SURAKSHITHA CHALANE- SMART VEGA NIYANTRANA PRANALIKE

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Keywords:

Speed Control, Road Safety, AI in Vehicles, Sensor-Based System, Intelligent Driving.

Introduction/Background:

With the rise of traffic and frequent cases of over speeding on highways, road safety has become a serious concern. Despite clear speed limits, many drivers unintentionally or intentionally exceed them, leading to accidents and fatalities. Over-speeding reduces the driver's reaction time and increases the severity of accidents. To address this, there is a growing need for intelligent systems that can intervene when speed limits are violated. This project introduces an AI-powered sensor-based speed regulation system for vehicles. The system uses road-side sensors and smart algorithms to detect speed limit zones in real time. Once a speed limit is detected, the system automatically adjusts the throttle of the vehicle to match the permitted speed. The transition in speed is done gradually to avoid discomfort or instability. It ensures that the vehicle slows down progressively as it passes through regulated zones.

Manual control is still possible in case of emergencies when the driver presses the brake, control is handed back. However, the vehicle will still not be allowed to exceed the predefined limit. A user-friendly mobile interface displays alerts and speed status to the driver. Data from the vehicle's performance is stored for future safety analysis and improvements. This sensor-based AI system not only improves driver awareness but also reduces human error. It ensures smoother, safer, and smarter traffic flow, especially in accident-prone zones and highways. With proper implementation, this technology can drastically reduce road accidents and save lives. This innovation can significantly enhance road safety and contribute to the development of intelligent transport systems across the country.

Objectives:

- To Integrate sensors to monitor vehicle speed and road conditions in real time. By Using innovative AI algorithms to automatically manage speed.
- It Allow drivers to retain manual control when necessary and maintain the respected limit. By Developing a mobile app that provides instant feedback on speed limits and system controls.
- By Gathering data to continually improve the system and using insights to inform traffic safety strategies.

Methodology:

We began the project by researching existing traffic safety technologies and identifying current challenges related to speeding. This allowed us to define the core requirements and goals of the system. Following this, we selected and integrated appropriate sensors capable of detecting vehicle speed and environmental conditions in real-time. These sensors were connected to a central control system.

We then developed a sample AI algorithms to analyse incoming sensor data and control the vehicle’s throttle automatically. The algorithms were programmed to detect when the vehicle exceeded speed limits and to apply corrective actions instantly. Alongside this, we designed and developed a user-friendly mobile application to provide real-time feedback to drivers, showing speed limit notifications and allowing for manual control settings.

Then we will be integrating the system to conduct a test in both controlled and real-world environment to verify its reliability and performance. We will also collect user feedback during testing which will help us make key adjustments to improve system responsiveness.

Results & Conclusions:

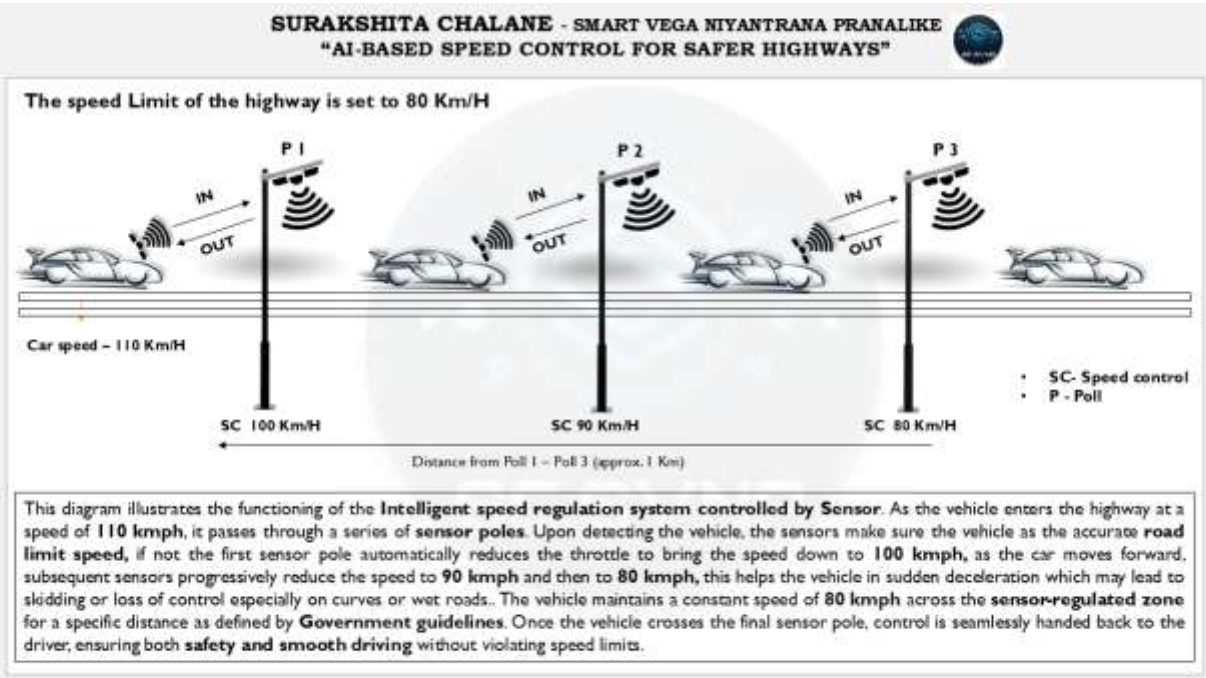
The prototype successfully demonstrated automatic speed adjustment based on sensor input. The AI module accurately detected speed limit signs using camera-based recognition and processed the data in real time. Once the speed limit was identified, the system adjusted the vehicle's throttle smoothly, ensuring the vehicle complied with the zone's prescribed speed. The deceleration process was executed gradually, enhancing passenger comfort and vehicle stability. The use of sensor poles to regulate speed step-by-step proved effective in reducing the vehicle's speed from high-speed entry (e.g. 110 kmph) down to a safe level (e.g. 80 kmph) over multiple checkpoints. Manual override was also tested by pressing the brake pedal. As expected, the system allowed immediate manual control while still preventing any speed beyond the enforced limit. This ensured both safety and flexibility in emergency conditions. The mobile app interface displayed accurate, real-time updates regarding the current speed, upcoming speed zones, and system status. Drivers were well-informed throughout the process, improving awareness and reducing reliance on manual speed monitoring. Testing was conducted under various scenarios, including day and night conditions, wet surfaces, and simulated traffic zones. In each case, the system responded reliably, reinforcing its adaptability. Overall, the results showed that the prototype significantly enhances driver compliance with speed limits and helps prevent over speeding-related incidents. The project validates the feasibility of integrating AI, sensor systems, and vehicle control mechanisms to create a safer highway experience. This system has the potential to play a major role in next-generation intelligent transport systems and traffic enforcement frameworks.

