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Intelligent System for Surrounding Vehicle Recognition and Road Situation Notification

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Abstract:

This research presents an intelligent system designed to recognize surrounding vehicles and notify the road situation. The system incorporates a vehicle information collecting unit, a surrounding vehicle recognizing unit, and a situation notifying unit. The vehicle information collecting unit collects location information of the own vehicle and surrounding vehicles. The surrounding vehicle recognizing unit generates a lane based on the collected location information and identifies the location of surrounding vehicles. Finally, the situation notifying unit determines the road situation based on the recognized surrounding vehicles. This system aims to enhance road safety and facilitate informed decision-making for drivers.

Keywords: Surrounding vehicle recognition, road situation notification, intelligent system, vehicle information collecting unit, lane generation.

Introduction:

With the increasing number of vehicles on the road, ensuring road safety has become a paramount concern. The ability to accurately recognize and assess the location of surrounding vehicles is crucial for drivers to make informed decisions and avoid potential collisions. To address this need, we propose an intelligent system that utilizes a vehicle information collecting unit, a surrounding vehicle recognizing unit, and a situation notifying unit.[1] This system aims to provide real-time updates on the surrounding vehicles and the overall road situation, empowering drivers with crucial information to enhance their driving experience.

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Related Work:

In recent years, there has been a growing emphasis on developing advanced technologies and applications in the automobile industry to minimize accidents and enhance road safety.[2] One key area of research in this domain revolves around the periphery of vehicles, specifically focusing on vehicle identification methods and lane recognition techniques.[3] These research endeavors aim to leverage the use of cameras and sensors to enable efficient tracking and detection of nearby vehicles.

Traditionally, cameras and sensors mounted on vehicles have been utilized to capture images and gather data for analyzing and understanding the surrounding environment.[4] These systems play a crucial role in performing tasks such as lane tracking and detecting nearby vehicles.[5] However, there are certain challenges associated with relying solely on camera and sensor-based approaches, particularly when it comes to adverse weather conditions or varying levels of external brightness.[6]

In scenarios where weather conditions deteriorate, such as during heavy rain, snowfall, or when visibility is low, the effectiveness of camera or sensor-based track detection diminishes.[7] The cameras or sensors may struggle to accurately sense the tracks on the road or may only detect a limited portion of the lane due to reduced visibility. Similarly, in situations with intense sunlight or instances where backlighting occurs, cameras or sensors may fail to capture the necessary information to identify the tracks accurately.[8,9]

To overcome these limitations, vehicle manufacturers and researchers have explored alternative sensing technologies. Among these alternatives, radar and vision-based sensing devices have gained prominence. Radar sensors utilize radio waves to detect nearby objects, allowing for more reliable detection regardless of weather conditions or external brightness. Vision-based sensing devices, on the other hand, employ advanced computer vision algorithms and image processing techniques to identify and track lanes and nearby vehicles.[10]

Considering the aforementioned challenges, inter-vehicular communication techniques have emerged as a promising avenue for identifying nearby vehicles. Instead of relying solely on individual sensors, these methods leverage communication between vehicles to exchange information about their locations, speeds, and trajectories.[11] By utilizing inter-vehicular communication, vehicles can collectively create a more comprehensive and accurate perception of their surroundings, enabling enhanced safety measures.

In summary, the automobile industry is actively engaged in researching and developing techniques to improve the identification of nearby vehicles and lane recognition. While cameras and sensors have traditionally been employed for these tasks, their effectiveness can be compromised under adverse weather

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conditions or challenging lighting situations. As a result, the adoption of radar sensors, vision-based systems, and inter-vehicular communication methods has garnered attention as viable alternatives. By advancing these technologies, the industry aims to improve road safety and minimize accidents through more accurate and reliable detection of surrounding vehicles.

Research Objective:

The main objective of this research is to develop an intelligent system for recognizing surrounding vehicles and notifying the road situation. The specific objectives are as follows: (FIG. 1)

To design and implement a vehicle information collecting unit capable of gathering location information of the own vehicle and surrounding vehicles.

To develop a surrounding vehicle recognizing unit that generates a lane based on the collected location information and identifies the location of surrounding vehicles.

To create a situation notifying unit that determines the road situation based on the recognized surrounding vehicles.

To evaluate the performance of the intelligent system in terms of accuracy, reliability, and efficiency.

To assess the effectiveness of the system in enhancing road safety and aiding driver decision-making.

