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IOT Based Smart Vehicle Safety System Using Arduino Nano

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Abstract - *Road accidents are a major cause of injuries and loss of life worldwide. Many accidents occur due to poor visibility, environmental conditions, and lack of real-time monitoring. This paper presents an IoT based smart vehicle safety system using Arduino Nano, LiDAR sensor, DHT11 sensor, GSM module (SIM900A), light sensor, motor driver, and buzzer. The system detects obstacles using LiDAR technology and automatically stops the vehicle to prevent collisions. It also monitors environmental conditions such as temperature, humidity, and light intensity to identify fog or night situations. In such conditions, the system activates a buzzer alert to warn the driver. In emergency cases, the GSM module sends an alert message to a predefined mobile number. The system is designed to be cost-effective, reliable, and efficient for real-time safety applications. Experimental results show that the system performs accurately and improves vehicle safety under different conditions, making it suitable for smart transportation systems.*

Key Words: IoT, Arduino Nano, LiDAR, GSM Module, Vehicle Safety, DHT11 Sensor, Obstacle Detection

1.INTRODUCTION

Road safety has become a major concern in recent years due to the rapid increase in the number of vehicles on the road. A large number of accidents occur every year because of human errors, poor visibility conditions such as fog and night driving, and the absence of effective real-time monitoring systems. These accidents not only lead to loss of life but also cause serious injuries and economic damage. Traditional vehicle safety systems mainly depend on the driver's awareness and manual control.

With the advancement of Internet of Things (IoT) technology, it has become possible to design smart systems that can monitor environmental conditions and take automatic actions without human intervention. IoT enables communication between sensors, controllers, and communication modules, allowing continuous data collection and real-time processing. This helps in identifying risks.

To overcome the limitations of existing systems, an IoT based smart vehicle safety system is proposed. The system is developed using Arduino Nano as the main controller along with LiDAR sensor, DHT11 sensor, GSM module (SIM900A), light sensor, motor driver, and buzzer. The LiDAR sensor is used for accurate obstacle detection by measuring the distance between the vehicle and surrounding objects. When an obstacle is detected within a predefined range, the system automatically stops the vehicle to prevent collisions. In addition, environmental sensors monitor conditions such as fog and low light, enabling the system to provide timely alerts and enhance driving safety.

1.1 Existing System

In most of the existing vehicle safety systems, the overall safety primarily depends on the driver's attention, awareness, and reaction time. Drivers are responsible for identifying obstacles, maintaining safe distance, and taking necessary actions to avoid accidents. However, in many situations such as high-speed driving, poor visibility, or driver fatigue, human response may not be fast or accurate enough to prevent collisions this limitation significantly increases.

Some modern vehicles are equipped with basic safety features such as ultrasonic sensors and simple alert systems. These sensors can detect nearby obstacles and provide warning signals to the driver. However, ultrasonic sensors have limited range and accuracy, especially when compared to advanced sensing technologies. They may not perform effectively in long-distance detection or in complex road conditions.

Another major limitation of existing systems is the lack of environmental monitoring. Most systems do not consider external conditions such as fog, humidity, or low light, which are common causes of road accidents. In foggy or night conditions, visibility is significantly reduced, and traditional systems fail to provide proper alerts or assistance. Due to these drawbacks, existing vehicle safety systems are not fully reliable for preventing accidents in all situations.

1.2 Proposed System

The proposed system is designed to improve vehicle safety by integrating advanced sensing, control, and communication technologies. It uses LiDAR sensor for accurate and long-range obstacle detection, along with DHT11 and light sensor to monitor surrounding conditions. The LiDAR sensor operates based on laser signal reflection, which allows precise measurement of distance between the vehicle and nearby objects. This ensures reliable detection.

The Arduino Nano acts as the central processing unit, continuously collecting data from all sensors and analyzing it in real time. When an obstacle is detected within a predefined threshold distance, the controller immediately sends a signal to the motor driver to stop the vehicle automatically, thereby preventing possible collisions. This reduces the dependency on human reaction and improves responses.

