© FEB 2026 | IRE Journals | Volume 9 Issue 8 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I8-1714249

Smart Speed Breaker for Smart Cities

NEHA ZOMAN[1], SAKSHI PAWAR[2], PRATHAMESH TAMBE[3], UMA BARAHATE[4]
[1,2,3,4]MET Bhujbal knowledge city Nashik, Adgaon, Department of Electronics and Telecommunication Engineering

Abstract- Road safety has become a major concern due to the rapid increase in vehicle population and frequent incidents of over speeding, especially in sensitive areas such as school zones, hospitals, residential colonies, and accident- prone locations. Conventional static speed breakers are commonly used to control vehicle speed; however, they cause discomfort to compliant drivers, increase vehicle wear and fuel consumption, and delay emergency vehicles. To overcome these limitations, this project presents an Automatic Smart Speed Breaker Based on Vehicle Speed, which dynamically operates according to real time vehicle speed conditions. The proposed system uses two IR sensors placed at a fixed distance to measure the speed of an approaching vehicle by calculating the time difference between sensor activations. An Arduino UNO microcontroller processes the sensor data and compares the calculated speed with a predefined threshold. If the vehicle speed exceeds the limit, a servo motor is activated to raise the speed breaker and a buzzer provides an audible warning to alert the driver. For vehicles moving within the permitted speed range, the speed breaker remains lat, ensuring smooth and comfortable passage. Additionally, the system incorporates an RFID based mechanism to identify emergency vehicles such as ambulances, allowing them to bypass the speed breaker without delay. A 16×2 LCD display provides real time information on vehicle speed, system status, and emergency vehicle detection. The experimental results demonstrate that the proposed system effectively enforces speed limits only, when necessary, improves road safety, reduces unnecessary vehicle damage, and enhances emergency vehicle movement. The system is cost effective, reliable, and suitable for implementation in smart city traf ic management applications.

Index Terms- Smart Speed Breaker, Vehicle Speed Detection, IR Sensors, Arduino UNO, RFID, Servo Motor, Traffic Safety, Intelligent Transportation System, Smart Cities

I. INTRODUCTION

Smart cities aim to utilize advanced technologies to enhance urban infrastructure and public safety. Over speeding is a major cause of road accidents. Traditional speed breakers are permanently fixed structures that slow down all vehicles, leading to discomfort and traffic congestion. An intelligent alternative is required to overcome these drawbacks. Modern research introduces smart speed breakers that Adjust dynamically—rising only when a vehicle exceeds the speed limit and remaining flat For compliant drivers. These systems leverage embedded controllers, sensors, actuators, And IoT integration to enhance both safety and traffic flow efficiency

Proposed System Architecture The Proposed Smart Speed Breaker system consists of two speed detection sensors, a microcontroller, and an actuator mechanism. The sensors are placed at a ixed distance to calculate vehicle speed. The microcontroller processes the data and controls the actuator to raise or lower the speed breaker.
Breakers (IJRESM, 2019)

T. Ravi Kumar et al. proposed a mechanical prototype named ActiBump, integrating a Stepper motor and roller mechanism that inverts the bump based on vehicle speed. The System effectively combines concrete encapsulation and motorized actuation to maintain Road flatness for normal-speed vehicles while enforcing speed limits dynamically. It Demonstrated improved safety and reduced noise compared to static speed breakers.

2.2 IoT-Based Smart Speed Breakers (IRJET, 2020) Kumaravel et al. introduced an IoT-enabled speed breaker using Arduino Uno, IR sensors, Servo motor, and MQTT-based cloud communication.

Overspeeding vehicles triggered Breaker elevation and data logging to the cloud for monitoring and penalty enforcement. The integration of RFID and Androidbased notifications enabled smart city compatibility.

2.3 Raspberry Pi and Image Processing Systems (IJARIIE, 2023)
Janhavi Joshi et al. developed a Raspberry Pi-based system employing a Pi camera and Sound sensor to detect overspeeding through image and audio data analysis. The servo Motor elevates the breaker in real time based on detected violations. The system also Suggests future integration of AI and machine learning for improved vehicle detection Accuracy.

