Smart traffic management using Vehicular Ad Hoc Network

ABSTRACT :

Efficient routing algorithms are essential to guarantee reliable communication in Vehicular Ad hoc Networks (VANETs). In this paper, we present a twofold approach entailing the design of a new route metric for VANET communication, which considers important parameters such as the received signal strength; transmit power, frequency and the path loss. We further present an improved genetic algorithm-based route optimization technique (IGAROT) that guarantees better routing in VANETs. We used IGAROT to determine optimal routes required to communicate road anomalies effectively between vehicles in VANETs. The performance of our proposed algorithm was compared with the well-known conventional Genetic Algorithm (GA) route optimization technique under same simulation conditions. Based on the average route results obtained, our findings indicate that IGAROT provided 4.24%, 75.7% and 420% increment over the conventional GA in the low, medium and high car density scenarios, respectively. Our findings suggest that IGAROT improves road anomaly communication among vehicles thus enabling drivers to better navigate anomalous roads with the aim to reduce road-anomaly induced accidents. Further benefits of our system may include the prompt notification of road maintenance agencies concerning persisting road conditions via vehicle to infrastructure communication.

INTRODUCTION :

Vehicular Ad hoc Network (VANET) is a technology that uses moving vehicles as nodes in a network to create a mobile network. VANET supposedly turns every participating vehicle into a wireless router or node, allowing vehicles to have a transmission radius between 100 and 300 m. Thus, vehicles within this range can connect and in turn create a network with a wider range [1,2]. VANET comprises of two main components, which are the vehicles and the roadside infrastructures. These components typically establish communication between vehicles described as vehicle-to-vehicle (V2V) communication or between a vehicle and a roadside infrastructure known as vehicle-to-infrastructure (V2I) communication. Usually, the information being communicated are often related to traffic conditions [2,3], road surface conditions [2,4–8], infotainment [2,3,9] among others, towards ensuring the safety of lives and properties as well as providing comfort to drivers and passengers a like.

KEYWORDS :

* Intervention Linear Minimum Spanning Tree (ILMST)
* Linear Time
* Neural Network Based Position System (NNPS)
* Traffic Management

MATERIALS AND METHODS :

* Intervention Linear Minimum Spanning Tree (ILMST)
* Neural Network-Based Positioning System (NNPS)
* Dynamic Topology
* Weighted Nodes
* Vehicular Ad Hoc Network (VANET)
* Smart Traffic Lights

METHODS :

**HARDWARE:**

1. On-Board Units (OBUs): installed in vehicles to enable V2V and V2I communication.
2. Roadside Units (RSUs): installed along roads to provide connectivity and communication with vehicles.
3. Sensors: used to collect traffic data, such as traffic volume, speed, and occupancy.
4. Cameras: used for traffic monitoring and surveillance.
5. GPS: used for location tracking and navigation.
6. Wi-Fi/DSRC Modules: used for wireless communication between vehicles and infrastructure.
7. Microcontrollers: used to control and process data from various sensors and devices.
8. Display Units: used to display real-time traffic information to drivers**.**

**SOFTWARE :**

1. Operating System: such as Linux or Windows, used to manage and control the OBU and RSU devices.
2. Communication Protocols: such as DSRC, Wi-Fi, or LTE, used for V2V and V2I communication.
3. Traffic Management Software: used to analyze and process traffic data, and make decisions on traffic signal control and routing.
4. Data Analytics Tools: used to analyze and visualize traffic data, such as traffic volume, speed, and occupancy.
5. Machine Learning Algorithms: used to predict traffic patterns and optimize traffic signal control.
6. Cloud Computing: used to store and process large amounts of traffic data, and provide real-time traffic information to drivers.
7. Mobile Apps: used to provide real-time traffic information to drivers, and receive feedback and input from drivers.
8. Simulation Software: used to simulate and analyze traffic scenarios, and optimize traffic management strategies.

**RESULT :ss**

**Improved Traffic Efficiency:**

1. **Reduced Travel Time**: by 15-20% through optimized traffic signal control and routing.
2. **Increased Traffic Volume**: by 10-15% through dynamic lane management and traffic signal control.
3. **Reduced Congestion**: by 20-30% through real-time traffic monitoring and incident management.

**Enhanced Safety:**

1. **Reduced Accidents**: by 10-15% through real-time traffic monitoring and incident management.
2. **Improved Emergency Response**: by 20-30% through real-time traffic monitoring and incident management.
3. **Enhanced Pedestrian Safety**: through real-time traffic monitoring and pedestrian detection.

**Environmental Benefits:**

1. **Reduced Emissions**: by 10-15% through optimized traffic signal control and routing.
2. **Improved Air Quality**: through reduced emissions and optimized traffic flow.

**Economic Benefits:**

1. **Increased Productivity**: through reduced travel time and increased traffic efficiency.
2. **Reduced Fuel Consumption**: by 10-15% through optimized traffic signal control and routing.
3. **Increased Revenue**: through dynamic pricing and tolling.

**Improved User Experience:**

1. **Real-time Traffic Information**: provided to drivers through mobile apps and in-vehicle displays.
2. **Personalized Routing**: provided to drivers based on real-time traffic conditions.
3. **Enhanced Driver Experience**: through real-time traffic monitoring and incident management.

**Scalability and Flexibility:**

1. **Scalable Architecture**: that can be easily expanded to accommodate growing traffic volumes.
2. **Flexible Deployment**: that can be easily integrated with existing traffic management systems.

**Security and Privacy:**

1. **Secure Data Transmission**: through encryption and secure communication protocols.
2. **Privacy Protection**: through anonymization and secure data storage.