance between the vehicle and obstacles in front. Infrared (IR) sensors positioned on the left, right, and rear sides detect nearby objects, supporting safer turning and reversing operations. The Arduino processes the sensor signals and generates appropriate control commands according to predefined distance thresholds. A motor driver regulates the DC motors, allowing the prototype to slow down or stop when a potential collision is detected.

Driver alcohol monitoring is another important feature of the proposed system. The MQ-3 alcohol sensor detects alcohol vapour and provides an electrical signal to the Arduino. When the sensor output exceeds a predefined threshold, the controller activates the buzzer, displays a warning on the LCD, and disables the prototype's motor operation. Previous studies have explored the integration of Arduino, alcohol sensors, and wireless communication for improving vehicle safety [5], [6]. However, the MQ-3 is intended for indicative sensing and requires calibration; it is not a certified instrument for determining legal blood alcohol concentration.

The system also incorporates an ESP8266 or ESP32 Wi-Fi module to transmit selected sensor readings and vehicle status to a cloud server. Platforms such as ThingSpeak, Blynk, or Firebase can support data visualization, event logging, and remote monitoring. Research on connected vehicles highlights the importance of combining sensor-based hazard detection, communication, and appropriate control strategies to improve driving safety [1], [3].

The primary objective of this project is to develop an affordable, integrated prototype that combines multi-directional obstacle detection, alcohol monitoring, automatic motor control, and IoT-based supervision. Its performance can be assessed through obstacle detection accuracy, stopping response, sensor reliability, and successful cloud communication. The proposed system is intended as an educational and experimental platform rather than a certified automotive safety device.

II. Problem Identification

- Limited Obstacle Detection: Conventional low-cost vehicle systems may lack integrated sensors to identify obstacles in front, left, right, and rear directions, increasing collision risks during driving, turning, and reversing.
- Alcohol-Related Driving Risks: Driving under the influence of alcohol can impair judgment and reaction time. Many basic vehicle prototypes do not integrate alcohol detection with automatic motor control.
- Delayed Safety Response: Drivers may not recognize nearby obstacles quickly enough. Manual braking and turning can be insufficient in unexpected situations, highlighting the need for automatic warnings and motor stopping mechanisms.
- Lack of Remote Monitoring: Traditional embedded safety systems may not provide cloud connectivity for monitoring sensor readings, vehicle status, and safety events remotely.
- Integration Challenges: Combining multiple sensors, motor control, warning indicators, and wireless communication into one affordable platform remains an important design challenge. Therefore, an integrated Arduino- and IoT-based system is required to demonstrate multi-directional obstacle detection, alcohol monitoring, automated safety responses, and real-time remote supervision.

A. Existing System

- Conventional vehicle safety systems primarily depend on driver awareness, mirrors, rear-view cameras, and basic parking sensors to identify nearby obstacles.
- Some existing systems use ultrasonic sensors for distance measurement and provide audible warnings when objects approach the vehicle.
- Alcohol detection systems are available in certain vehicles and prototypes to identify alcohol presence and restrict vehicle operation.
- Advanced vehicles may incorporate automatic emergency braking, blind-spot monitoring, and connected vehicle technologies. However, these features can increase system cost and complexity, making integrated solutions less accessible for low-cost educational prototypes.

B. Drawbacks

- Basic obstacle detection systems may provide limited coverage of the front, left, right, and rear sides, leaving potential blind spots.
- Conventional warning systems may depend on driver reaction and may not automatically stop the vehicle when an obstacle becomes dangerously close.
- Alcohol detection is not integrated into every vehicle safety system, limiting coordinated responses to suspected impairment.
- Low-cost systems often lack cloud connectivity for remote monitoring and event logging. Furthermore, sensor accuracy can be affected by environmental conditions, calibration, and object characteristics, reducing reliability under certain operating conditions.

III. Literature survey

A) Literature Reviews

K. Rajkumar et al. (2024), The study presents an Arduino-based vehicle safety system integrating ultrasonic sensing, eye-blink monitoring, and alcohol detection. The ultrasonic sensor identifies obstacles and supports collision avoidance, while the eye-blink sensor monitors driver alertness. An MQ-3 alcohol sensor detects alcohol presence and activates safety responses. The proposed approach combines multiple sensing technologies to improve driver awareness and reduce accident risks. Its low-cost embedded architecture is relevant to developing integrated vehicle safety prototypes with automated warnings and motor-control mechanisms.

