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Accuracy Enhancement for Decision Making in VANET using Machine Learning Approach

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***Abstract*—VANET-based smart automobiles have made commuting safer, more efficient, more environmentally friendly, and more cost-effective than it has ever been. The best routes may not be the most efficient if researchers are unable to get exact real time traffic densities because vehicle densities fluctuate so frequently; consequently, the best routes may not be the most efficient. By predicting automobile movements, research may then use machine learning to choose the most effective paths for transferring packets. It is very important in VANET that the accuracy in decision making of VANET is high which results in good communication quality. In this paper, the main objective to enhance the communication quality of VANET using the deep learning technique has been implemented to improve the performance in terms of accuracy, precision, recall, and f1-score using the LSTM model. Results show improvement in terms of the above parameters.**

***Index Terms*— Machine Learning, Wireless ad hoc network, VANET and routing protocols.**

I. INTRODUCTION

Transportation-related changes commonly alter the topology and communication links of VANETs. Developing a reliable transmission system is a complex problem. Thus, researchers are increasingly interested in finding the best routes to transfer packets, avoiding carry-and-forward situations, as well as minimizing transmission delays. Traffic flow forecasting, as well as machine learning route, is planned. Each mobile node's safety and the reduction of accidents and data transmission delays are the major goals of VANET. Routing problems are caused by the network's inconsistency. Data congestion on RSUs is caused by the VANET system's data-heavy environment. Traffic flow, safety, and low latency communication between cars and RSUs are the primary objectives of Intelligent Transportation Systems. Various academic groups have taken an interest in the Vehicular Ad hoc Network (VANET) because of these issues. Because of the massive amounts of data created by VANET's many applications, machine learning methods may now be applied to the massive amounts of data generated by these systems (for example, crowd sourcing, pollution control, environment monitoring, etc.). Based on previously processed data, machine learning is a technique that allows the system to learn and improve itself. VANET's goal is successfully implemented by these algorithms, which enable efficient supervised and unsupervised learning of the given data, respectively. A case study illustrating a VANET-based situation served as a capstone to our discussion of the future path and problems. The rest of this paper is organized as follows. In section II Literature Reviews are studied. After that, the Need of Research is presented in section III. Moreover, Methodology and Proposed Work are discussed in section IV. Section V described the simulation results. Finally, section VI concludes the paper.

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II. LITERATURE REVIEW

There have been several researches in the field of machine learning, wireless ad hoc networks, and VANET. This section focuses on previous studies on these topics.

The author recorded the performance of autonomous and human-driven vehicle communication routing strategies in Madinah city under various traffic conditions. An extracted map of Madinah city was used to depict traffic density in the evaluation of three ad-hoc routing algorithms in two different application situations. In busy traffic, fully autonomous vehicle scenarios reduced travel durations by up to 7.1%; however, reactive ad-hoc routing strategies delivered network packets to neighbouring VANET cars with the least amount of delay. The Madinah VANET implementation may use reactive ad hoc routing protocols based on these findings. Travel time is drastically reduced thanks to autonomous cars. ANOVA testing was also used to see how the factors analysed influenced the findings' variability. [1] [2]

Researchers evaluated the usage of four metrics, to find the best strategy to choose cluster leaders for interviews. CH's stability is impacted by the vehicle's speed, rate of acceleration, distance, and velocity change. They all tallied toward the total gain. Changing the model requires pinpoint precision for the vehicle's location. A forecast of CH stability was produced using the Kalman filter's help. For the benefit element, the results beat the existing state of the art. Due to the vehicle's speed, it was expected that there would be frequent disconnections in communication lines. [3] [4]

Modern vehicle network topologies were explored and security concerns on vehicle networks were characterized according to a taxonomy provided by the authors. Based on their relevance in vehicular network applications, they grouped the ML techniques described in the literature ML approaches were utilized to manage a broad variety of security challenges, and the authors went into great depth on how these functioned. A debate was conducted on the restrictions and issues of applying ML-based techniques in vehicular networks." Finally, they presented their perspectives on what they had done. [5]

