Simulation of Smart Traffic Management using a Predictive Collision Avoidance Algorithm

Under the guidance of

Dr. Sourav Banerjee

Assistant Professor

Computer Science & Engineering

Kalyani Government Engineering College

Department of Computer Science and Engineering Kalyani

Government Engineering College

(Affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal)

Kalyani - 741235, Nadia, WB

Submitted By,

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AYAN KAR(10200121025)

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SWAYANGDIPTA DEY(10200121028)

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ANKAN MONDAL(10200121035)

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JAKIRUL SK.(10200122010)

Abstract:
To develop a simulation model for smart traffic management with a focus on collision avoidance using a predictive algorithm.

1. Introduction

With the rise in urban vehicular traffic, road safety has become a significant challenge. Conventional traffic management systems often fail to prevent collisions effectively due to delayed response mechanisms. This project focuses on simulating a smart traffic environment integrated with a Forward Collision Warning (FCW) algorithm to predict and avoid potential vehicle collisions in real-time. The simulation is based on real-world mapping and leverages wireless communication technologies for early warnings and improved traffic safety.

2. Objectives of the Project

- To develop a smart traffic simulation incorporating collision detection and avoidance techniques.

- To propose and evaluate a predictive collision avoidance algorithm.

- To use real location data (Kalyani map) for realistic simulation.

- To establish communication between vehicles using a wireless network module in the simulation.

3. Work Completed So Far

1. Proposed Predictive Collision Avoidance Algorithm (FCW): A Forward Collision Warning algorithm was designed to detect and alert drivers about potential rear-end collisions in advance.

2. Review and Analysis of Existing Algorithms: Existing collision avoidance algorithms were analyzed, and their disadvantages were identified, such as delayed response time and lack of adaptability in urban environments.

3. Warning/Alarming System for Collision Identification: An alert mechanism was implemented to simulate real-time warning signals to vehicles in potential collision scenarios.

4. Creation of Wireless Network Module with Simulation: A basic wireless communication framework was simulated to enable vehicle-to-vehicle (V2V) communication for sending collision warnings.

5. Location Identification and Mapping (Kalyani): The real map of Kalyani was extracted and processed for simulation purposes.

6. SUMO Configuration File Creation: A complete SUMO configuration file based on the Kalyani map was created to enable realistic traffic simulation.

4. Work in Progress / To Be Done

1. Inculcating Collision Factors into the Simulation: Integration of dynamic collision variables (speed, vehicle type, spacing) into the simulation to reflect real-world traffic scenarios more accurately.

2. Collision Avoidance Using the Proposed Algorithm: Implementation and testing of the FCW algorithm within the simulation to assess its effectiveness in real-time avoidance.

3. Analysis of Advantages and Future Scope: Evaluation of the benefits of the proposed algorithm compared to existing methods, and outlining future improvements like integration with autonomous driving systems.

5. Expected Outcomes

- A simulation-based model that effectively predicts and avoids potential collisions using the FCW algorithm.

- Enhanced awareness of traffic participants through early warning systems.

- Foundational framework for future research in intelligent transportation systems and smart city planning.

6. Conclusion

The project is progressing steadily, with a significant portion of the groundwork already completed. The upcoming tasks focus on implementing the proposed algorithm and analyzing its real-time performance. Once completed, this simulation can provide valuable insights into safer, smarter urban traffic management.