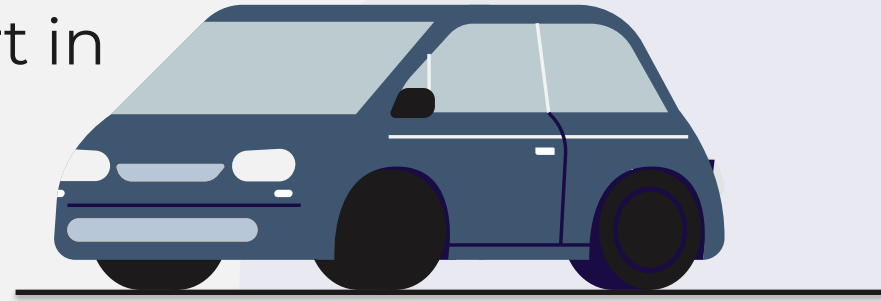
Enhancing Road Safety and Traffic Efficiency Through Vehicular Communication Networks

By Hilda Noueihed.

TABLE OF CONTENTS

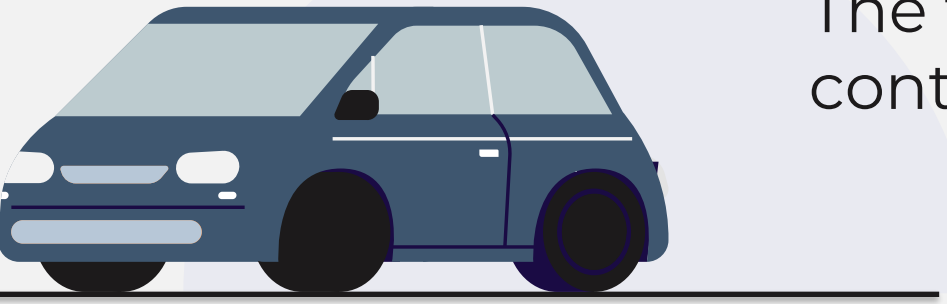
Introduction

Vehicles play a necessary part in our day-to-day lives...



...Traffic accidents are among the most critical issues...

Problem Statement



The traditional method of traffic control emphasizes...

...can be established in a networked environment by integrating VCNs...

Related work

A strong foundation for this research is provided by the literature on vehicular communication networks and their effects on traffic efficiency and road safety. Through timely information dissemination and cooperative driving techniques, studies have shown how VCNs can drastically reduce accidents and enhance traffic flow

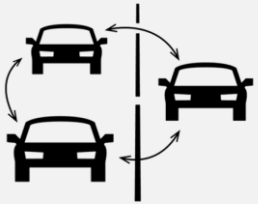
the objectives of this thesis are:

01 Identification of Critical Factors

02 Evaluation of Accident Prevention

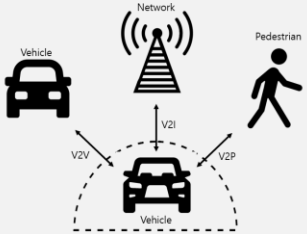
03 Examination of VCNs' Role in Intelligent Traffic Management

What Is Vehicular Communication Networks ?



V2V

V2V wireless communication allows cars to communicate with one another in real-time, sharing data about their position, velocity, and trajectory.



V2X

V2X technology allow cars to communicate with other cars as well as with other drivers and their environment.

Research Design

Emergency Response Scenario Simulation

Accident Notification and Traffic Rerouting Simulation

Vehicle Malfunction Alert Simulation

Simulation Model Development

01

Simulation of Urban Mobility (SUMO)

02

Objective Modular Network Testbed in C++ (Omnet++)

03

Vehicles in Network Simulation (Veins)

04

Internet Networking (Inet)

01

Emergency Response Scenario Simulation

The road structure generated by SUMO, including the lane configuration and car placement in the simulation.

01 Emergency Response Scenario Simulation

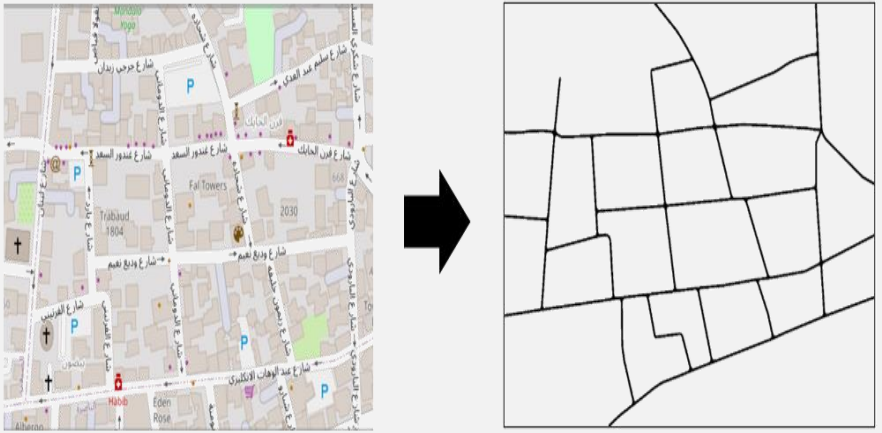
Simulation generated with OMNeT++, where . The six cars engaged in this situation are represented by nodes.

