AUTOMATIC SPEED BRAKING TIME DEMAND BASED EMBEDDED SYSTEM

Mr. M. Anbarasan[1], G. M. Eniarasi[2], S. Priyadarshini[3], S. Priyanka[4], K. Subalakshmi[5]

Assistant Professsor ,UG Scholars ,Department of Electronics and Communication Engineering, Adhiyamaan College Of Engineering (AUTONOMOUS), Hosur

ABSTRACT

In modern transportation systems, ensuring road safety and preventing accidents caused by overspeeding is a critical concern. This paper presents an Automatic Speed Braking Time Demand Based Embedded System, which dynamically controls vehicle speed based on environmental conditions and obstacles. The system integrates an real-time obstacle detection and a DHT11 Sensor to monitor environmental conditions, such as temperature and humidity.A Nano Controller (microcontroller) processes sensor data and makes intelligent braking decisions. The Driver Board controls Gear Motors to regulate the vehicle's movement based on the detected obstacles and predefined speed thresholds. An LCD Display provides real-time feedback on speed adjustments and environmental parameters. Additionally, Serial Communication enables data exchange with external monitoring systems.The proposed system is designed to enhance vehicle safety by automatically adjusting speed and applying brakes when necessary, reducing collision risks and improving driver response time. This embedded system can be implemented in smart vehicles, autonomous systems, and industrial automation for improved safety and efficiency.

Keywords: Automatic Braking System, Embedded Systems, LCD, Ultrasonic Sensor, Power supply, Real Time Processing, Control Algorithm, Vehicle Safety, Machine Learning, Adaptive Braking, Collision Avoidance.

I.INTRODUCTION

- With the increasing number of road accidents due to overspeeding and delayed braking responses, there is a growing need for an intelligent system that can assist in real-time speed control and automatic braking. The Automatic Speed Braking Time Demand Based Embedded System is designed to enhance vehicle safety by integrating smart sensors and embedded technology to monitor the surrounding environment and dynamically adjust the vehicle’s speed.
- A Nano Controller serves as the central processing unit, analyzing data from the sensors and controlling the Driver Board, which regulates the speed of Gear Motors. The system also includes an LCD Display for real-time status updates and Serial Communication for external data exchange, making it adaptable for various applications, including
autonomous vehicles and industrial automation.
- By automating the speed regulation process and integrating obstacle detection, this system aims to reduce human errors, enhance reaction time, and improve overall road safety. The implementation of such an embedded system can play a crucial role in
developing smart and safe transportation technologies for the future.

- Furthermore, the system can be enhanced with artificial intelligence or machine learning algorithms to optimize braking efficiency based on traffic conditions and driving patterns. By providing a real-time, intelligent braking solution, this system minimizes the risk of accidents, making transportation safer and more reliable.

II. LITERATURE REVIEW

The development of automatic speed braking time demand based embedded systems has gained significant attention in the automotive industry, focusing on enhancing vehicle safety through real-time control of braking systems. These systems use embedded controllers to calculate the time required for a vehicle to decelerate safely based on its current speed, road conditions, and the distance to an obstacle. Key research in this area, such as that by George et al. (2015), discusses the integration of Time-to-Collision (TTC) and Time-to-Stop (TTS) algorithms to determine the braking demands, while studies like those by Cao et al. (2018) focus on automatic emergency braking (AEB), which uses sensor data to detect imminent collisions and trigger braking actions. Embedded systems incorporate various sensors, including radar, LIDAR, and cameras, to collect data, and use algorithms such as PID controllers and fuzzy logic to process these inputs in real-time. Additionally, machine learning techniques have been applied to predict braking time demands more accurately, with Zhang et al. (2022) demonstrating how machine learning can enhance system performance by learning from dynamic driving environments. However, challenges remain, such as ensuring system response times are fast enough to avoid accidents and adapting to varied environmental conditions like road surface changes or weather. Despite these obstacles, the integration of vehicle-to-vehicle (V2V) communication and continuous advancements in sensor fusion are expected to further improve the reliability and accuracy of automatic braking systems, leading to safer and more efficient driving experiences.