In addition to obstacle detection, the system also focuses on environmental safety. DHT11 sensor measures temperature and humidity, which helps in identifying fog conditions, while light sensor detects low light intensity such as night or dark environments. When such low visibility conditions are detected, the system activates a buzzer alert to warn the driver.

Furthermore, the GSM module (SIM900A) is used for communication purposes. In emergency situations, it sends an alert message to a predefined mobile number using cellular network technology. This ensures that timely information is delivered even in remote areas. Overall, the proposed system provides a reliable, cost-effective, and real-time solution for enhancing vehicle safety.

2. LITERATURE REVIEW

Various research works have been carried out in the field of vehicle safety systems using sensors, wireless communication, and Internet of Things (IoT) technologies. These systems are mainly developed to reduce road accidents by improving obstacle detection, monitoring environmental conditions, and providing timely alerts to drivers. Researchers have focused on designing systems that can enhance safety and minimize human errors.

Many existing systems use ultrasonic sensors for obstacle detection due to their low cost and simple working principle. These sensors measure distance using sound waves and are suitable for short-range applications. However, their accuracy decreases with increasing distance, and they may not perform effectively in complex environments. To overcome these limitations, some advanced systems use camera-based technologies and image processing techniques for object detection and lane monitoring.

Although these systems provide better results, they require high computational power and are expensive to implement.
Recent developments in sensing technologies have introduced LiDAR-based systems, which offer higher accuracy and long-range detection using laser signals. LiDAR technology is widely used in modern smart vehicles and autonomous driving systems due to its reliability and precision. In addition, many researchers have integrated GSM modules and IoT platforms to enable communication and real-time alerts during emergency situations.

Despite these advancements, most of the existing systems have certain limitations such as high cost, complex design, and lack of environmental monitoring. Many systems only provide warning alerts without automatic control, which still depends on driver response. Therefore, there is a need for a cost-effective and efficient system that can provide accurate detection, automatic response, and real-time communication, which is addressed by the proposed system.

2.1 Existing Research

Previous research studies have demonstrated that sensor-based vehicle safety systems play an important role in reducing road accidents by providing timely alerts to drivers. These systems typically use sensors such as ultrasonic, infrared, and proximity sensors to detect obstacles and warn the driver about potential collisions. By providing early warnings, these systems help in improving driver awareness.

In addition to obstacle detection, several researchers have developed GSM-based systems for emergency communication. These systems are capable of sending alert messages to predefined contacts in case of accidents or critical situations. This feature helps in ensuring faster response and assistance, especially in remote areas.

However, despite these advantages, many existing research systems face limitations in terms of accuracy, reliability, and response time. Sensor-based systems using traditional technologies often provide less accurate results and may fail under certain environmental conditions such as fog, rain, or low light. Moreover, many systems only provide alerts without taking automatic preventive action, which still depends on the driver's response. These challenges highlight the need for more advanced and integrated solutions for vehicle safety.

2.2 Limitations Of Existing Systems

Despite significant advancements in vehicle safety technologies, existing systems still face several limitations that reduce their effectiveness in real-world conditions. Many systems rely on ultrasonic sensors for obstacle detection, which operate using sound waves. Although these sensors are cost-effective and easy to implement, they have a limited detection range and lower accuracy when compared to advanced sensing technologies. Their performance can also be affected by environmental factors such as temperature variations and surface properties of objects.

Camera-based systems, on the other hand, provide better detection capabilities by using image processing and computer vision techniques. However, these systems require high computational power, complex algorithms, and expensive hardware, making them less suitable for low-cost applications.

Another major limitation of existing systems is that many of them only provide warning alerts to the driver without taking any automatic action. In such cases, the effectiveness of the system depends on the driver's reaction time, which may not be sufficient in critical situations. Furthermore, most systems do not include environmental monitoring features such as detection of fog or low light conditions, which are important factors contributing to accidents. These limitations highlight the need for a more reliable, cost-effective, and automated vehicle safety system.

2.3 Proposed Approach

The proposed system is designed to overcome the limitations of existing vehicle safety systems by integrating advanced sensing, control, and communication technologies. Unlike traditional systems that rely on basic sensors, this approach uses LiDAR technology for accurate and long-range obstacle detection. LiDAR operates based on laser signal reflection, which provides precise distance measurement and improves detection reliability even in complex environments.

