Traffic Control Methodology through Locating Emergency Vehicles

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Abstract

Ensuring prioritized passages for emergency vehicles is one of the significant tasks for traffic safety. To cooperate with this task, drivers have to locate emergency vehicles first. However, it is challenging for drivers to identify the exact location of emergency vehicles in real time because they typically depend only on their sight and hearing to find the emergency vehicles. To resolve this issue, we propose a machine learning model to predict the trajectory of emergency vehicles and an algorithm to control vehicle traffic based on the predictions. Simulation results demonstrate the potential of our approach to guide vehicles on the road to allow an emergency vehicle to move out quickly.

Keywords : Traffic Control Methodology, Emergency Vehicles, Trajectory Prediction, LSTM

1 Introduction

To expedite the passage of emergency vehicles, surrounding vehicles should yield to emergency vehicles after identifying their relative locations to the emergency vehicles. However, it is hard to locate emergency ones since drivers usually try to find them through the sound of sirens. To resolve this issue, we propose a system architecture to guide vehicles according to predicted locations of emergency vehicles. In particular, our architecture enables emergency and their surrounding vehicles to select optimal lanes to quickly pass through.

2 Architecture

2.1 Prediction Model for Emergency Vehicle Trajectory

This paper deals with the process of securing a dataset to establish an optimal movement recommendation service for surrounding vehicles based on the location of an emergency vehicle. Obtaining real-time data for road traffic information is extremely challenging due to legal constraints. Therefore, we considered a method of predicting the future using historical road data instead. There are various proposed methods for predicting vehicle trajectories using machine learning.in particular, models for location prediction using LSTM are known to exhibit practical performance. Similarly , in this paper, we predict the positions of vehicles, especially emergency vehicles, using a self-trained

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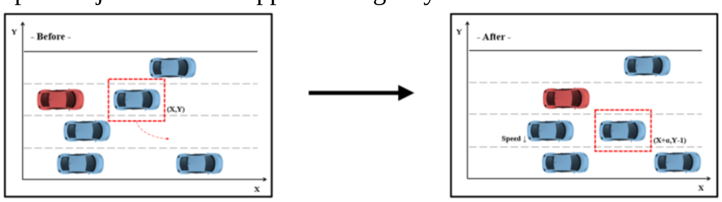
LSTM model. The dataset used for training is the highD dataset[2]. From the highD dataset, we normalize time series data by incorporating vehicle IDs, x and y coordinates, and IDs of left and right leading vehicles. This enables us to track changes in vehicle coordinates and the presence of leading vehicles over time. Using this time series data, we perform the task of predicting future values based on past data. We create an LSTM model, adjust the weights based on the training data, and minimize the loss function. Once training is completed, we use the model's predictions for future vehicle movements to predict the future coordinates and the presence of leading vehicles. Testing the trained model resulted in an average distance error of less than 0.806, demonstrating sufficient accuracy for lane allocation control.

2.2 Optimal Lane Assignment Algorithm

The result values predicted in 2.1 are used as successive input values for the algorithm. The proposed algorithm consists of the following steps: 1) Choose 20 of the surrounding vehicles of the emergency vehicle at random. 2) A vehicle with the same x-coordinate as the emergency vehicle and greater y-coordinate than the emergency vehicle among neighboring vehicles is considered a leading vehicle in the same lane as the emergency vehicle. 3) Peripheral vehicles classified in 2 will guide lane changes to the left or right. Vehicles attempting a lane change will perform a lane change when no other vehicle has the same x-coordinate ±1 difference and y-coordinate. 4) Reduce speed if there are other vehicles with ±1 differences in x coordinates and the same y coordinates.

This algorithm ensures smooth traffic for emergency vehicles and neighboring vehicles perform lane changes and speed adjustments to support emergency vehicles.



3 Conclusion and Future Work

This paper covers data acquisition for research where surrounding vehicles are efficiently moved away for emergency vehicles. We would like to conduct a study to establish a route guidance service by applying the data secured through the proposed data collection methodology to the actual environment. Therefore, as a future plan, we intend to increase the accuracy of the study by conducting DQN (Deep Q-Network) reinforcement learning through the sumo simulator. This can reduce the development of autonomous vehicles and traffic congestion, and the quality of emergency services is improved through this expected effect.

References

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