Project Outcome & Industry Relevance:

This project delivers a functional and practical model of intelligent vehicle speed control using AI and sensor-based automation. It addresses a real-world problem over speeding on highways by offering a smart solution that can be implemented across various sectors. The system combines multiple technologies, including sensor integration, AI-based decision-making, real-time data processing, and vehicle control. Its application is especially relevant in the transportation, automotive, and smart mobility sectors. Automotive manufacturers can adopt this system to enhance the safety features of their vehicles, particularly in high-speed zones. It aligns with the growing demand for driver-assist and autonomous systems, making it a strong candidate for integration into semi-autonomous and autonomous vehicles. Traffic enforcement agencies can use this system as part of smart city infrastructure to enforce speed limits dynamically without physical intervention. It can also be deployed in public transport and logistics fleets to ensure compliance and minimize human error. The project supports data logging and analytics, providing authorities with insights into speed compliance, accident-prone zones, and traffic behaviour.

Working Model vs. Simulation/Study:

Working Model (developed using sensors, microcontroller, and throttle simulation system)



Project Outcomes and Learnings:

- Built a real-time speed regulation system for vehicles.
- Learned about embedded systems, AI integration, and sensor communication.
- Understood practical challenges in hardware-software interfacing.
- Gained insights into traffic safety systems and driver behaviour.

Future Scope:

The project has strong potential for future enhancements and real-world deployment. One of the key areas of development is the integration of **GPS-based zone mapping**, which will enable automatic speed regulation based on location-specific rules, such as school zones, accident-prone areas, or residential neighbourhoods.

The system can also be linked to **real-time traffic databases** for dynamic speed limit updates, adapting instantly to temporary changes like roadwork, diversions, or emergency zones. This would make the system more responsive and aligned with smart city frameworks.

Voice alerts, **visual cues**, and **haptic feedback** can be added to improve driver interaction and awareness, especially in noisy or high stress driving environments. To further improve safety, a **machine learning model** could be used to better recognize worn-out or obscured road signs, including regional language variations.

A **cloud-based dashboard** can be developed for centralized monitoring by traffic departments or fleet operators. This can help in analysing speed compliance trends, accident hotspots, and overall driving behaviour analytics.

Additionally, the system can be customized for **different vehicle types**, including electric vehicles (EVs), heavy transport vehicles, and even two-wheelers with digital systems. It may also be integrated with **V2X (Vehicle-to-Everything)** communication in future mobility networks.

Pilot testing can be conducted in collaboration with government agencies, transport authorities, or logistics companies to validate the system in real-world traffic conditions. The model could be modularized for easy deployment across both new and existing vehicles, making it an accessible and scalable solution for improving road safety nationwide.

Overall, the future scope of this project is vast, and with continued innovation, it has the potential to contribute meaningfully to next-generation intelligent transport systems.