Chapter 9
Optimizing Vehicular Network Architecture and Communication Models With Machine Learning Approach

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ABSTRACT

Vehicular networks are a digital web that links the entities of vehicles, infrastructure, and information to enable road transportation safer, more efficient, and amicable to the users. It is a more comprehensive system comprising different communication models and architecture, where the latter supplies a supportive framework for the communication models. This chapter proposes a machine learning approach to determine a more suitable combination between the VNA & CM to optimize the efficacy of the VL. The ML algorithm of DL networks with multi-layers is leveraged to analyze factors such as traffic patterns, network topology, communication range, and application needs to identify the most appropriate combination of VNA and CM. The capability of the ML approach is validated using the performance metrics in comparison with other learning algorithms to identify the limitations of the proposed model. This machine learning-based decision model shall also be employed as a predictive model to determine the optimal combination of VNA & CM for optimal

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planning and implementation of VN.

1. INTRODUCTION

The present modern era of intelligent transportation systems is governed by the emergence of vehicular networks which are the intrinsic components of ensuring smart technology and connectivity. These vehicular networks are termed VANETs i.e. Vehicular Ad hoc NETworks which are embedded with the potency of establishing communications with the vehicles, pedestrians, and infrastructure for sustaining safe transportation. The efficiency of vehicular network communication is solely determined by the vehicular network architecture (VNA) as it is very broader encompassing the suitable infrastructure and framework for communication enabling the communications between the vehicles and other roadside units (Jurczenia & Rak, 2022). VAN assists in building a robust and well-connected network. VAN comprises both onboard units and roadside units, where the former are inherited in the vehicles and the latter are placed to meet the demands of connectivity. VAN considers various factors such as coverage range, scalability, consistency, and latency. These architectural frameworks are vital in traffic management, collision avoidance, automotive driving and other related applications.

Vehicular network communication models (VNC) are of various kinds such as Vehicle-to -vehicle, vehicle-to-pedestrians, vehicle-to-infrastructure, vehicle-to-grid and many other. The choice and the suitability of VNC are based on the available feature of architectural frameworks. The matching of VNC with VAN is very essential to make decisions on the choice of the communication models (Cho, Park, & Paek, 2022). This matching between the entities shall be made optimal with the integration of machine learning algorithms. The intervention of machine learning approaches will alleviate the hurdles in maximizing the competence and effectiveness of communication networks. The functioning of this integrated machine learning approach decreases the manual intervention thereby increasing the efficacy of the automated process of making decisions. The matching model shall be made optimal by considering large data sets to find out the patterns. Also, these algorithms have the potency to accommodate new data sets and provide suitable feedback to make the VNC respond to fluctuating circumstances. In general, these algorithms are applied in evaluating the performances of the VNC, identifying the threatful nodes in networks, and in detecting the hurdles causing the phenomenon. However, machine learning-based algorithms are not applied in building a matching model. Hence, leveraging machine learning algorithms in optimizing the matching of vehicular network architecture and vehicular communication models assists in

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