III. EXISTING SYSTEM

The existing transportation system primarily relies on manual speed control and braking mechanisms, where drivers are solely responsible for adjusting speed and applying brakes based on their perception and reaction time. This approach often leads to delayed responses in critical situations, increasing the risk of accidents, especially due to overspeeding. While conventional vehicles are equipped with speedometers to display speed, they lack an automated system for real-time speed regulation based on environmental conditions or obstacles. Additionally, traditional braking systems do not incorporate real-time obstacle detection, making collision prevention highly dependent on human judgment. Furthermore, current vehicles do not monitor environmental factors such as temperature and humidity, which can impact road conditions and vehicle performance. The absence of smart integration with external monitoring systems further limits the ability to enhance safety through automated decision-making. Given these limitations, there is a need for an Automatic Speed Braking Time Demand Based Embedded System that can dynamically adjust vehicle speed, detect obstacles in real time, and incorporate environmental awareness to improve overall road safety and efficiency.

IV. PROPOSED METHODOLOGY

- The Automatic Speed Braking Time Demand Based Embedded System is designed to enhance vehicle safety by incorporating real-time obstacle detection, environmental monitoring, and automated speed regulation. This system integrates a DHT11 sensor to continuously monitor environmental parameters such as temperature and humidity, which can influence vehicle performance and road conditions. A Nano Controller (microcontroller) processes sensor data and makes intelligent braking decisions, ensuring timely speed adjustments based on predefined thresholds. The system also features a Driver. Board that controls Gear Motors, allowing smooth and automatic braking when obstacles are detected.

- To provide real-time feedback, an LCD Display is incorporated to display speed adjustments and environmental conditions, helping the driver stay informed about the vehicle's operational status. Additionally, Serial Communication enables seamless data exchange with external monitoring systems, ensuring integration with smart transportation networks and industrial automation. By automatically adjusting speed and applying brakes when necessary, this embedded system reduces collision risks, improves driver response time, and enhances overall road safety. The proposed system is ideal for implementation in smart vehicles, autonomous transportation, and industrial automation, making road travel safer and more efficient.