In addition to obstacle detection, the system incorporates environmental sensors such as DHT11 and light sensor to monitor surrounding conditions. The DHT11 sensor measures temperature and humidity, which helps in identifying foggy conditions, while the light sensor detects low light intensity such as night or dark environments. This combination of sensors allows the system to analyze both physical obstacles and environmental factors that affect safety.

The Arduino Nano acts as the central controller, processing data from all sensors in real time and making quick decisions. When a potential risk is detected, such as an obstacle within a threshold distance or low visibility conditions, the system automatically takes necessary actions. These actions include stopping the vehicle using the motor driver and activating a buzzer alert to warn the driver.

3. PROPOSED SYSTEM

The proposed system is developed to enhance vehicle safety by utilizing Internet of Things (IoT) technology along with advanced sensors and communication modules. The system integrates multiple hardware components that work together to provide continuous monitoring of the vehicle's surroundings and take automatic actions when potential risks are detected. The main objective of the system is to reduce accidents by minimizing human dependency and ensuring quick response in critical situations.

The system operates by collecting real-time data from various sensors such as LiDAR, DHT11, and light sensor. These sensors are responsible for detecting obstacles as well as monitoring environmental conditions like temperature, humidity, and light intensity. The collected data is processed by the Arduino Nano, which acts as the

central controller of the system. Based on the processed data, the controller makes decisions and controls different output devices.
When an obstacle is detected within a predefined distance, the system automatically stops the vehicle using the motor driver, thereby preventing possible collisions. In addition, if the system detects low visibility conditions such as fog or darkness, it activates a buzzer alert to warn the driver. The integration of GSM module further enhances the system by enabling communication, as it sends alert messages during emergency.

Overall, the proposed system provides a reliable, cost-effective, and efficient solution for vehicle safety. It ensures real-time monitoring, automatic control, and quick response, making it suitable for modern smart transportation systems.

3.1 System Architecture

The system architecture of the proposed vehicle safety system is divided into three main sections: input, processing, and output. This structured approach ensures smooth data flow and efficient system operation. Each section performs a specific function, and together they enable real-time monitoring and automatic control of the vehicle.

The input section consists of various sensors such as LiDAR, DHT11, and light sensor. These sensors are responsible for collecting real-time data from the surrounding environment. The LiDAR sensor detects obstacles by measuring the distance between the vehicle and nearby objects using laser signals. The DHT11 sensor measures temperature and humidity, which helps in identifying environmental conditions such as fog. The light sensor detects ambient light intensity to determine whether the vehicle is operating in daylight or low visibility.

The processing section is handled by the Arduino Nano microcontroller, which acts as the central unit of the system. It receives input data from all sensors, processes information, and makes decisions based on predefined conditions. The controller continuously runs in a loop, ensuring real-time data analysis and quick response to any changes.

The output section includes components such as the motor driver, buzzer, and GSM module. Based on the processed data, the Arduino Nano sends control signals to these output devices. The motor driver is used to control the movement of the vehicle and stop it automatically when an obstacle is detected. The buzzer provides warning alerts in case of low visibility or risky conditions. The GSM module (SIM900A) is used to send alert messages during emergency situations, ensuring communication even in remote areas. This complete architecture enables efficient coordination between sensing, processing, and action.

3.2 Hardware Components

The proposed system consists of several hardware components that work together to ensure proper functioning and enhance vehicle safety. Arduino Nano is used as the central controller of the system, which processes data received from different sensors and controls the output devices accordingly. It plays a crucial role in decision-making.

The LiDAR sensor is used for obstacle detection and provides accurate distance measurement by using laser-based technology. It offers better precision and range compared to traditional sensors. The DHT11 sensor is used to measure temperature and humidity levels, which helps in identifying environmental conditions such as fog. The light sensor is responsible for detecting ambient light intensity.