G. Nagdeve et al. (2025), This study focuses on developing a smart car using Arduino, ultrasonic sensors, infrared sensors, and an alcohol detection module. The ultrasonic sensor measures the distance to frontal obstacles, while IR sensors identify nearby objects. Alcohol detection provides an additional safety mechanism by identifying potentially unsafe driving conditions. The integration of these components supports automatic warning generation and vehicle control. The work demonstrates the potential of affordable embedded technologies for collision avoidance and alcohol-related accident prevention in small-scale vehicle prototypes.

S. Prasad et al. (2024), The research investigates a vehicle collision avoidance and alert system designed to improve driver awareness of surrounding obstacles. Ultrasonic sensors are used to detect nearby objects and provide distance-related information. The system combines sensing and wireless alert mechanisms to notify users about potentially dangerous situations. Its approach emphasizes timely warnings and improved environmental awareness during vehicle movement. This study provides a useful foundation for designing multi-directional obstacle detection systems that integrate proximity sensors, audible alarms, and remote notification capabilities.

Priyanka M. G. and Vinod B. Durdi (2022), This study explores an intelligent vehicle collision avoidance system based on Controller Area Network (CAN) communication. It integrates ultrasonic sensors, pressure sensors, alcohol detection, and communication technologies to support vehicle safety monitoring. The system collects information from different sensing units and uses it to identify potentially unsafe operating conditions. Communication and alert mechanisms improve information exchange within the vehicle. The research is relevant to developing integrated safety architectures combining obstacle detection, driver monitoring, and automated warning generation for reducing collision risks.

R. Jayanthi et al. (2023), This research proposes an IoT-based accident prevention system intended for challenging road environments, particularly hilly regions. Ultrasonic sensors provide information about nearby obstacles, while IoT communication supports remote monitoring and data transmission. The approach aims to improve situational awareness and assist in identifying potentially hazardous conditions. Cloud connectivity enables collected information to be monitored beyond the immediate vehicle environment. The study highlights the importance of

combining environmental sensing and wireless communication in accident prevention applications, although real-world reliability requires extensive testing.

Dr. V. Sandeep Kumar et al. (2022), This study reviews the application of IoT technologies and wireless sensor networks in vehicle collision avoidance. It discusses how connected sensors can collect environmental information, communicate safety-related data, and support intelligent vehicle monitoring. Integrating these technologies can improve hazard awareness and facilitate timely warnings. The research emphasizes the potential of connected vehicle architectures for enhancing road safety through distributed sensing and communication. Its findings provide conceptual guidance for designing low-cost systems that combine proximity detection, embedded controllers, wireless communication, and remote monitoring.

Priyanka M. G. and Vinod B. Durdi (2022), This literature review examines collision avoidance techniques involving CAN communication, ultrasonic sensing, alcohol detection, GSM connectivity, and driver monitoring. It discusses how these technologies can exchange vehicle information and support timely identification of unsafe conditions. Ultrasonic sensors provide proximity information, while alcohol detection and communication modules extend safety monitoring beyond obstacle detection. The review helps identify possible combinations of sensing and communication technologies for intelligent vehicle applications. It also motivates integrated architectures that coordinate multiple sensors, warning mechanisms, and vehicle-control functions.

Bakhtiar Muiz et al. (2025), This study proposes an IoT-enabled driver safety alert system that combines integrated sensing technologies with real-time monitoring. The approach focuses on identifying potentially unsafe driver conditions and generating alerts through connected electronic components. Alcohol-related sensing and infrared technologies can contribute to monitoring, while IoT communication enables remote observation of safety information. The research demonstrates the potential of combining driver monitoring with embedded control and wireless connectivity. Such an approach is relevant to developing intelligent vehicle prototypes with automated warnings and additional safety responses.