01 Emergency Response Scenario Simulation Result

After receiving the notification of the emergency car three cars in the same lane quickly changed lanes after.

02

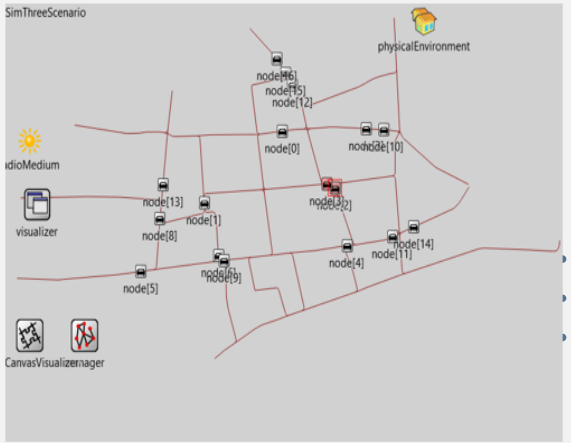
Accident Notification and Traffic Rerouting Simulation



A section of the Ashrafie road map is replicated in the road structure created for this simulation using SUMO.

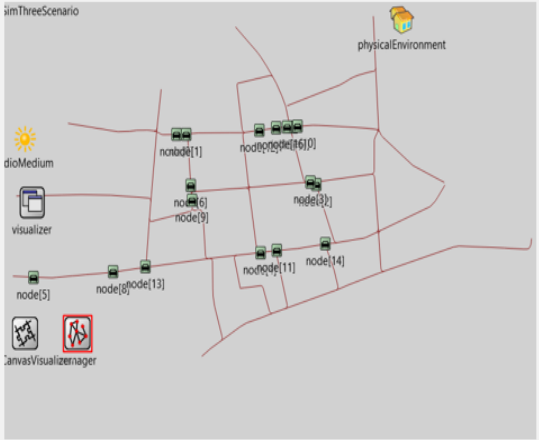
02 Accident Notification and Traffic Rerouting Simulation

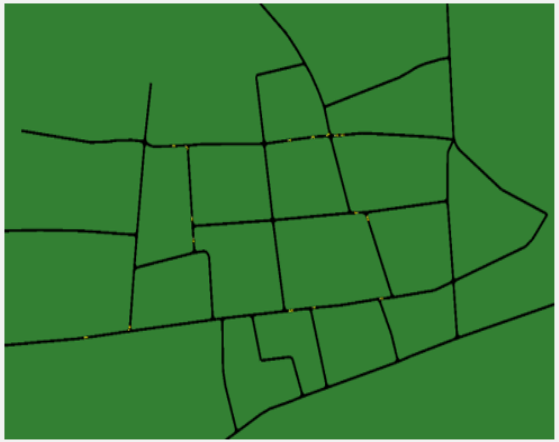
Simulation generated with OMNeT++, with nodes standing in for the 17 cars that are involved.



02 Accident Notification and Traffic Rerouting Simulation Result

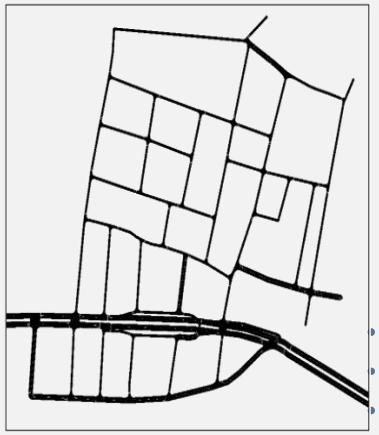
After receiving the notification of the crash cars, the cars that are close to the accident will reroute.