For communication purposes, the GSM module (SIM900A) is integrated into the system. It is used to send alert messages to a predefined mobile number during emergency situations using the cellular network. The motor driver (L298N) is used to control the movement of the vehicle by receiving signals from the Arduino Nano. It enables automatic stopping of the vehicle.

In addition, a buzzer is used to provide warning alerts to the driver in case of dangerous conditions such as low visibility or obstacle detection. A stable power supply is also required to provide the necessary voltage and ensure proper operation of all components. Together, these hardware components form an integrated system that supports real-time monitoring and improves overall vehicle safety.

3.3 Working Principle

The proposed system operates by continuously collecting real-time data from multiple sensors and processing it using the Arduino Nano microcontroller. The system follows a continuous monitoring approach, where sensor data is analyzed in a loop to ensure immediate response to any changes in the environment. The LiDAR sensor plays a key role in obstacle detection by emitting laser pulses and calculating the time taken for the reflected signal to return, based on the time-of-flight principle. This method provides highly accurate and reliable distance measurement over a longer range compared to conventional sensors. When the detected distance becomes less than a predefined threshold value, the Arduino Nano quickly processes the data and sends control signals to the motor driver (L298N), which stops the vehicle automatically to prevent possible collisions.

In addition to obstacle detection, the system also performs environmental monitoring to enhance safety under different conditions. The DHT11 sensor continuously measures temperature and humidity levels, which helps in identifying foggy conditions where visibility is reduced. At the same time, the light sensor monitors ambient light intensity and determines whether the system is operating in normal daylight or low-light conditions such as night or dark environments. When such conditions are detected, the Arduino Nano activates a buzzer alert to warn the driver about potential risks, thereby improving awareness and safety.
Furthermore, the GSM module (SIM900A) adds communication capability to the system by sending SMS alerts to a predefined mobile number during emergency situations. This communication is established through cellular network technology, which ensures reliable message delivery even in remote areas where internet connectivity may not be available. The integration of sensing, processing, and communication allows the system to operate efficiently in real time. Overall, the system provides continuous monitoring, quick decision-making, and automatic control, making it highly effective for vehicle safety applications.

In addition, the system is designed to ensure smooth and reliable operation under varying conditions by maintaining continuous interaction between all components. The Arduino Nano not only processes sensor data but also manages the synchronization between input and output devices, ensuring that actions are performed without delay. The use of predefined threshold values allows the system to make quick decisions without complex computations, making it efficient and suitable for real-time applications. Moreover, the integration of multiple sensors improves the overall accuracy of the system by reducing the chances of false detection. This coordinated operation of sensing, processing, and actuation enhances system stability and ensures effective performance in different environmental scenarios.

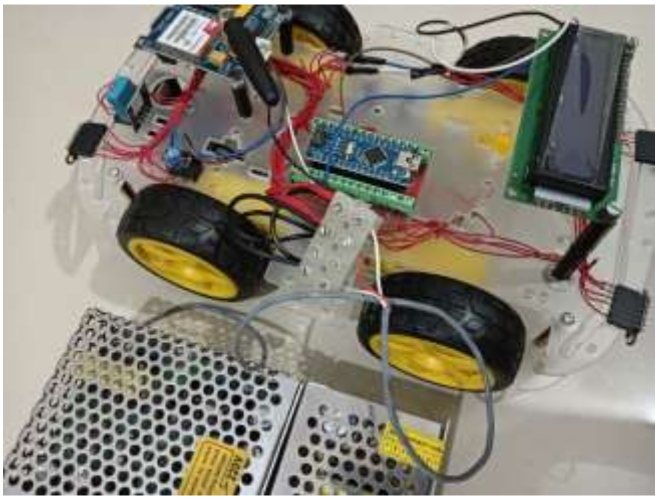

Fig 1: Prototype Model of Smart Vehicle Safety System

4. RESULTS AND DISCUSSION

The proposed system was successfully implemented and tested under various environmental and operational conditions to evaluate its performance and reliability. Different test scenarios were created, including obstacle detection, low light conditions, and fog simulation, to analyze how the system responds in real-time situations. The results obtained from these tests demonstrate the effectiveness of the system in improving vehicle safety.