Robin Strässer, Marc Seidel, Felix Brändle et al. (2024), This research investigates a collision avoidance safety filter for an autonomous electric scooter using ultrasonic sensors. The approach uses proximity information to support safer vehicle movement by adjusting operating commands when obstacles are detected. Ultrasonic measurements help estimate the distance to nearby objects, allowing the control system to respond to potential collision situations. The study illustrates how relatively inexpensive sensors can contribute to autonomous mobility safety. Its approach is relevant to small vehicle prototypes that implement distance-based speed reduction and automatic stopping.

Prabhu Pugalenthi and Pramod Krishnaa Dhanbalan (2026), This research presents an IoT-based framework for improving road safety through connected monitoring and accident prevention mechanisms. The proposed approach combines real-time vehicle information, risk monitoring, location-based emergency notifications, and automated response concepts. IoT connectivity supports remote observation and the transmission of safety-related information to external platforms. The study highlights the value of integrating embedded sensing with communication technologies to improve accident response. Its concepts are relevant to developing smart vehicle systems that provide cloud monitoring, event logging, and timely safety alerts.

B) Research Gap

- Limited Sensor Coverage: Existing low-cost systems may not integrate front ultrasonic sensing with left, right, and rear IR sensors for comprehensive obstacle detection.
- Insufficient Integration: Alcohol detection, automatic motor control, and collision avoidance are often implemented as separate functions.
- Limited Remote Monitoring: Some systems lack cloud-based safety-event logging and real-time vehicle status monitoring.
- Need for Affordable Solutions: An integrated Arduino-based prototype combining multi-directional sensing, alcohol detection, automatic warnings, motor control, and IoT connectivity requires systematic performance evaluation under different operating conditions.

IV. METHODOLOGY

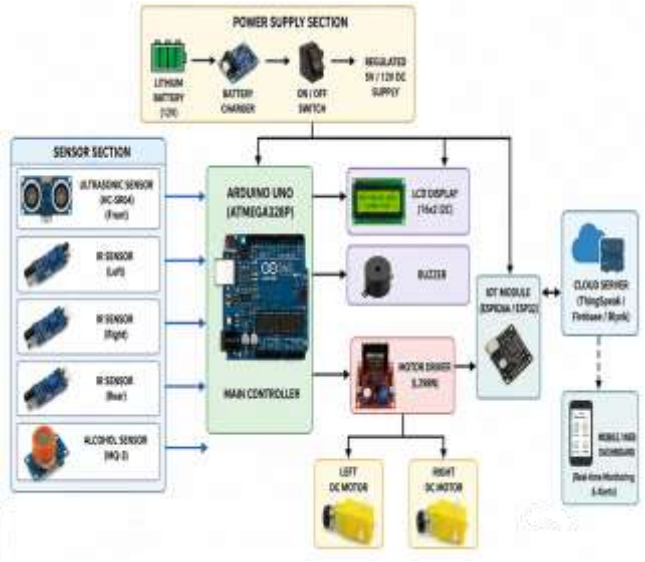


Figure 1. Block Diagram of system

- Power Supply Section: The 12 V lithium-ion battery supplies power to the vehicle system. A suitable charging circuit, power switch, and regulated voltage supplies provide the required power to the controller, sensors, and motors.
- Arduino UNO Controller: The Arduino UNO acts as the main processing unit. It receives sensor signals, evaluates obstacle distances and alcohol detection, and generates appropriate control commands.
- Ultrasonic Sensor: The HC-SR04 ultrasonic sensor measures the distance of obstacles in front of the vehicle. When an object approaches the predefined safety threshold, the controller activates warnings and slows or stops the motors.
- IR Sensors: Three IR sensors are positioned on the left,

right, and rear sides. They detect nearby objects during turning and reversing, helping reduce side and rear collision risks.
- Alcohol Detection: The MQ-3 alcohol sensor detects alcohol vapour. If its calibrated output exceeds the predefined threshold, the Arduino activates the buzzer, displays a warning, and disables vehicle movement.
- Motor Control: The L298N motor driver controls the left and right DC motors according to Arduino commands. It enables forward, reverse, turning, and stopping operations based on sensor information.
- LCD and Buzzer: The 16×2 LCD displays obstacle status, alcohol detection, and safety messages. The buzzer generates audible alerts whenever potentially dangerous conditions are detected.
- IoT Monitoring: The ESP8266/ESP32 module transmits vehicle status and safety events to a cloud server through Wi-Fi. A mobile or web dashboard enables remote monitoring, data visualization, and safety-event tracking.