Edge AI and VANET were suggested for the recognition of road anomalies by autonomous automobiles and the distribution of road information to arriving vehicles. Reduce the number of accidents and risks on poor roads by employing camera-captured road images and a vehicle-mounted trained algorithm for recognizing road irregularities. For automated recognition & categorization of roads such as potholes, bumps, cracks, and plain roads free of anomalies, datasets from multiple online sources were utilized using the techniques Residual CNN and VGG-11. The research found that models used to detect road imperfections worked better than others. [6][7]

The author introduced VANET networks, followed by a description of a variety of attacks that may harm them. After that, we learned about the basics of machine learning and some of the most common AI algorithms utilized in VANET networks. Like any other network, VANET's intrinsic nodes have flaws and vulnerabilities that jeopardize its reliability. In an attempt to improve the reliability of the VANET network by detecting intrusions and producing predictions, machine learning methods have been widely investigated. [8] [9]

III. NEED OF RESEARCH

There is the absence of real-life applicability in the earlier investigations. The breadth of prior investigations was relatively narrow. There is a need to boost accuracy and efficiency in the area of VANET. Also, earlier research neglected the possibility of merging deep learning, and machine learning with VANET. In other words, earlier researchers have not been able to apply their results in the real world. Previous research only looked at a tiny piece of the overall picture. In VANET, accuracy and efficiency must be enhanced. Furthermore, earlier studies neglected to examine the potential advantages of VANET-integrated deep learning and machine learning. There is a need to research on VANET to improve the accuracy parameters.

IV. METHODOLOGY

In this section, the research methodology and results of the proposed work have been presented along with comparative analysis, Process flow, and working of the proposed model.

A. Research Methodology

The proposed work has focused on performance enhancement by making use of the deep learning model. As shown in Fig 1, the proposed work is considering an experimental research methodology where existing research is related to machine learning. Performance has been considered. Then the problem and issue related to existing research related to machine learning have been considered. A novel approach would be proposed considering such issues and classification and deep learning approaches would be used together to reduce the issues of performance and accuracy. After building the proposed model the comparison of performance and accuracy parameters such as precision, recall value, and f-score would be made.

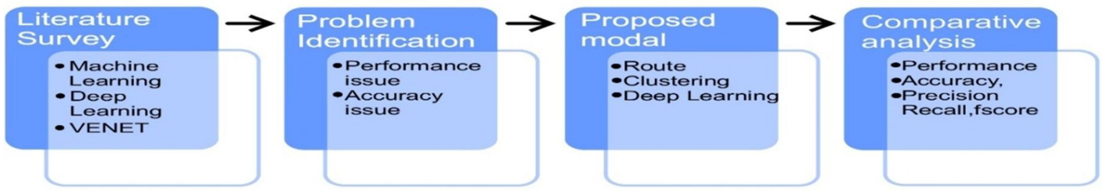

Figure 1. Research Methodology

In Fig. 1, a literature survey of machine learning, deep learning and VANET has been made and problem identification face considers performance and accuracy issues. The proposed model section is considering route, clustering, and deep learning. Finally, a comparative analysis of performance, accuracy, recall value, f-score, and precision has been made.

B. Proposed Work

The proposed work is focusing on performance enhancement by making use of the deep learning model the successful route once calculated is saved in the dataset. This data set is then passed to the machine learning model to allow VANET to take decisions dynamically.