During obstacle detection testing, the LiDAR sensor accurately measured the distance between the vehicle and nearby objects. When an obstacle was placed within the predefined threshold distance, the system responded immediately by sending a signal to the motor driver, which stopped the vehicle automatically. The response time of the system was observed to be fast and consistent, ensuring reliable performance in preventing collisions.

In environmental testing, the DHT11 sensor effectively detected changes in temperature and humidity, which helped in identifying fog-like conditions. Similarly, the light sensor successfully detected low light intensity during night conditions. In both cases, the system activated the buzzer alert to warn the driver about reduced visibility. This feature enhances driver awareness and reduces the chances of accidents in unfavorable conditions.

The GSM module was also tested for communication reliability. It successfully sent alert messages to a predefined mobile number during emergency situations. The message delivery was consistent and worked effectively even without internet connectivity, as it uses the cellular network.

Overall, the system showed stable performance across all test conditions. The integration of multiple sensors improved detection accuracy, while the automatic control mechanism reduced dependency on human response. The results confirm that the proposed system is efficient, reliable, and suitable for real-time vehicle safety applications.

4.1 Experimental Results

The LiDAR sensor successfully detected obstacles with high accuracy due to its precise distance measurement based on laser signal reflection using the time-of-flight principle. It provided reliable and consistent detection even at longer ranges when compared to traditional sensors such as ultrasonic sensors. The system demonstrated a fast response time, where the Arduino Nano processed the sensor data almost instantly and activated the motor driver to stop the vehicle effectively. This quick response helped in preventing potential collisions and ensured safe operation under different test conditions.

The environmental sensors, including the DHT11 and light sensor, accurately detected fog and low light conditions by continuously monitoring humidity, temperature, and ambient light intensity. The system was able to identify changes in environmental conditions and responded appropriately by activating the buzzer alert to warn the driver. This feature is particularly useful in situations where visibility is reduced, such as during night driving or foggy weather.

In addition, repeated testing was carried out to evaluate the consistency and reliability of the system. The results showed that the system maintained stable performance over multiple trials without significant variation in response time or accuracy. The integration of multiple sensors improved the overall efficiency by minimizing false detections and ensuring correct decision-making. These observations confirm that the proposed system is effective, reliable, and suitable for real-time vehicle safety applications.

4.2 Performance Analysis

The performance of the proposed system was evaluated based on parameters such as response time, accuracy, and reliability under different operating conditions. The system demonstrated a fast response time, as the Arduino Nano was able to process sensor data quickly and generate appropriate control signals without noticeable delay. This rapid processing is essential in real-time applications where immediate action is required to prevent accidents.

The integration of multiple sensors, including LiDAR, DHT11, and light sensor, significantly improved the overall detection accuracy of the system.

The LiDAR sensor provided precise distance measurements for obstacle detection, while the environmental sensors ensured proper identification of fog and low light conditions. This combination of sensors helped in reducing false alarms.

Furthermore, the system maintained stable performance during repeated testing, showing consistency in its operation. The coordination between sensing, processing, and output components ensured smooth functioning without interruptions. Overall, the system achieved a good balance between accuracy, speed, and reliability, making it suitable for practical vehicle safety applications.

4.3 Discussion

The results obtained from the experimental analysis clearly indicate that the proposed system is effective in enhancing vehicle safety under different operating conditions. The use of advanced sensing technologies such as LiDAR, along with environmental sensors, enables accurate detection of obstacles and surrounding conditions. This improves the system's ability to identify potential risks at an early stage.

The integration of automation plays a significant role in reducing dependency on human intervention. In traditional systems, safety largely depends on the driver's attention and reaction time, which may not always be reliable. However, in the proposed system, automatic decision-making ensures that necessary actions, such as stopping the vehicle or generating alerts, are performed immediately without delay. This significantly reduces the chances of accidents.

Moreover, the combination of multiple sensors improves the overall efficiency and reliability of the system by minimizing errors and false detections. The inclusion of GSM communication further enhances the system by enabling emergency alerts, ensuring timely assistance when required. Overall, the system demonstrates a practical and effective approach for improving vehicle safety and can be considered a valuable solution for modern smart transportation systems.

