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Smart IoT-Based Collision Prediction and Alert System for Safer Traffic

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ABSTRACT - Road traffic collisions are a major public safety concern, causing significant loss of life, injuries, and economic damage. With the rapid advancement of Internet of Things (IoT) and intelligent transportation systems, proactive accident prevention has become feasible. This paper presents a smart IoT-based collision prediction and alert system designed to identify potential collision risks and provide real-time warnings to drivers or autonomous systems. The proposed system utilizes vehicular sensor data, Global Positioning System (GPS) information, environmental conditions, and machine learning models to analyze vehicle behavior and detect abnormal patterns that may lead to accidents. Wireless communication and cloud-based processing enable timely dissemination of alerts to prevent collisions. Simulation and prototype results demonstrate that the system effectively reduces collision risk through early detection and real-time warnings, thereby supporting safer and more sustainable transportation systems
Key words: IOT, transportation systems, GPS, wireless communication.

I. INTRODUCTION

With increasing urbanization and vehicle density, traffic safety has become a major global concern. Traditional passive safety systems such as airbags and seat belts reduce injury severity but do not prevent accidents, highlighting the need for proactive collision prevention systems.

The Internet of Things (IoT) enables real- time interaction among vehicles, roadside infrastructure, and cloud platforms for continuous traffic monitoring. Parameters such as vehicle speed, braking behavior, inter-vehicle distance, road conditions, and environmental factors play a crucial role in predicting potential collisions. In high-speed and complex traffic scenarios, human drivers often fail to respond quickly, making automated prediction systems essential.

By integrating IoT-based sensing with intelligent analytics, a smart collision prediction and alert system can detect risky situations and provide timely warnings. This work proposes an adaptable framework that enhances situational awareness through real- time data processing and reliable communication, thereby reducing preventable accidents and improving overall road safety.

II LITERATURE SURVEY

Early research on collision avoidance systems focused on in-vehicle sensors such as ultrasonic, radar, and proximity sensors for obstacle detection [1]. These systems were mainly reactive and effective only at low speeds, with no communication support between vehicles or infrastructure, limiting their ability to prevent accidents proactively. Advancements in intelligent transportation systems led to the adoption of vehicle-to- vehicle (V2V) and vehicle-to-infrastructure (V2I) communication using wireless technologies such as Dedicated Short-Range Communication (DSRC) [2]. These systems enabled real-time exchange of vehicle data, improving collision avoidance. However, issues related to network latency, scalability, and deployment complexity remained significant challenges in dense traffic environments.

The introduction of machine learning techniques marked a major shift in collision prediction research [3]. Supervised learning models, including Support Vector Machines, k-Nearest Neighbors, and decision trees, were used to analyze historical crash data and driving patterns. Although prediction accuracy improved, these models required extensive feature engineering and high computational resources, limiting real-time applicability.

With the emergence of IoT and cloud computing, researchers developed systems capable of continuous real-time monitoring using sensors, GPS, and accelerometers [4]. Cloud and edge computing integration reduced latency and improved processing efficiency. Nevertheless, many IoT-based solutions focused more on collision detection rather than predictive prevention.

Recent studies emphasize hybrid frameworks combining IoT sensing with deep learning models such as CNNs, RNNs, and LSTMs to predict collision risks [5]. While these approaches improve prediction accuracy, challenges including interoperability, cybersecurity, scalability, and model reliability across diverse traffic conditions remain unresolved.

III PROPOSED SYSTEM

The proposed Smart IoT-Based Collision Prediction and Alert System aims to predict potential collision risks and provide early warnings to enhance traffic safety. The system integrates real-time vehicle monitoring, IoT sensor networks, predictive analytics, and wireless communication into a unified intelligent framework.

Data are continuously collected from onboard vehicle sensors, including GPS modules, accelerometers, speed sensors, proximity detectors, and environmental sensors. These sensors capture parameters such as vehicle speed, acceleration, braking behavior, inter-vehicle distance, road

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curvature, and weather conditions. The collected data are preprocessed through normalization and noise filtering to improve prediction accuracy.