03

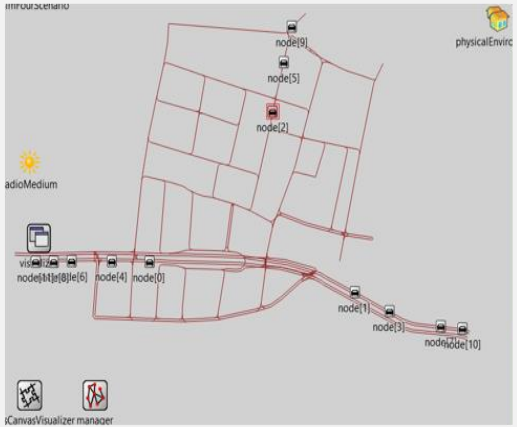
Vehicle Malfunction Alert Simulation



A section of the Mar Mikhael road map is replicated in the road structure created for this simulation using SUMO.

03 Vehicle Malfunction Alert Simulation

- **Case 1:** Simulation generated with OMNeT++, where node [2] was designed to malfunction and keep sending out a message to cars in the are.



03 Vehicle Malfunction Alert Simulation Result

- **Case 1:** After receiving the notification (every 10 sec) of the node[2] malfunction, the cars that are close to the accident will reroute.

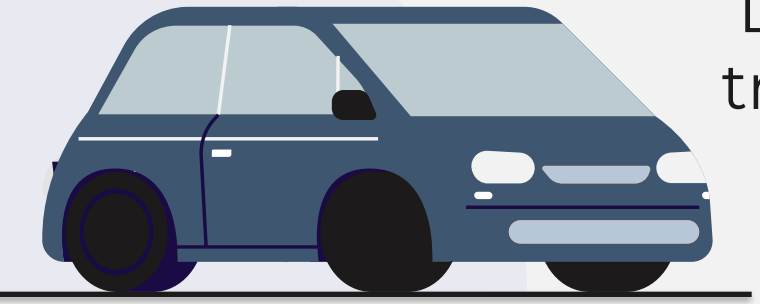
03 Vehicle Malfunction Alert Simulation

- **Case 2:** Simulation generated with OMNeT++, where node [0]. was designed to malfunction without initiating a comparable message repetition process.

03 Vehicle Malfunction Alert Simulation Result

- **Case 2:** After receiving the notification of the node[0] malfunction, the cars that are close to the accident will reroute.

Conclusion

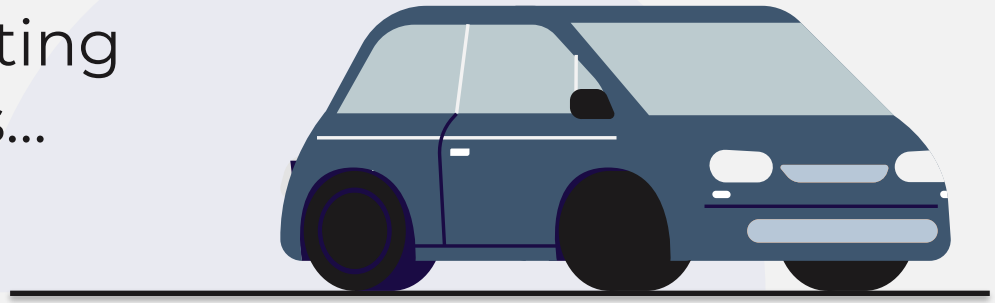


Due to the escalating problems of traffic congestion...

...VCNs have demonstrated their capacity to adjust and maximize traffic flow in...

Future Recommendation

Developing and implementing smart vehicle technology is...



...is necessary for the successful integration of VCNs into actual transportation networks...

Reference

[1] P. Eh. Hovsepian, A. P. Ehiasarian, and I. Petrov, “Structure evolution and properties of TiAlCN/VCN coatings deposited by reactive HIPIMS,” Surf. Coat. Technol., vol. 257, pp. 38–47, Oct. 2014, doi: 10.1016/j.surfcoat.2014.07.065.

[2] G. Karagiannis et al., “Vehicular Networking: A Survey and Tutorial on Requirements, Architectures, Challenges, Standards and Solutions,” IEEE Commun. Surv. Tutor., vol. 13, no. 4, pp. 584–616, 2011, doi: 10.1109/SURV.2011.061411.00019.

[3] C. Sommer, Zheng Yao, R. German, and F. Dressler, “Simulating the influence of IVC on road traffic using bidirectionally coupled simulators,” in IEEE INFOCOM Workshops 2008, Phoenix, AZ: IEEE, Apr. 2008, pp. 1–6. doi: 10.1109/INFOCOM.2008.4544655.

[4] S. Zhang et al., “Vehicular Communication Networks in Automated Driving Era.” arXiv, May 24, 2018. Accessed: Apr. 25, 2024. [Online]. Available: http://arxiv.org/abs/1805.09583

[5] C. Zoghlami, “Enhancing V2X communication systems for cooperative perception: road users safety”.

Thank you for your attention