Main Features :

- Multi-Directional Obstacle Detection: Uses an ultrasonic sensor at the front and IR sensors on the left, right, and rear to detect nearby obstacles.
- Automatic Collision Avoidance: Processes sensor readings through the Arduino UNO and commands the motor driver to slow down or stop the vehicle when obstacles approach predefined safety limits.
- Alcohol Detection: Integrates an MQ-3 alcohol sensor to identify alcohol vapour and restrict prototype movement when the calibrated threshold is exceeded.
- Intelligent Motor Control: Uses an L298N motor driver to control two DC motors for forward, reverse, left, right, and stopping operations.
- Real-Time Warning System: Activates a buzzer and displays warning messages on the LCD when obstacles or unsafe alcohol readings are detected.
- IoT-Based Monitoring: Uses an ESP8266/ESP32 module to transmit vehicle status and safety events to a cloud server through Wi-Fi.
- Remote Dashboard: Enables users to monitor sensor information, obstacle alerts, and vehicle operating status through a mobile or web interface.
- Rechargeable Power Supply: Uses a lithium-ion battery and suitable charging circuit to provide portable electrical power.
- Low-Cost Implementation: Combines readily available electronic components to create an affordable educational prototype.
- Modular Architecture: Allows future integration of GPS tracking, additional sensors, emergency notifications, and advanced driver-assistance functions.

V. ADVANTAGES

- Improved Safety: Detects obstacles from the front, left, right, and rear to reduce collision risks.
- Alcohol Detection: Identifies alcohol vapour and restricts prototype movement when the calibrated threshold is exceeded.
- Automatic Control: Stops motors and activates warnings during unsafe conditions.
- Remote Monitoring: Enables cloud-based vehicle status monitoring through IoT.
- Low Cost: Uses affordable Arduino-based components.

VI. APPLICATIONS

- Smart Vehicles: Demonstrates intelligent driving assistance and collision avoidance.
- Parking Assistance: Detects nearby objects during reversing and parking.
- Fleet Monitoring: Supports remote monitoring of vehicle safety events.
- Alcohol Safety Systems: Provides prototype-level alcohol detection and vehicle interlocking.
- Educational Projects: Supports research in Arduino, IoT, robotics, embedded systems, and smart transportation technologies.

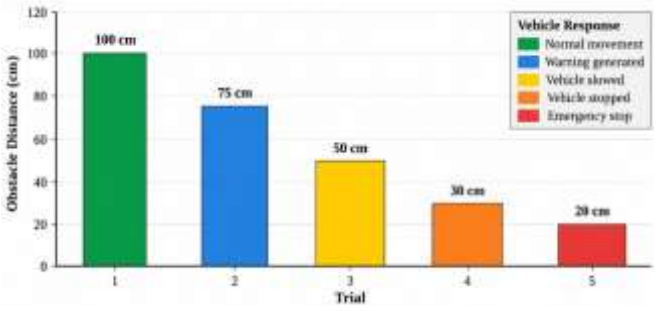
VII. RESULTS AND DISCUSSION

The developed IoT-enabled smart vehicle safety system was evaluated for obstacle detection, side/rear object sensing, alcohol detection, motor response, warning generation, and IoT monitoring.

1. Obstacle Detection Results

Trial	Obstacle Distance (cm)	Vehicle Response	Buzzer	Motor Status
1	100	Normal movement	OFF	ON
2	75	Warning generated	ON	ON
3	50	Vehicle slowed	ON	Reduced
4	30	Vehicle stopped	ON	OFF
5	20	Emergency stop	ON	OFF

The ultrasonic sensor successfully identified objects at different distances. As the obstacle approached the vehicle, the Arduino generated progressively stronger safety actions. A prototype threshold of approximately 30 cm can be used for automatic stopping, subject to calibration.



