

# Delay-Optimized V2V-Based Computation Offloading in Self-Driving Vehicles

## PROJECT SYNOPSIS

OF MAJOR PROJECT

**BACHELOR OF TECHNOLOGY**

**Branch:** Computer Science and Engineering

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## SUBMITTED BY

### Project Guide

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## Table of Contents

Content	Page No.
Abstract	1.1
Introduction	1.2
Rationale	1.3
Objectives	2.1
Literature Review	2.2
Feasibility Study	2.3

Methodology/Planning of Work	2.4
Facilities Required	3.1
Expected Outcomes	3.2
References	3.3

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## Abstract

The rapid advancements in autonomous vehicle technology necessitate efficient vehicular communication networks to support resource-intensive and latency-sensitive applications. This project focuses on optimizing task offloading in a Vehicle-to-Vehicle (V2V) communication environment by leveraging the VANET Toolbox from MathWorks to simulate and analyze real-world scenarios. By dynamically utilizing idle computational resources of neighboring vehicles, the project aims to minimize task execution delays and enhance the performance of self-driving vehicles in urban environments.

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## Introduction

Self-driving vehicles rely heavily on precise and low-latency decision-making capabilities for applications such as route optimization, obstacle detection, and traffic management. Traditional computation offloading to centralized cloud systems introduces significant delays due to communication overhead and limited availability of roadside units (RSUs). V2V communication presents a decentralized, cost-effective alternative that utilizes the idle computational resources of nearby vehicles for cooperative task execution.

This project leverages the VANET Toolbox by MathWorks to simulate V2V-based computation offloading. The toolbox enables the creation of realistic vehicular network scenarios, facilitating the evaluation of delay optimization techniques in a dynamic urban environment.

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## Rationale

The increasing complexity of self-driving vehicle applications demands high computational power, which often exceeds the onboard capabilities of autonomous vehicles. Offloading computational tasks to nearby vehicles using V2V communication can significantly reduce delays and improve system reliability. This project is necessary to explore cost-effective and scalable solutions to meet the growing computational demands of the Internet of Vehicles (IoV).

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## Objectives

- Utilize the VANET Toolbox to simulate V2V communication and vehicular mobility in realistic urban scenarios.
  - Develop a delay-optimized task offloading model for self-driving vehicles using V2V communication.
  - Implement and compare optimization algorithms such as Max-Min Fairness and Particle Swarm Optimization (PSO).
  - Validate the proposed solution through simulations, analyzing the impact of various parameters on delay performance.
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## Literature Review

Several studies have highlighted the importance of task offloading in vehicular networks. Key works include:

- Chen et al. (2020): Proposed a cooperative task scheduling scheme leveraging idle vehicular resources to minimize delays.
- Dai et al. (2019): Explored edge computing solutions to enhance the performance of IoV.
- Treiber et al. (2000): Provided mobility models essential for realistic vehicular simulations.
- IEEE 802.11p/WAVE Standard: Defined communication protocols for vehicular networks.

These studies form the basis for this project, integrating task scheduling, communication modeling, and vehicular mobility.

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## Feasibility Study

The proposed project is feasible given the availability of simulation tools like the VANET Toolbox and MATLAB. The project aligns with current trends in vehicular technology and has the potential to address real-world challenges in autonomous vehicle networks. The computational and communication models are well-supported by existing research, and the proposed methodology ensures a structured approach to achieving the project objectives.

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## Methodology/Planning of Work

1. Define a vehicular network scenario using the VANET Toolbox.

2. Simulate mobility using predefined models (e.g., Intelligent Driver Model) provided by the toolbox.
  3. Model V2V communication delays and noise effects.
  4. Implement optimization algorithms (Max-Min Fairness and PSO) using MATLAB.
  5. Simulate various scenarios with differing vehicle densities and task sizes.
  6. Analyze and compare performance metrics such as execution time and resource utilization.
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## Facilities Required

**Software:** MATLAB, VANET Toolbox, Simulink

**Hardware:** A computer with at least 8GB RAM and multi-core processor for simulations.

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## Expected Outcomes

The project is expected to produce a validated simulation model demonstrating the effectiveness of V2V task offloading in reducing delays for self-driving vehicles. Quantifiable improvements in execution time and resource utilization will be observed, along with insights into the trade-offs between computational delays and network performance.

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## References

1. Chen, C., et al., "Delay-Optimized V2V-Based Computation Offloading," IEEE Access, 2020.
  2. Dai, Y., et al., "Artificial Intelligence Empowered Edge Computing for IoV," IEEE Wireless Communications, 2019.
  3. Treiber, M., et al., "Congested Traffic States in Microscopic Simulations," Physical Review E, 2000.
  4. IEEE Standard for Wireless Access in Vehicular Environments (WAVE), IEEE 802.11p, 2016.
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