


Chapter 13

Cluster Head Selection Based on ACO in Vehicular Ad- Hoc Networks

Anjali C. Pise

 <https://orcid.org/0009-0003-7735-7374>

SKN Sinhgad College of Engineering, India

Kailash J. Karande

SKN Sinhgad College of Engineering, India

ABSTRACT

A critical aspect of Vehicular Ad-Hoc Networks (VANETs) is the selection of cluster heads. In this paper, an approach to cluster head selection in VANETs based on Ant Colony Optimization (ACO) is presented. By utilizing the collective intelligence of ants, the proposed algorithm will guide the selection process and optimize network performance. The algorithm selects cluster heads by taking into account a variety of parameters, as vehicle proximity, communication range, residual energy, and the attractiveness of neighboring vehicles based on pheromone values. Using extensive simulations and performance evaluations, it has been verified that the proposed algorithm has shown a significant improvement in network performance, as it reduces packet loss, improves network throughput, and extends the life of the network, also, the algorithm exhibits adaptability and self-organization, allowing it to dynamically adjust to changes in the vehicular environment in real-time. The results of this study highlight an overall improvement of communication and data dissemination in vehicular networks.

DOI: 10.4018/979-8-3693-3940-4.ch013

1. INTRODUCTION

In recent years, Vehicular Ad-Hoc Networks (VANETs) have gained significant attention for improving traffic efficiency, road safety, and communication in transportation. Vehicles can communicate with each other and with roadside infrastructure through VANETs, enabling information to be exchanged about road conditions, traffic congestion, and safety hazards. There are, however, several challenges with VANETs, including limited bandwidth, frequent topology changes, and dynamic network conditions. By dividing the network into clusters and selecting Cluster Heads (CHs), Liu et. al. (2013), cluster-based routing addresses these challenges effectively. A CH coordinates data aggregation, routing, and resource management within a cluster, thereby reducing communication overhead and enhancing VANET scalability. For cluster-based routing to succeed, CH selection is critical. Traditional CH selection methods often rely on heuristics, such as node density, position, or communication range. A dynamic network, heterogeneous vehicles, and changing traffic conditions may not be considered by these methods. A Vehicle Ad-Hoc Network (VANET) is a type of Mobile Ad-Hoc Network (MANET) Liu et. al. (2013), capable of enabling vehicle-to-vehicle communication (V2V) and vehicle-to-infrastructure communication (V2I). A VANET utilizes Dedicated Short-Range Communications (DSRC), Peng et. al. (2015) or Cellular Vehicle-to-Everything (C-V2X), P. Manickam et. al. (2019) to facilitate real-time communication. Since VANETs enable vehicles to connect with one another and exchange information about potential road hazards, they have safety applications. Examples of safety applications include collision warnings, emergency vehicle alerts, junction assistance, and safeguarding the most vulnerable road users.

The VANETs may improve traffic flow and congestion management by providing real-time traffic information, dynamic routing concepts, and adaptive traffic signal control. By improving traffic flow, cutting down on travel times, and other factors, Zahid Khan et. al. (2019), these projects contribute to improved road efficiency. Intelligent Transportation Systems (ITS), of which VANETs are an essential component, integrate cutting-edge technology for improved transportation management and control, AA Khan et. al. (2018). Examples of ITS applications include dynamic route guidance, intelligent parking systems, eco-driving assistance, and incident management. Location-based services, social networking, multimedia streaming, and internet access In-car versions of these entertainment and information services may be offered through VANETs, Liu et. al. (2018). Cluster-based routing is a valuable tactic to improve the effectiveness and scalability of communication in VANETs. Fleets of vehicles are arranged into “clusters,” each of which is headed by a CH, using cluster-based routing. The CH serves as the central node for all

20 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/cluster-head-selection-based-on-aco-in-vehicular-ad-hoc-networks/357295

Related Content

Cluster Head Selection Based on ACO in Vehicular Ad-Hoc Networks

Anjali C. Piseand Kailash J. Karande (2025). *Machine Learning for Environmental Monitoring in Wireless Sensor Networks* (pp. 269-290).

www.irma-international.org/chapter/cluster-head-selection-based-on-aco-in-vehicular-ad-hoc-networks/357295

A Power Control Strategy for IoT Sensors Developed for 5G Networks

Weston Mwashitaand Marcel Ohanga Odhiambo (2020). *International Journal of Smart Sensor Technologies and Applications* (pp. 22-41).

www.irma-international.org/article/a-power-control-strategy-for-iot-sensors-developed-for-5g-networks/272126

Designing Mobile Learning Smart Education System Architecture for Big Data Management Using Fog Computing Technology

Muhammad Adnan Kaim Khani, Abdullah Ayub Khan, Allah Bachayo Brohiand Zaffar Ahmed Shaikh (2022). *The International Journal of Imaging and Sensing Technologies and Applications* (pp. 1-23).

www.irma-international.org/article/designing-mobile-learning-smart-education-system-architecture-for-big-data-management-using-fog-computing-technology/306653

Biomedical Sensor Networks and Remote Patient Monitoring: An Exploratory Insights

T. Mathankumarand S. Vijayarani (2025). *Battery-Free Sensor Networks for Sustainable Next-Generation IoT Connectivity* (pp. 221-252).

www.irma-international.org/chapter/biomedical-sensor-networks-and-remote-patient-monitoring/374298

GuideMe: A Complete System for Indoor Orientation and Guidance

Eirini Barri, Christos John Bouras, Apostolos Gkamasand Spyridon Aniceto Katsampiris Salgado (2020). *International Journal of Smart Sensor Technologies and Applications* (pp. 36-53).

www.irma-international.org/article/guideme/281602