5.ADVANTAGES AND APPLICATIONS

5.1 Advantages

- The proposed IoT based smart vehicle safety system offers several advantages in terms of accuracy, efficiency, and reliability. One of the major advantages of the system is the use of LiDAR technology, which provides highly accurate and long-range obstacle detection compared to traditional sensors. This improves the overall safety of the vehicle by ensuring timely identification of potential hazards.

Another important advantage of the system is automatic vehicle control. The system reduces dependency on human intervention by automatically stopping the vehicle when an obstacle is detected within a predefined distance. This helps in minimizing accidents caused by delayed human reaction. The system also supports real-time monitoring, as it continuously collects and processes data from sensors, ensuring immediate response to changing conditions.

In addition, the system is capable of detecting environmental conditions such as fog and low light using DHT11 and light sensors. This enhances safety in situations where visibility is reduced. The use of GSM module for communication allows the system to send alert messages during emergency situations, ensuring timely assistance. Furthermore, the system is cost-effective and easy to implement, making it suitable for practical applications and large-scale deployment.

5.2 Applications

The proposed system has a wide range of applications in different fields related to safety and transportation. It can be used in smart vehicles to enhance driving safety by providing automatic obstacle detection and control. The system is also useful in accident prevention systems, where early detection and quick response can reduce the chances of collisions.

In addition, the system can be applied in industrial environments where safety monitoring is required to prevent accidents involving machinery or vehicles. It is also suitable for use in smart transportation systems, where advanced technologies are used to improve traffic safety and efficiency. Overall, the system can be adapted for various real-world applications that require reliable monitoring and automated safety solutions.

6. FUTURE SCOPE AND CONCLUSION

6.1 Future Scope

The proposed system can be further enhanced by integrating additional advanced technologies to improve its performance and functionality. One possible improvement is the inclusion of GPS tracking, which can provide real-time location information of the vehicle during emergency situations. This would help in faster response and assistance. The system can also be upgraded by incorporating artificial intelligence and machine learning algorithms for better decision-making.

In addition, camera-based object detection can be integrated along with LiDAR to provide more detailed analysis of surrounding objects. Cloud-based IoT platforms can also be used to store and analyze data remotely, enabling remote monitoring and control of the system.

6.2 Conclusions

The IoT based smart vehicle safety system developed in this project provides an effective and reliable solution for reducing road accidents. By integrating advanced sensing technologies such as LiDAR along with environmental sensors like DHT11 and light sensor, the system is capable of accurately detecting obstacles as well as monitoring surrounding conditions. The Arduino Nano plays a key role in processing sensor data and making real-time decisions, while the motor driver ensures automatic control of the vehicle.

The system also enhances safety by providing alert mechanisms through a buzzer and communication support using the GSM module, which sends messages during emergency situations. The experimental results confirm that the system performs efficiently under different environmental conditions with quick response time and stable operation. Overall, the system is cost-effective, easy to implement, and suitable for real-world applications in smart transportation systems. It demonstrates how IoT technology can be effectively used to improve vehicle safety and reduce accidents.

REFERENCES

[1] Arduino, "Arduino Nano Documentation," Arduino Official Website. [Online]. Available: https://www.arduino.cc/

[2] SIMCom, "SIM900A GSM Module Datasheet," SIMCom Wireless Solutions, 2013.

[3] Aosong Electronics, "DHT11 Temperature and Humidity Sensor Datasheet," 2010.

[4] Garmin Ltd., "LiDAR Technology Overview and Applications," Technical Report, 2020.

[5] R. S. Sengar and P. Sharma, "IoT Based Vehicle Safety System," International Journal of Engineering Research & Technology, vol. 8, no. 5, pp. 123–126, 2019.

[6] S. Madakam, R. Ramaswamy, and S. Tripathi, "Internet of Things (IoT): A Literature Review," Journal of Computer and Communications, vol. 3, no. 5, pp. 164–173, 2015.

[7] M. A. Khan and K. Salah, "IoT Security: Review, Blockchain Solutions, and Open Challenges," Future Generation Computer Systems, vol. 82, pp. 395–411, 2018.