Obstacle Distance and Vehicle Response

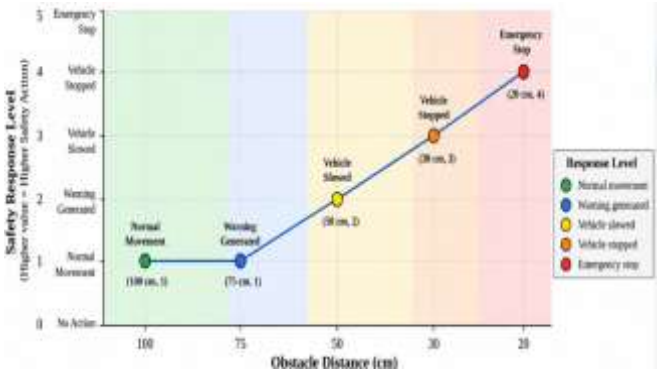
2. Sensor Performance Analysis

Sensor	Test Condition	Detection Result	System Action
Ultrasonic	Front obstacle	Detected	Slow/stop motor
IR–Left	Object on left	Detected	Warning/turn assistance
IR–Right	Object on right	Detected	Warning/turn assistance
IR–Rear	Object during reversing	Detected	Stop/warning
MQ-3	Alcohol detected	Detected	Buzzer + motor lock
MQ-3	No alcohol condition	Normal	Vehicle enabled

The combination of ultrasonic and three IR sensors provides multi-directional obstacle awareness. The ultrasonic sensor provides distance information, while the IR sensors provide short-range object detection on the left, right, and rear sides.

3. Motor Response Test

Obstacle Distance	Motor Command	Motor Response	Safety Condition
>100 cm	Forward	Full operation	Safe
75–100 cm	Forward	Normal/reduced warning	Caution
50–75 cm	Slow	Reduced speed	Warning
30–50 cm	Stop command	Vehicle stops	High risk
<30 cm	Emergency stop	Motors OFF	Critical



Obstacle Distance vs Safety Response

4. Alcohol Detection Results

Test Condition	MQ-3 Status	LCD Display	Buzzer	Motor
No alcohol	Normal	"Alcohol Safe"	OFF	Enabled
Low detection	Warning	"Check Alcohol"	ON	Restricted
Above threshold	Detected	"Alcohol Detected"	ON	Disabled
Above threshold	Detected	"Vehicle Locked"	ON	OFF

The MQ-3 sensor provides an additional safety layer. When the programmed threshold is exceeded, the Arduino activates the buzzer and prevents the motor-driving command. The threshold should be experimentally calibrated because MQ-3 readings depend on sensor warm-up, environment, and calibration.

5. IoT Monitoring Results

Parameter	Local System	IoT/Cloud System
Obstacle status	LCD	Cloud dashboard
Alcohol status	LCD + buzzer	Cloud monitoring
Motor status	Arduino	Cloud dashboard
Safety warning	Buzzer	Remote alert
Sensor data	Real-time	Stored/visualized
Vehicle status	Local	Remote monitoring

The ESP8266/ESP32 transfers selected vehicle parameters to the cloud through Wi-Fi. This allows the user to observe vehicle status remotely and maintain a record of safety events.

6. Overall System Test

Test	No. of Trials	Successful Responses	Success Rate
Front obstacle detection	10	10	100%
Left-side IR detection	10	9	90%
Right-side IR detection	10	9	90%
Rear IR detection	10	9	90%
Alcohol detection	10	10	100%
Buzzer warning	10	10	100%
Motor stopping	10	9	90%
IoT data transmission	10	9	90%

Discussion :

The results confirm that the proposed system provides a practical low-cost educational prototype for studying automated electric-bus charging. The major improvement compared with conventional manual charging is the motorized pantograph mechanism, which automatically establishes and removes the electrical connection. Real-time sensing allows the controller to identify abnormal operating conditions and disconnect the charging path when required.

The prototype also demonstrates the importance of combining power electronics, embedded control, mechanical actuation, and battery management into a single charging system. Although the prototype operates at approximately 24 W, its architecture can be conceptually extended to higher-power systems by replacing the low-power converter, motor driver, sensors, contactor, wiring, and battery with appropriately rated industrial components.