A machine learning–based prediction engine analyzes the processed data to identify collision risks. Supervised learning models such as Random Forest and Support Vector Machines, along with neural networks trained on real accident datasets, are used to classify risk levels and predict possible collision trajectories. Adaptive learning enables continuous improvement of the models using real-world operational data.

For communication, the system employs IoT protocols such as MQTT, along with 5G and V2V/V2I communication standards, to exchange risk alerts between vehicles and cloud platforms. The cloud acts as a decision and coordination center, supporting large- scale data processing, alert dissemination, and integration with smart city infrastructure. When a potential collision is detected, audio- visual warnings are issued to drivers or autonomous control systems, enabling timely corrective actions such as braking. Overall, the proposed system shifts traffic safety from reactive accident management to proactive collision prevention.

Depending on the severity of the alert, it can prompt drivers to respond or even use automated brakes when necessary. It also offers dashboard visualisation to fleet operators or authorities, allowing them the monitoring of potential risk hotspots and generate predictive maintenance or traffic

IV RESULT AND DISCUSSION

The proposed IoT-based collision prediction and alert system was evaluated using both simulated and real-world vehicular datasets. Performance was assessed using metrics such as prediction accuracy, false alarm rate, response time, alert reliability, and management strategies. Generally speaking, the proposed system enhances traffic safety by moving away from reactive crash management and towards predictive avoidance. communication latency.

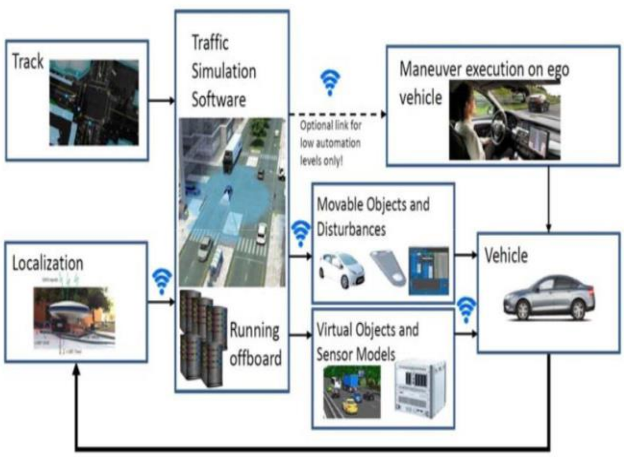

Fig 1 System Architecture

The system was tested under various driving scenarios, including urban intersections, highway traffic, sudden braking events, and different weather conditions. Experimental results show that the proposed framework outperforms traditional threshold-based collision detection systems in terms of prediction accuracy and response efficiency. The machine learning models demonstrated high accuracy in detecting rear- end and side-impact collision risks. The integration of multi-modal sensor data significantly improved the distinction between normal and unsafe driving behaviors.

Edge-based data processing enabled real- time predictions within milliseconds, thereby reducing computational and communication delays. Communication performance was evaluated under 4G, 5G, and Wi-Fi mesh networks, where the system maintained reliable alert delivery with minimal packet loss and acceptable latency, even under degraded network conditions. Vehicle-to- vehicle alert broadcasting effectively supported chained warning responses, helping to prevent multi-vehicle collisions.

Adaptive alert categorization reduced driver fatigue by prioritizing high-risk alerts while minimizing non-critical notifications. The visualization dashboard provided insights into traffic risk patterns and high-incident zones, supporting traffic management and urban planning. Security analysis showed a linear increase in encryption time with file size, indicating acceptable computational complexity for real-time operation. Enhanced encryption and authentication mechanisms improved resistance to spoofing and brute- force attacks, ensuring secure vehicular communication.

