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# IoT-Enabled Smart Overspeed Vehicle Detection Systems for Road Safety Applications

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**ABSTRACT:** Speeding remains a leading factor in road accidents globally. This paper examines **IoT-enabled smart overspeed vehicle detection systems** developed up to and around 2018 for enhancing road safety. Key among early innovations is the **Automatic Speed Surveillance and Vehicle Alerting System Using IoT**, introduced in 2018, which implements a real-time autonomous monitoring architecture using RFID tags, Wi-Fi, and a controller to detect and alert on speed violations without disrupting traffic flow Science Publishing Corporation. The system autonomously logs overspeed incidents, facilitating effective enforcement. Complementing this is a 2018 prototype from **Paras Sandip Waykole et al.**, featuring a smart vehicle system that employs hall-effect sensors to record speed and GPS coordinates, storing data in the cloud for later analysis of overspeed statistics IJARIIT.

Together, these IoT-based systems demonstrate early trends: real-time detection, automated alerting, and cloud-enabled data logging. This paper synthesizes their architectures, detection mechanisms, and data workflows, assessing efficacy in improving safety and law enforcement responsiveness. The analysis reveals strengths—instant alerts, scalable monitoring, reduced human intervention—and weaknesses—sensor accuracy, infrastructure dependency, and privacy concerns.

We propose a refined **IoT architecture** combining **on-board units**, **roadside gateways**, and commercial communication protocols—drawing inspiration from broader Internet-of-Vehicles (IoV) frameworks (i.e., OBU, RSU, cloud structure) Wiley Online Library. Through comparative evaluation of 2018 prototypes and this conceptual design, the findings offer actionable recommendations for deploying smart overspeed detection systems. The study concludes that IoT-based systems from the 2018 era laid a solid foundation for intelligent, scalable overspeed enforcement, marking an important leap toward safer, data-driven roads.

**KEYWORDS:** IoT, Overspeed Detection, Vehicle Speed Surveillance, Road Safety, Smart Vehicle System, Internet of Vehicles

## I. INTRODUCTION

Speeding contributes massively to road fatalities and injuries worldwide. Traditional enforcement tools like speed cameras and radar systems are often static, costly, and limited in responsiveness. By 2018, the emerging **Internet of Things (IoT)** promised transformative solutions—enabling connected sensors, automated monitoring, and real-time response in traffic enforcement.

In 2018, Athira Gopal et al. introduced an **Automatic Speed Surveillance and Vehicle Alerting System** using IoT, integrating RFID, Wi-Fi, and controllers to autonomously detect and report overspeed violations Science Publishing Corporation. Simultaneously, Waykole et al. developed a **Smart Vehicle System for Over-Speeding Detection**, leveraging hall-effect sensors and GPS data uploaded to the cloud for analytics and reporting IJARIIT. Both systems illustrate early adoption of IoT platforms for proactive, real-time speed monitoring.

These innovations share a common architecture: in-vehicle or roadside sensing units, connected via network protocols to cloud or control centers for alerts and data storage. This contrasts with earlier analog or manual methods by offering richer data granularity, continuous monitoring, and integration potential with broader **Internet of Vehicles (IoV)** frameworks Wiley Online Library.

This paper aims to contextualize these 2018 systems:

1. **Architectural Analysis**: Dissect their sensing, communication, and alert mechanisms.
2. **Performance Evaluation**: Assess real-time responsiveness, accuracy, and law enforcement integration.
3. **IoT Integration**: Explore potential enhancements through IoV concepts (OBU, RSU, cloud).

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4. **Safety Impact**: Consider how these systems improved detection coverage, reduced violations, and supported road safety.

By retrospectively analyzing 2018 prototypes within a structured IoT architecture, this study illuminates the state of early smart overspeed detection systems and their trajectory toward intelligent transportation systems.

## II. LITERATURE REVIEW

In 2018, research into IoT-based overspeed detection began gaining traction, driven by the need for scalable, automated road safety solutions.

1. **Automatic Speed Surveillance and Vehicle Alerting System (2018)**
   Designed by Gopal et al., this system used **RFID**, **Wi-Fi**, and microcontroller-based controllers to detect overspeed violations and autonomously file reports. It minimized disruption to traffic flow and promoted stricter enforcement without human dependency Science Publishing Corporation.
2. **Smart Vehicle System for Over-Speeding Detection (2018)**
   Waykole et al. presented a smart vehicle architecture using **hall-effect sensors** to measure speed, while **GPS modules** captured location data. Recorded data was uploaded to the cloud for analytics, enabling tracking of overspeed occurrences by time and place—especially useful for parent monitoring two-wheelers and aggregated safety studies IJARIIT.
3. **Broader IoT and IoV System Architectures**
   Later frameworks in related domains depicted **On-Board Units (OBUs)** integrated with **Vehicle-to-Infrastructure (V2I)** communication, **Roadside Units (RSUs)**, and **cloud servers**, facilitating real-time detection and reporting of speed violations using secure IoV protocols Wiley Online Library. Although not from 2018, these architectures show the direction IoT overspeed systems could evolve.
4. **Advantages and Gaps**
   Advantages observed include real-time alerts, continuous data logging, reduced human labor, and flexibility of deployment both onboard and roadside. However, limitations remained: reliance on sensor accuracy, infrastructure complexity, connectivity robustness, security/privacy risks, and lack of standardized communication.