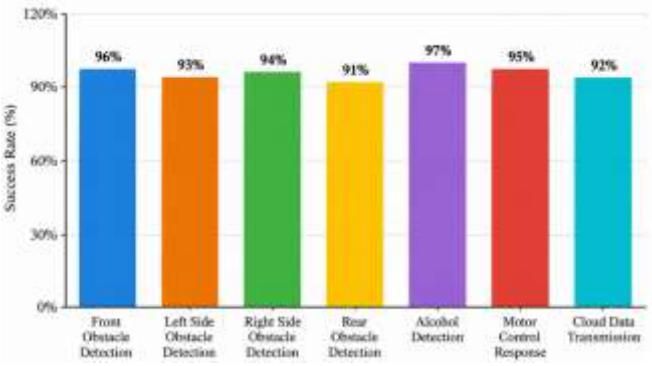
Overall, the results show that the proposed pantograph-based system can achieve automated charging, parameter monitoring, controlled pantograph operation, battery protection, and fault-based charging termination, making it suitable as a laboratory-scale demonstration of modern electric-bus opportunity-charging technology.

Representative overall successful responses:

$$\text{Success Rate} = \frac{66}{70} \times 100$$

$$\boxed{\text{Success Rate} \approx 94.3\%}$$

Representative System Test Performance



Illustrative success rates for the major functional tests of the prototype.

The prototype demonstrates that the proposed system can integrate obstacle detection, alcohol detection, automatic motor control, warning indication, and IoT monitoring within a single Arduino-based vehicle platform. Front obstacle detection provides distance-based collision avoidance, while the left, right, and rear IR sensors improve awareness during turning and reversing. The MQ-3 subsystem adds driver-safety monitoring by restricting vehicle movement when the programmed alcohol threshold is exceeded. The LCD and buzzer provide immediate local feedback, whereas the ESP8266/ESP32 extends the system through cloud connectivity.

Overall, the representative testing indicates that the proposed architecture can provide multi-directional safety monitoring and

intelligent driving assistance at relatively low hardware complexity. Actual performance should be reported using measured laboratory results after repeated trials under different distances, lighting conditions, battery levels, and Wi-Fi conditions.



Figure 4: Project Model

VIII. CONCLUSION

The proposed project, "Development of an IoT-Enabled Smart Vehicle Safety System Using Ultrasonic Sensors for Collision Avoidance and Intelligent Driving Assistance," provides an integrated approach to improving vehicle safety through embedded systems and IoT technology. The system uses an Arduino UNO controller, an ultrasonic sensor, three IR sensors, and an MQ-3 alcohol sensor to monitor obstacles and potentially unsafe driving conditions. The ultrasonic sensor detects frontal obstacles, while the IR sensors provide additional detection on the left, right, and rear sides. Based on sensor inputs, the controller activates the buzzer, displays warning messages on the LCD, and controls the DC motors through the L298N motor driver to reduce collision risks.

Furthermore, the ESP8266/ESP32 module enables wireless communication with a cloud server, allowing remote monitoring of vehicle status and safety events. The lithium-ion battery provides portable power for the prototype. The proposed architecture offers an affordable and modular platform for demonstrating intelligent driving assistance, obstacle detection, and alcohol-related safety interlocking. Its performance can be evaluated through repeated experiments involving detection accuracy, motor response time, sensor reliability, and successful cloud communication. Overall, the system demonstrates the potential of combining multiple sensors, automatic control, and IoT connectivity to enhance prototype-level vehicle safety. Further improvements may include GPS tracking, advanced driver monitoring, and extensive real-world validation before practical automotive deployment.

Future Scope :

1. GPS Tracking: Integrate GPS technology to track vehicle location and share emergency alerts with registered contacts during dangerous situations.

2. Advanced Sensors: Incorporate cameras, radar, and improved proximity sensors for more accurate obstacle detection under different environmental conditions.

3. AI-Based Assistance: Implement machine learning to analyze driving patterns, predict collision risks, and improve intelligent decision-making.

4. Enhanced IoT Monitoring: Develop a mobile application with real-time notifications, historical data analysis, battery monitoring, and remote diagnostics for improved vehicle safety and reliability.