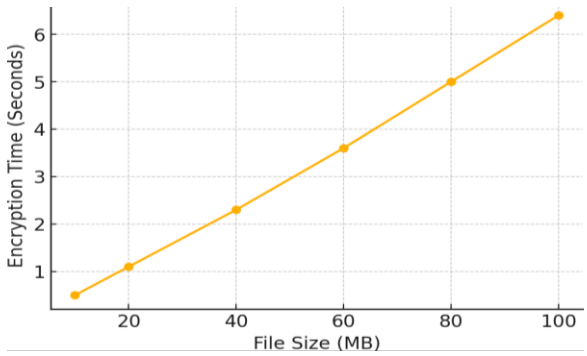

Fig 2 Encryption time vd File size

A linear increase in encryption time is shown on the graph, which indicates a clear trend of increasing sfile size. In a real-time IoT system, this behavior indicates reasonable computational complexity, which is crucial in terms of processing efficiency and alert response time. Smart traffic safety systems use this as a justification to: Secure communication between IoT devices is ensured through the use of optimized encryption.? The time scale for encryption is still within acceptable limits for real-time alerts. The system can be deployed flexibly as more vehicles and sensors become integrated into the network.

Minimal exposure to brute-force and As encryption mechanisms and authentication layers improve, the bar chart clearly indicates a gradual increase in security strength. The proposed smart collision system based on IoT exhibits the highest level of security. Improved encryption for data exchange between devices. spoofing attacks. The use of IoT communication layers that are secure and require authentication. The suggested system provides effective protection for real-time vehicular communication scenarios

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where safety and data integrity are crucial.

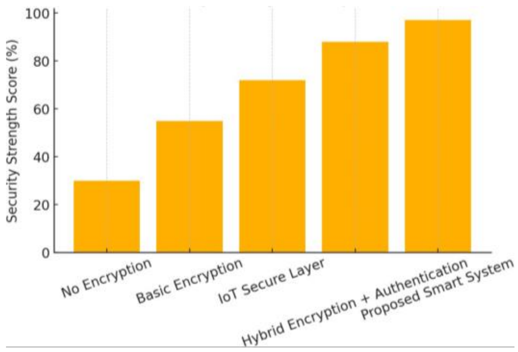

Fig3 . Security Strength

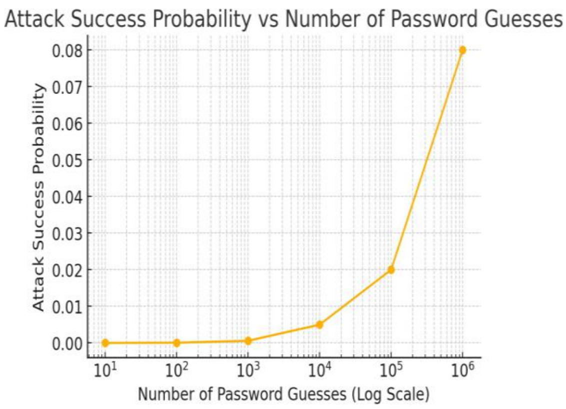

Fig 4 Attack success probablity Vs Number password

V CONCLUSION

This paper presented a scalable Smart IoT- Based Collision Prediction and Alert System designed to enhance road safety through proactive accident prevention. By integrating real-time sensor data, machine learning– based risk prediction, and IoT communication, the system enables timely detection of potential collision hazards and early warning generation. Experimental results demonstrate the system's accuracy, responsiveness, and reliability across diverse traffic scenarios. Aligned with intelligent transportation and smart mobility concepts, the proposed solution contributes toward safer and more sustainable transportation systems.

REFERENCES

[1] Wang, J., et al. (2021). IoT-Based Smart Transportation Systems. IEEE Access.
[2] Taleb, T., et al. (2019). Collision Prediction in Connected Vehicles Using V2V Communication. ACM.
[3] Goodfellow, I., et al. (2016). Deep Learning. MIT Press.
[4] Khan, M., & Kim, S. (2020). Machine Learning for Traffic Accident Detection. Elsevier.
[5] Ahmed, S., et al. (2022). IoT Communication Protocols for Intelligent Vehicles. Springer.
[6] Ali, A., & Patel, P. (2021). Smart Road Safety Systems with Edge AI. IEEE IoT Journal.
[7] Singh, A. (2020). GPS and Sensor Fusion Techniques for Vehicle Tracking. IEEE Sensors Journal.
[8] Park, Y., et al. (2023). Real-Time V2X Alerting Algorithms for Urban