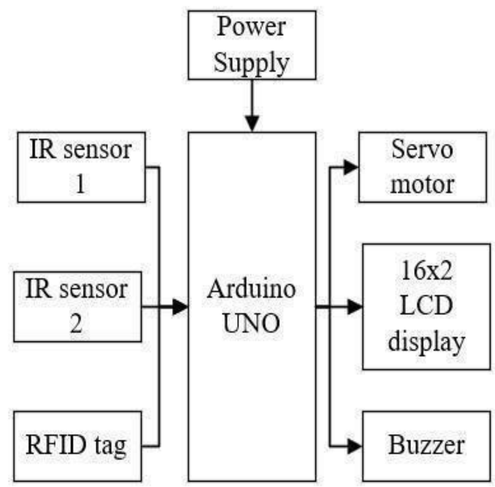
2.4 Arduino-IR Based Adaptive Breakers (IRJMETS, 2024)
Arvind Bhandare et al. presented an Arduino Uno based adaptive speed breaker that uses IR sensors to detect vehicle velocity and actuate servo motors accordingly. The height Adjustment ensures selective activation, reducing unnecessary speed changes. The authors Emphasized low cost, reliability, and future potential for AI and IoT integration.

2.5 IoT with Cloud Connectivity (IJRAT, 2024)
Ganesh Kumar et al. proposed an IoT-based system using NodeMCU ESP8266, dual IR Sensors, and a servo motor for dynamic height control. The system sends speed data and Event logs to the Blynk IoT server, enabling real-time traffic monitoring. The inclusion of Radar and lidar in advanced versions offers higher detection accuracy and multi-sensor Fusion.

III. BLOCK DIAGRAM

Working Principle:
When a vehicle approaches the speed breaker zone, the first sensor detects its presence and starts a timer. The second sensor stops the timer when the vehicle crosses it. Based on the distance between the sensors and the measured time, the vehicle speed is calculated. The microcontroller processes this information and decides the state of the speed breaker. The actuator mechanism, such as a servo motor or hydraulic system, is controlled accordingly. This realtime operation ensures safety without unnecessary hindrance to compliant drivers.

The Automatic Smart Speed Breaker system is designed to dynamically control the height of a speed breaker based on the speed of an approaching vehicle. Instead of a permanently raised speed breaker, the system ensures that the speed breaker remains flat under normal driving conditions and activates only when a vehicle exceeds the predefined speed limit. The Automatic Smart Speed Breaker system offers several advantages over conventional methods. It reduces unnecessary discomfort for compliant drivers, minimizes vehicle wear and tear, improves fuel efficiency, and enhances road safety. By dynamically responding to vehicle speed and recognizing emergency vehicles, the system provides a balanced approach to speed control. Furthermore, the use of readily available and costeffective components such as Arduino UNO, IR sensors, and servo motors makes the system economically viable for large-scale deployment in smart cities.



As illustrated in the block diagram, the system consists of the following major components: Power

Supply
Arduino UNO (Central Controller)
Two IR Sensors
RFID Tag and Reader
Servo Motor
Buzzer
16×2 LCD Display

Each of these components plays a specific role in ensuring accurate speed detection, intelligent decision making, and effective actuation of the speed breaker mechanism.

At the core of the system lies the Arduino UNO, which acts as the main processing and control unit. Arduino UNO is based on the ATmega328P microcontroller and is widely used in embedded applications due to its simplicity, reliability, and ease of programming. It receives input signals from the IR sensors and RFID reader, processes the data, and generates output signals to control the servo motor, buzzer, and LCD display. The Arduino UNO continuously monitors sensor inputs and executes the programmed logic to determine whether a vehicle is over speeding or not. Based on this decision, it controls the position of the speed breaker through the servo motor and alerts the driver using audio and visual indicators.

