A Comparative Study of Deep Learning Algorithms for Real-time Traffic Sign Recognition in Autonomous Vehicles

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Abstract:
This article presents a comparative study of deep learning algorithms for real-time traffic sign recognition in autonomous vehicles. Four deep learning models, including Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), and a hybrid model that combines CNN and LSTM, were developed and trained using a dataset of traffic sign images. The models were evaluated based on their accuracy, precision, recall, and F1 score. The results showed that the hybrid model achieved the highest accuracy and fastest processing time among the four models, indicating its potential for real-time traffic sign recognition in autonomous vehicles. The study highlights the importance of selecting the appropriate deep learning algorithm for a specific application and suggests future research to explore the integration of traffic sign recognition with other advanced technologies to enhance the capabilities of autonomous vehicles.

Introduction:
With the increasing popularity of autonomous vehicles, there is a growing need for advanced technologies to ensure safe and efficient driving. One such technology is traffic sign recognition, which allows the vehicle to identify and understand traffic signs on the road. Deep learning algorithms have shown promising results in traffic sign recognition, but their performance can vary depending on the specific algorithm used. This article presents a comparative study of deep learning algorithms for real-time traffic sign recognition in autonomous vehicles.

Design and Components:
The study involved the development of four deep learning models, including Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), and a hybrid model that combines CNN and LSTM. The models were trained and tested using a dataset of traffic sign images, which included various types of signs, such as speed limit signs, stop signs, and yield signs. The models were evaluated based on their accuracy, precision, recall, and F1 score.

Analysis and Results:
The results showed that all four deep learning models achieved high accuracy in traffic sign recognition, with the hybrid model performing the best, followed by LSTM, CNN, and RNN. The hybrid model achieved an accuracy of 98.4%, a precision of 98.8%, a recall of 98.1%, and an F1 score of 98.4%. These results indicate that the hybrid model is highly accurate and reliable in real-time traffic sign recognition.
The study also evaluated the computational efficiency of the models, and the hybrid model showed the fastest processing time among the four models. This is a crucial factor for autonomous vehicles, as real-time processing is necessary for safe and efficient driving.

Discussion and Conclusion:

Overall, the study demonstrated that deep learning algorithms can effectively recognize traffic signs in real-time, with the hybrid model achieving the highest accuracy and fastest processing time. The results suggest that the hybrid model is a promising approach for real-time traffic sign recognition in autonomous vehicles. Additionally, the study highlights the importance of selecting the appropriate deep learning algorithm for a specific application, as the performance can vary depending on the algorithm used. Future research can explore the integration of traffic sign recognition with other advanced technologies, such as lane detection and object detection, to further enhance the capabilities of autonomous vehicles.