V.BLOCK DIAGRAM

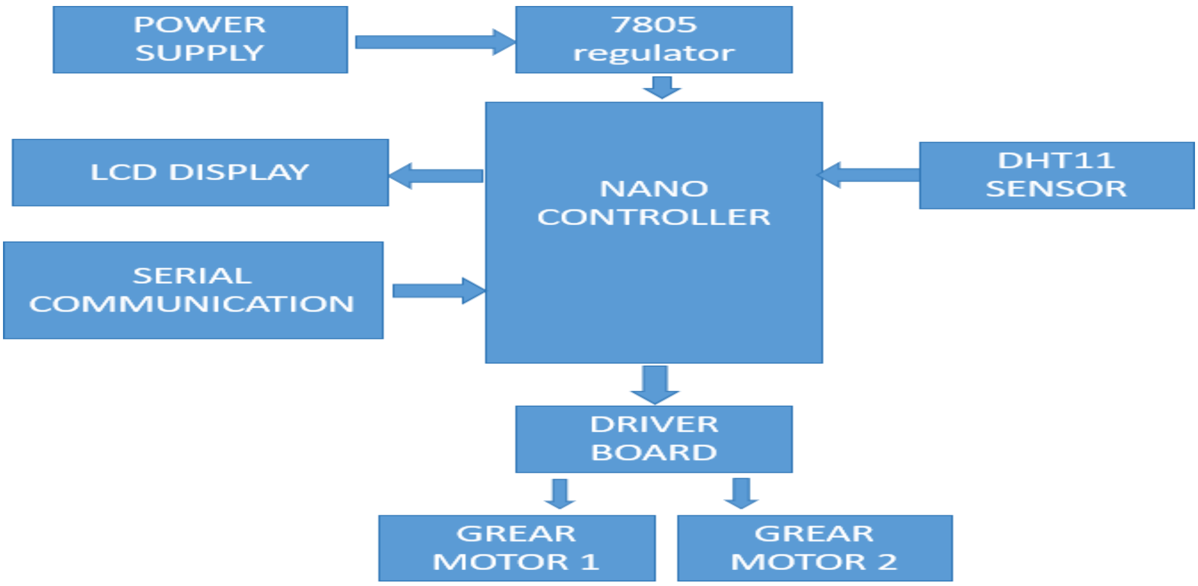

Fig : Block diagram

The block diagram represents an embedded system based on a **Nano Controller**, which serves as the central processing unit. The system receives power from a **power supply**, which is regulated by a **7805 voltage regulator** to ensure a stable 5V output for the components. The **DHT11 sensor** collects temperature and humidity data and sends it to the nano controller for processing. The **LCD display** is used to present real-time data, making it easier for users to monitor system performance. Additionally, **serial communication** enables data exchange with external devices such as computers or microcontrollers. The nano controller also controls two **gear motors** through a **driver board**, which acts as an interface to handle the power requirements of the motors. This setup is commonly used in automation systems, IoT applications, or robotics projects for environmental monitoring and control. However, the diagram contains a small spelling error—"Grear Motor" should be corrected to "Gear Motor."

VI. ADVANTAGES

- The system automatically adjusts vehicle speed and applies brakes when necessary, reducing the risk of accidents caused by overspeeding or delayed human response.
- The integration of obstacle detection technology ensures timely braking and speed adjustments, preventing collisions with objects or other vehicles.
- The DHT11 sensor monitors temperature and humidity, allowing the system to adapt to varying environmental conditions for improved vehicle performance and safety.
- The microcontroller processes sensor data and intelligently controls speed based on predefined thresholds, eliminating reliance on human judgment alone.

VII. APPLICATIONS

An **Automatic Speed Braking Time Demand-Based Embedded System** enhances safety and automation by controlling braking based on speed and time parameters.
Applications:

- **Automotive:** Emergency braking, adaptive cruise control, hill descent control.
- **Railways:** Automatic train braking, collision avoidance.
- **Industrial Automation:** Conveyor belt speed control, robotic machinery braking.
- **Smart Traffic:** Intelligent signals, toll booth speed regulation.
- **Aerospace:** Autonomous landing systems, drone speed control.
- **Heavy Vehicles:** Braking for trucks, buses, and construction equipment.
- **Electric Vehicles (EVs):** Regenerative braking, self-driving car automation.

This system is widely used in transportation, automation, and safety-critical applications.

VIII. RESULTS

The implementation of the Automatic Speed Braking Time Demand Based Embedded System has demonstrated significant improvements in vehicle safety by integrating real-time obstacle detection and automatic braking. The system effectively detects obstacles using ultrasonic sensors and processes the data through a microcontroller to trigger the braking mechanism instantly. This eliminates human reaction time delays and ensures immediate braking response, reducing the chances of collisions. The system performs efficiently in various driving conditions, including low visibility scenarios such as fog, rain, or nighttime driving, making it a reliable safety solution. Additionally, the seamless integration of embedded technology ensures smooth communication between the sensors, speed monitoring unit, and braking mechanism for optimal performance. The system also has the potential for further enhancement through artificial intelligence and machine learning, allowing for adaptive braking based on real-time traffic patterns and driver behavior. Overall, this cost- effective and intelligent braking solution significantly improves road safety by minimizing accidents and enhancing vehicle control in critical situations.

XI.CONCLUSION

The Automatic Speed Braking Time Demand Based Embedded System provides a real-time, intelligent braking solution that significantly enhances vehicle safety. By integrating ultrasonic sensors, a speed monitoring unit, and a microcontroller, the system effectively detects obstacles and applies brakes automatically, minimizing human reaction time delays and preventing collisions. The system operates efficiently in various driving conditions, including low visibility scenarios, ensuring reliable performance. Additionally, the potential integration of artificial intelligence and machine learning can further optimize braking efficiency based on real-time traffic patterns and road conditions. This cost-effective and autonomous braking mechanism offers a practical approach to reducing accidents and improving road safety. By minimizing the risks associated with human errors, the proposed system serves as a reliable and advanced safety solution for modern vehicles, making transportation safer and more secure.