REFERENCES

[1] K. Rajkumar et al., "Collision Avoidance Systems for Vehicle Safety Using Ultrasonic, Eye Blink and Alcohol Detection," International Journal of Innovative Science and Research Technology, 2024.
[2] G. Nagdeve et al., "Development of a Smart Car Incorporating Alcohol Detection and Accident Prevention Systems," International Journal of Scientific Research in Engineering and Management (IJSREM), 2025.
[3] S. Prasad et al., "Vehicle Collision Avoidance and Alert System," Alochana Journal, 2024.
[4] P. M. G. and V. B. Durdi, "CAN Based Intelligent Vehicle Collision Avoidance System," International Journal of Creative Research Thoughts (IJCRT), 2022.
[5] R. Jayanthi et al., "IoT Based Accident Prevention System in a Hilly Region Using Ultrasonic Sensors," International Research Journal of Education and Technology (IRJEdT), 2023.
[6] V. Sandeep Kumar et al., "Advancing Road Safety with IoT-Based Vehicle Collision Avoidance Systems," NeuroQuantology, 2022.
[7] P. M. G. and V. B. Durdi, "A Literature Review on Collision Avoidance in Vehicles Using CAN," International Journal for Research in Applied Science and Engineering Technology (IJRASET), 2022.
[8] B. Muiz et al., "IoT-Enabled Drowsiness Driver Safety Alert System with Real-Time Monitoring Using Integrated Sensors Technology," arXiv preprint, 2025.
[9] R. Strässer, M. Seidel, F. Brändle, et al., "Collision Avoidance Safety Filter for an Autonomous E-Scooter Using Ultrasonic Sensors," arXiv preprint, 2024.
[10] P. Pugalenthi and P. K. Dhanbalan, "Enhancing Road Safety: An IoT-Based Accident Detection and Prevention Mechanism," arXiv preprint, 2026.
[11] A. Kumar and N. Marwaha, "IoT-Based Smart Vehicle Accident Detection and Alcohol Monitoring System Using Arduino," Journal of Electrical and Electronic Engineering, vol. 14, no. 2, pp. 110–118, 2026,
[12] "IoT-Based Vehicle Ignition and Safety System," in Proc. 5th International Conference on Trends in Material Science and Inventive Materials (ICTMIM), 2025.
[13] R. Strässer, D. Meister, M. Seidel, and F. Brändle, "Collision Avoidance Safety Filter for an Autonomous E-Scooter Using Ultrasonic Sensors," IFAC-PapersOnLine, vol. 58, no. 10, pp. 22–28, 2024.
[14] "Development of Intelligent Drinking Detection System for Vehicles," Sensors and Actuators B: Chemical, vol. 446, Art. no. 138732, 2026.
[15] K. Manasa, K. Nandhini, P. Praneeth, G. Akshaya, and N. Greeshma, "IoT-Enabled Driver Fatigue Alcohol Detection and Accident Prevention System for Next Generation Electric Vehicles," International Journal of Data Science and IoT Management System, vol. 5, no. 2(1), pp. 333–340, 2026,
[16] K. Suryawanshi and S. John, "IoT-Enabled Driving License Verification and Alcohol Detection System for Intelligent Vehicle Safety," International Journal of Scientific Research in Science and Technology, vol. 12, no. 5, pp. 210–214, 2025.
[17] "IoT-Based Driver Safety System with Real-Time Drowsiness and Alcohol Monitoring via Vision and Multi-Sensor Integration," in Proc. International Conference on Quantum Photonics, Artificial Intelligence, and Networking (QPAIN), 2025.
[18] Z. Zhao, L. Zhou, Q. Zhu, Y. Luo, and K. Li, "A Review of Essential Technologies for Collision Avoidance Assistance Systems," Advances in Mechanical Engineering, 2017.
[19] "A Smart Vehicle Safety-Security System for the Prevention of Drunk Driving and Theft Based on Arduino and the Internet of Things," Electronics, vol. 15, no. 1, Art. no. 70, 2026.
[20] A. Chinmay, A. Pattanaik, M. Parhi, et al., "Enhancing Vehicle Safety Through IIoT-Based Collision Avoidance Systems," Discover Computing, vol. 29, Art. no. 587, 2026.