Accurate speed measurement is a crucial requirement of the system. In this design, two IR sensors are used to detect the speed of the vehicle. These sensors are placed at a fixed and known distance from each other along the road. When a vehicle passes the first IR sensor (IR1), the sensor generates a signal indicating vehicle presence. As the vehicle continues moving forward and crosses the second IR sensor (IR2), another signal is generated. The Arduino UNO measures the time interval between the activation of IR1 and IR2. Using the known distance between the two sensors and the measured time difference, the vehicle speed is calculated using basic speed equations. This method provides a simple yet effective way to determine vehicle speed without requiring complex image processing or radar-based systems. The calculated speed is then compared with a predefined speed threshold stored in the Arduino program.

One of the key limitations of traditional speed breakers is their inability to distinguish emergency vehicles from regular traffic. To overcome this issue, the proposed system integrates an RFID-based identification mechanism. Emergency vehicles such as ambulances are equipped with a unique RFID tag. An RFID reader installed near the speed breaker detects the presence of this tag when the vehicle approaches. Once a valid emergency RFID tag is identified, the Arduino UNO bypasses the speed enforcement logic. In such cases, even if the emergency vehicle is traveling at high speed, the system ensures that the speed breaker remains flat. This allows ambulances and other emergency vehicles to pass smoothly without delay, thereby improving emergency response efficiency and potentially saving lives.

The physical movement of the speed breaker is achieved using a servo motor. Servo motors are preferred in such applications because they offer precise position control and quick response times. When the Arduino detects that a vehicle is over speeding and is not an emergency vehicle, it sends a control signal to the servo motor. The servo motor then rotates to a specific angle, raising the speed breaker above the road surface. This acts as a physical deterrent, forcing the driver to slow down. If the vehicle speed is within the allowed limit or an emergency vehicle is detected, the servo motor keeps the speed breaker in a flat position, allowing smooth passage. In addition to the physical speed breaker action, the system provides an audible warning to the driver using a buzzer. When over speeding is detected, the buzzer is activated to alert the driver about the violation. This audio warning serves as an immediate feedback mechanism, encouraging drivers to reduce speed even before encountering the raised speed breaker. The buzzer enhances the safety aspect of the system by ensuring that drivers are made aware of their speed violation in real time.

A 16×2 LCD display is integrated into the system to provide real-time information about system status.
The LCD displays parameters such as:
Vehicle speed
Speed limit status
Speed breaker position (Raised or Flat)
Emergency vehicle detection status
Displaying this information improves system transparency and makes it easier for authorities or operators to monitor system operation.