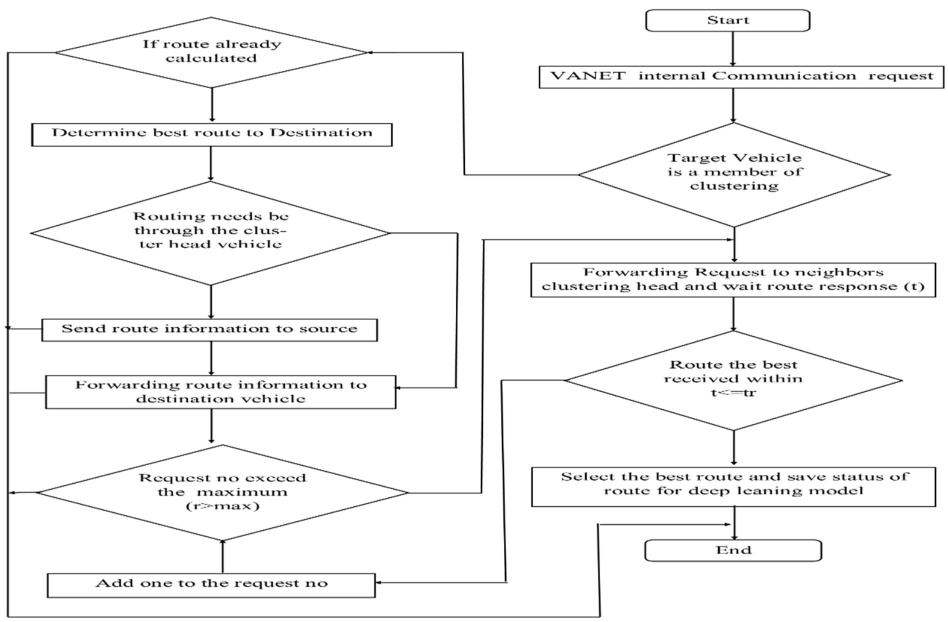

Figure 2. Proposed models for VANET routing with the deep learning approach

Fig. 2 presents that VANET internal communication request is considered and it is checked whether the target vehicle is a member of clustering. If it is true, then it is checked whether the route is already calculated or not. If the route is already calculated, then stop otherwise find the best route to the destination and it is confirmed whether routing needs to be done through the cluster head vehicle. If it is true, then forwarding route information to the destination vehicle is made otherwise route information is sent to the source. If the target vehicle is not a member of clustering, then forward the request to neighbour clustering head and wait for route response. Finally, the best route is chosen and status is saved for deep learning.

V. SIMULATIONS RESULTS

The simulation of VANET has been made and a deep learning model has been considered during route classification. The classification of routes in VANET in the case of the previous model provides the following confusion matrix. Table 1 is presenting the confusion matrix in the case of previous work. Here the classification of routing is required through the cluster head vehicle and routing is not required through the cluster head vehicle. Table 2 shows the accuracy parameters of previous work.

TABLE I. CONFUSION MATRIX OF PREVIOUS WORK AND PROPOSED WORK

	Previous Work		Proposed Work	
Routing needs to be through the cluster head vehicle	832	168	896	104
Routing does not need to be through the cluster head vehicle	192	808	128	872

TABLE II. ACCURACY PARAMETERS OF PREVIOUS WORK

Class	n (truth)	n (classified)	Accuracy	Precision	Recall	F1 Score
1	1024	1000	82%	0.83	0.81	0.82
2	976	1000	82%	0.81	0.83	0.82

The classification of routes in VANET in the case of the proposed model provides a confusion matrix that is presented in table 3. Table 3 is presenting the confusion matrix in the case of the proposed work. Here the classification of routing is required through the cluster head vehicle and routing is not required through the cluster head vehicle.

TABLE III. ACCURACY PARAMETERS OF PROPOSED WORK

Class	n (truth)	n (classified)	Accuracy	Precision	Recall	F1 Score
1	1024	1000	88.4%	0.90	0.88	0.89
2	976	1000	88.4%	0.87	0.89	0.88

A. Comparison Analysis

Accuracy of previous work and proposed work are taken for class 1 and class 2 and shown in table 4. It is observed that the accuracy of the proposed work is more than that of previous work.

 # Accuracy

TABLE IV. COMPARISON ANALYSIS OF ACCURACY

Class	Previous Work	Proposed Work
1	82%	88.4%
2	82%	88.4%

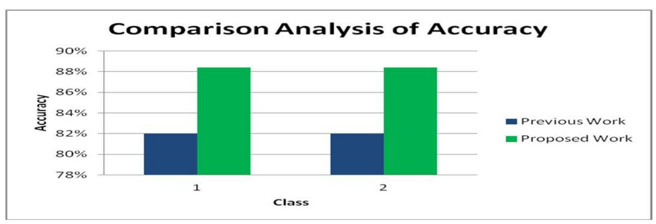

Figure 3. Comparison Analysis of Accuracy

Considering table 4 Fig. 3 is drawn to visualize the accuracy of the proposed work with respect to previous work. The precision of previous work and proposed work are taken for class 1 and class 2 and shown in table 5. It is observed that the precision of the proposed work is more than that of previous work.