X.FUTURE SCOPE

1. AI and Machine Learning Integration

Artificial intelligence and machine learning can enhance predictive braking by analyzing real-time road conditions, vehicle speed, and driver behavior. AI-driven braking systems will be able to anticipate obstacles and apply brakes efficiently, reducing accidents and improving vehicle safety.

2. Role in Autonomous Vehicles

As self-driving technology advances, automatic braking will become a crucial component of autonomous vehicles. Smart braking systems will help self-driving cars navigate safely, avoid collisions, and adapt to traffic conditions dynamically.

3. IoT and Smart Traffic Systems

With the rise of IoT, braking systems can be integrated with **Vehicle-to-Everything (V2X) communication** to interact with traffic signals, road sensors, and other vehicles. This will improve traffic flow, reduce congestion, and enhance road safety.

4. Application in Railways and Metro Systems

Automatic braking in high-speed trains and metro systems can prevent collisions, ensure precise station stopping, and improve passenger safety. AI-based braking solutions can also optimize fuel efficiency and reduce maintenance costs.

5. Energy-Efficient Braking Solutions

Regenerative braking, commonly used in electric vehicles, can be further optimized to convert kinetic energy into electrical energy, improving battery life and energy efficiency. This will contribute to the advancement of sustainable transportation.

6. Aerospace and Drone Technology

In aviation, automatic braking can assist in autonomous landings and emergency braking for aircraft. Drones with intelligent braking systems will improve precision in navigation and obstacle avoidance, making them more reliable for delivery and surveillance applications.

7. Industrial and Robotics Advancements

Automatic braking can enhance safety in **automated warehouses, conveyor systems, and robotic arms**, preventing accidents and ensuring smooth operations in industrial environments. This will lead to improved efficiency and reduced operational risks.

8. Government Regulations and Safety Standards

With increasing safety concerns, governments are expected to mandate automatic braking systems in commercial and passenger vehicles. This will lead to standardized safety protocols and encourage further research and innovation in braking technology.

X.REFERENCES

1. Ajay S., Govind G., Dharmendhar S., Parthasarathy J. “Automatic Speed Breaker on Time Demand using Embedded Systems.”International Journal of Engineering Research & Technology (IJERT), Vol. 8, Issue 4, 2019.

2. Muhammad Arsalan, Faraz Akbar. “An Ultrasonic Sensor Based Automatic Braking System to Mitigate Driving Exhaustion During Traffic Congestion.”

3. Varshit S. Dubey, Ruhshad Kasad, Karan Agrawal. “Autonomous Braking and Throttle System: A Deep Reinforcement Learning Approach for Naturalistic Driving.” arXiv preprint arXiv:2008.06696, 2020.

4. Hyunmin Chae et al. “Autonomous Braking System via Deep Reinforcement Learning.” arXiv preprint arXiv:1702.02302, 2017.

5. Muhammad Waqas Ashraf, Ali Hassan, Imad Ali Shah. “V-CAS: A Realtime Vehicle Anti-Collision System Using Vision Transformer on Multi-Camera Streams.” arXiv preprint arXiv:2411.01963, 2024.

6. Ajay P. Dhawan et al. “Automatic Braking System Using Ultrasonic Wave.” International Journal for Research in Applied Science and Engineering Technology (IJRASET), 2022.

7. Li J. et al. “Electro-Mechanical Brake System Architectural Design and Analysis Based on Functional Safety of Vehicles.” Micromachines, Vol. 13, Issue 9, 2022.

8. Zhang et al. “A Review of Electro-Mechanical Brake (EMB) System: Structure, Control and Application.” Sustainability, Vol. 15, Issue 5, 2023.

9. Andreas A. Malikopoulos et al. “Optimal Control for Speed Harmonization of Automated Vehicles.” arXiv preprint arXiv:1611.04647, 2016.