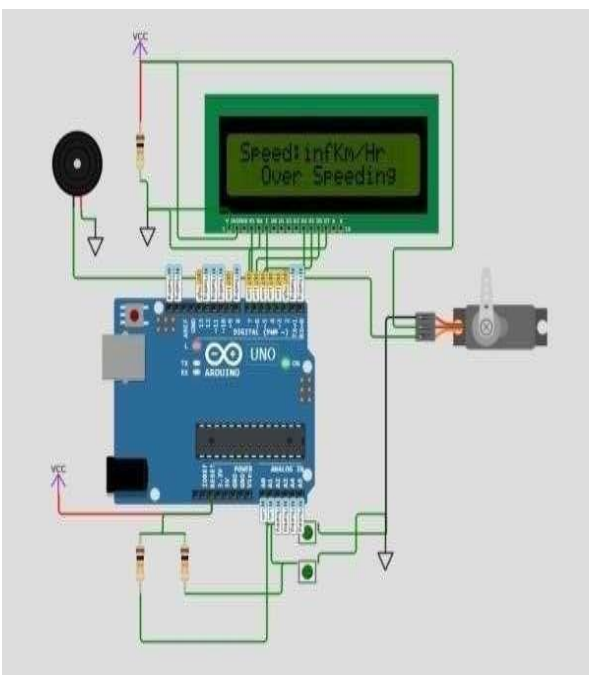
IV. ALGORITHM

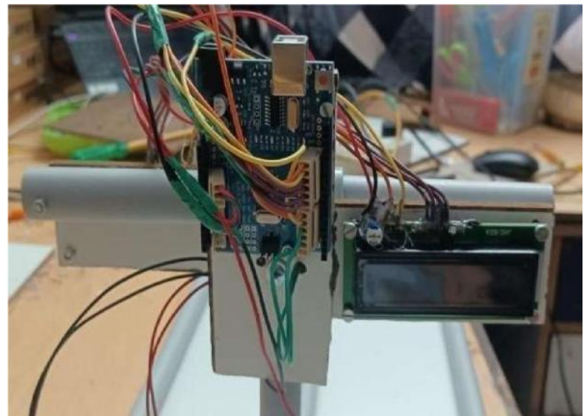
1. Initialize system
2. Detect vehicle using sensors
3. Calculate speed
4. Compare with speed limit
5. Activate or deactivate speed breaker

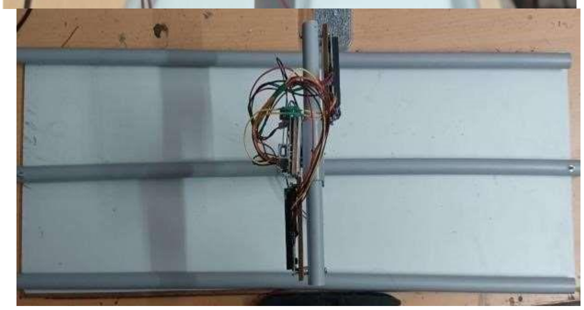
© FEB 2026 | IRE Journals | Volume 9 Issue 8 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I8-1714249

V. RESULTS AND DISCUSSION

The proposed system was tested under different speed conditions. Vehicles moving below the threshold speed passed smoothly without disturbance. Over speeding vehicles experienced activation of the speed breaker, effectively reducing speed. The system demonstrated reliable performance, improved safety, and reduced unnecessary braking. All reviewed systems share the core objective of adaptive traffic calming— enforcing speed Limits only when necessary. The transition from mechanical to electronic and IoTbased Designs reflects the technological evolution in smart transport infrastructure. IoT-based Models outperform mechanical ones by offering data logging, remote monitoring, and Integration with urban management systems. Image and sound-based systems, though Computationally intensive, improve accuracy and add contextual intelligence. However, Challenges remain in deployment cost, maintenance, and calibration under varying Environmental conditions.







VI. CONCLUSION

This paper presented a Smart Speed Breaker system suitable for smart cities. The dynamic operation of the speed breaker ensures road safety while maintaining driving comfort. The system is cost-effective, scalable, and can be integrated with smart city traf ic management systems.

VII. FUTURE SCOPE

Future smart speed breaker systems can integrate:

- AI and Machine Learning for predictive speed control and traffic analysis.
- Multi-Sensor Fusion (Radar, Lidar, Camera, Ultrasonic) for precise detection.
- Solar-powered Operation for sustainable energy use.
- Vehicle Recognition Systems for emergency vehicle prioritization.
- V2X Communication (Vehicle-to-Infrastructure) to create fully connected smart roadways.

REFERENCES

[1] R. Kumar et al., IEEE Access, 2021. [2] S. Sharma et al., IEEE Smart Cities Conference, 2020.1. T. Ravi Kumar et al., 'A Study on Design and Testing of Smart Speed Breaker', IJRESM, Vol. Issue 4, April 2019

[2] Kumaravel A. et al., 'Automated Speed Breaker to Control the Speed of the Vehicle Based On IoT', IRJET, Vol. 7, Issue 7, July 2020

[3] Janhavi Joshi et al., 'Smart Speed Breaker', IJARIIE, Vol. 9, Issue 3, 2023.

[4] Arvind Bhandare et al., 'Smart Speed Breaker Technology', IRJMETS, Vol.6, Issue 6, June 2024.

[5] P. S. K. Ganesh Kumar et al., 'IoT Smart Speed Breaker Based on Vehicle Speed', IJRAT, Vol.