 # Precision

TABLE V. COMPARISON ANALYSIS OF PRECISION

Class	Previous Work	Proposed Work
1	0.83	0.90
2	0.81	0.87

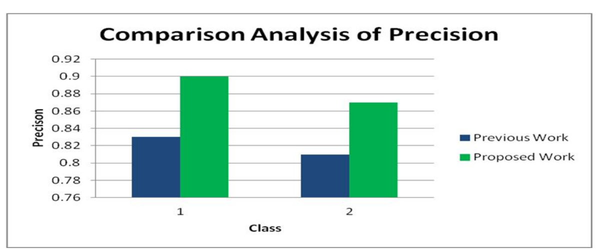

Figure 4. Comparison Analysis of Precision

Considering table 5 Fig. 4 is drawn in order to visualize the precision of the proposed work with respect to previous work.

Recall value of previous work and proposed work are taken for class 1 and class 2 and shown in table 7. It is observed that the Recall value of proposed work is more than that of previous work.

 # Recall Value

TABLE VI. COMPARISON ANALYSIS OF RECALL VALUE

Class	Previous Work	Proposed Work
1	0.81	0.88
2	0.83	0.89

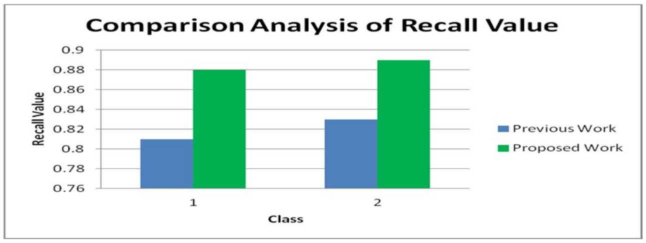

Figure 5. Comparison Analysis of Recall Value

Considering table 6 Fig. 5 is drawn in order to visualize the recall value of the proposed work with respect to previous work.

F1-Score of previous work and proposed work are taken for class 1 and class 2 and shown in table 10. It is observed that the F1-Score of the proposed work is more than that of the previous work.

 # F1-Score

TABLE VII. COMPARISON ANALYSIS OF F1-SCORE

Class	Previous Work	Proposed Work
1	0.82	0.89
2	0.82	0.88

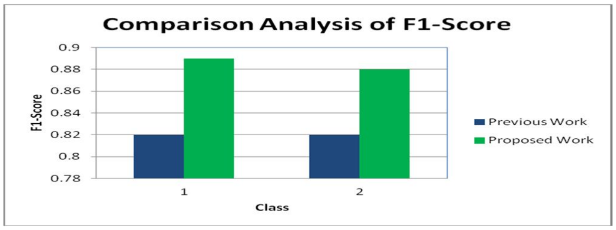

Figure 6. Comparison Analysis of F1-SCORE

Considering table 7 Fig. 6 is drawn in order to visualize the F1-Score of the proposed work with respect to previous work.

B. Result

As there is a need to improve the performance of machine learning mechanisms that are used in VANET routing, no work was proposed for enhancement of accuracy for decision making in VANET using Machine learning. The accuracy of proposed work is 88.4% where as it was 82% in the case of previous work. The precision of the proposed work is 0.90 whereas it was 0.83 in the case of previous work. The recall value of the proposed work is 0.89 whereas it was 0.83 in the case of previous work. The F1-score of the proposed work is 0.82 whereas it was 0.89 in the case of previous work.

VI. CONCLUSION

In this paper, technique has been proposed for enhancing of accuracy for decision making in VANET using machine learning. The proposed work has reduced the time consumption during VANET routing. Criteria that are considered routing needs to be through the cluster head vehicle and routing does not need to be through the cluster head vehicle. Classification of routing has been successfully made using a deep learning model and the proposed model has provided better accuracy, f-score, recall value, and precision. It is observed that there is limited work in the field of VANET and there is need to do more work to make routing decision making more efficient.

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