In summary, 2018 literature reflects foundational efforts in crafting IoT-based overspeed detection systems, setting the stage for more integrated, intelligent, and secure vehicle-infrastructure ecosystems in later years.

## III. RESEARCH METHODOLOGY

This study employs a **comparative, design-based methodology** to analyze 2018-era IoT-driven overspeed detection systems and propose refined architectures.

**Case Study Selection**
We analyze two key prototypes from 2018:
*Automatic Speed Surveillance and Vehicle Alerting System*, by Gopal et al. Science Publishing Corporation.
*Smart Vehicle System for Over-Speeding Detection*, by Waykole et al. IJARIIT.

**Architectural Decomposition**
For each system, components are identified:
Sensors (RFID, hall-effect, GPS)
Communication mediums (Wi-Fi, cloud connectivity)
Processing units (controllers, data storage)
Alert/reporting mechanisms (autonomous report filing, cloud dashboards)

**Comparative Matrix Analysis**
**We assess each system on dimensions:**
**Detection accuracy & real-time response**
**Alert and reporting latency**
**Coverage scope (vehicle-based vs. roadside)**
**Scalability and deployment feasibility**
**Data utilization and analytics capability**
**Security and privacy considerations**
**IoT/IoV System Proposal**

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## IV. RESULTS AND DISCUSSION

**Results**

The **Automatic Speed Surveillance System** demonstrated autonomous detection and reporting with minimal traffic disruption, relying on RFID/Wi-Fi and controllers Science Publishing Corporation.

- The **Smart Vehicle System** effectively logged speed and location data in the cloud using hall-effect sensors and GPS, enabling retrospective analysis and parental monitoring IJARIIT.
- **Discussion:**
- **Real-Time Capability vs Data Logging**: Gopal et al.'s system prioritized immediate speed violation alerting, while Waykole et al.'s design focused on logging to support future analysis. Together, these approaches represent complementary strategic goals in overspeed detection.
- **Sensor and Infrastructure Constraints**: Both systems relied on relatively simple sensors (RFID, hall-effect, GPS) and conventional communication (Wi-Fi, cloud). While feasible in controlled settings, they may lack reliability or granularity in varied traffic environments.
- **Scalability and Flexibility**: The vehicle-based system offers scalability through individual deployment but depends on user cooperation. The surveillance architecture points to more centralized detection but may require infrastructure upgrades.
- **Security and Privacy Gaps**: Neither system explicitly addresses data protection, communication security, or privacy. This underscores a key vulnerability in early IoT designs for road safety.
- **Enhanced IoV Architecture Potential**: Integrating OBUs, RSUs, and cloud elements as per IoV models (e.g., V2I communication) could improve detection reliability, enable driver warnings, coordinate across infrastructure, and secure data links Wiley Online Library.

These findings indicate that 2018 IoT prototypes were foundational—demonstrating feasibility—but future systems would benefit from layered architectures, secure communications, and dynamic sensor integration for more robust overspeed detection.

## V. CONCLUSION

This study reviewed IoT-based overspeed detection systems from 2018, highlighting two distinct approaches: real-time alert-driven systems (Gopal et al.) and cloud-logged vehicle monitoring (Waykole et al.). Both prototypes underscore IoT's early role in enhancing road safety through intelligent monitoring and data utilization.

While effective in their domains, these early systems had limitations: simplified sensing, infrastructure dependence, and a lack of security considerations. They nonetheless provided tangible proof-of-concept viability for IoT in overspeed enforcement.

By proposing an enhanced IoV-based architecture incorporating OBUs, RSUs, and secure cloud backends, this paper outlines a strategic progression path to more robust, scalable, and secure overspeed detection systems, marking key steps toward smart, connected road safety infrastructure.

## VI. FUTURE WORK

Promising directions include:

1. **Secure IoT Communication**: Researching encryption, authentication, and privacy-preserving protocols to safeguard driver and vehicle data.
2. **Advanced Sensing Technologies**: Integrating computer vision, edge computing, and machine learning for more accurate speed detection in diverse environments.
3. **Dynamic Speed Regulation**: Building systems that adapt thresholds based on real-time conditions, road geometry, and traffic context.
4. **V2X Integration**: Embedding overspeed detection into broader V2V and V2I communication ecosystems for coordinated safety responses.
5. **Pilot Deployment & Evaluation**: Field testing enhanced architectures across urban and highway contexts to assess impacts on compliance, response time, and accident reduction.

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