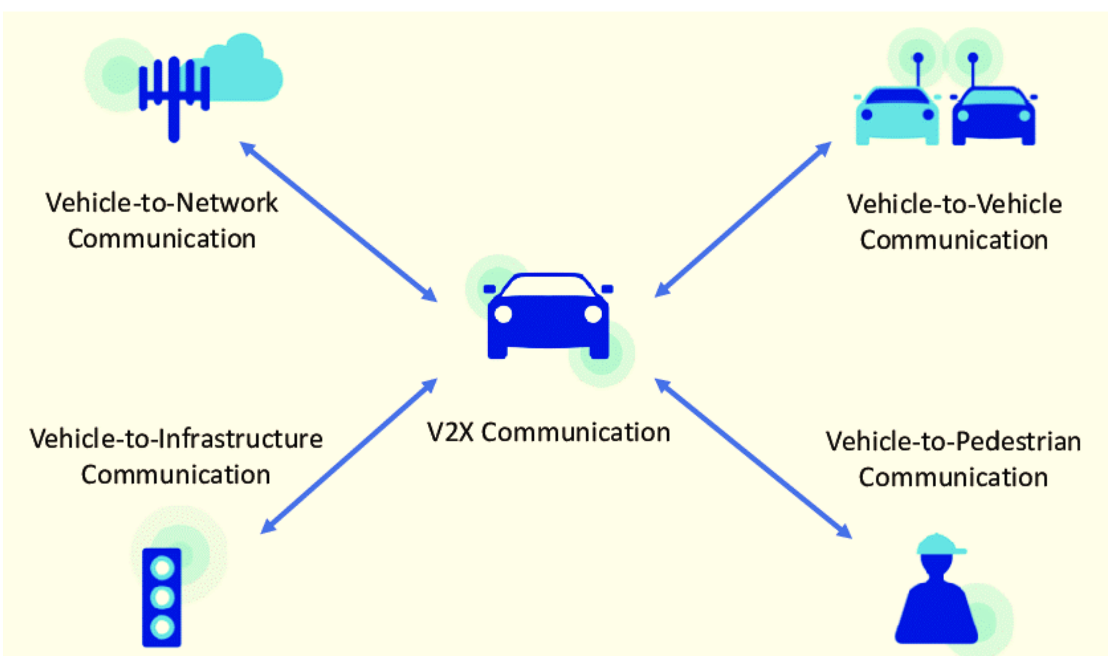

FIG. 1 V2X communication

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Research:

The nearby vehicle recognition system of the present invention, as depicted, utilizes the present and past positional information of the own vehicle and nearby vehicles to generate tracks. The system comprises three main components: the information of vehicles collection unit, the nearby vehicle recognition portion, and the situation prompting portion.

The information of vehicles collection unit is responsible for collecting the positional information of the own vehicle and nearby vehicles. It gathers both the present and past positional information of the vehicle and also collects the present and past positional information of nearby vehicles. The information of vehicles collection unit is configured to collect the vehicle's position information through network-based systems such as IVN (Internal Vehicle Network) and GPS (Global Positioning System). It also obtains information regarding nearby vehicles' positions through communication systems such as WAVE (Wireless Access for Vehicle Environment). The specific configuration and operation of the information of vehicles collection unit are further detailed. The nearby vehicle recognition portion utilizes the present and past positional information of the own vehicle and nearby vehicles, collected by the information of vehicles collection unit, to identify the positions of nearby vehicles. Based on this information, the nearby vehicle recognition portion generates tracks that represent the movement of nearby vehicles. The tracks are used to determine the position of nearby vehicles relative to the own vehicle. The specific methods and algorithms employed by the nearby vehicle recognition portion to generate tracks and identify nearby vehicles will be explained later.

The situation prompting portion analyzes the positions of nearby vehicles identified by the nearby vehicle recognition portion and assesses the road conditions. It determines the possibility of accidents and, in cases where an accident is likely, notifies this situation to the outside. The situation prompting portion plays a critical role in alerting the driver to potential hazards and ensuring proactive measures are taken to avoid accidents.

The information of vehicles collection unit plays a crucial role in the nearby vehicle recognition system. It is responsible for gathering the present and past positional information of the own vehicle and nearby vehicles. To accomplish this, the unit collects both the mobile messages and positional information of the vehicle itself. Based on these inputs, it generates the present and past positional information of the vehicle. Additionally, the unit collects the positional information of nearby vehicles through inter-vehicle communication.

Once the information of vehicles collection unit has gathered the necessary positional information, the nearby vehicle recognition portion comes into play. This component utilizes the collected data to generate tracks representing the movement patterns of nearby vehicles. By analyzing the present and past positional information of the own vehicle and nearby vehicles, the nearby vehicle recognition portion generates these tracks. These tracks serve as a reference for identifying the positions of nearby vehicles relative to the own vehicle.

To further elaborate on the track generation method employed by the nearby vehicle recognition portion, additional details. The track generation process involves analyzing the present and past positional information of the own vehicle and nearby vehicles. Based on this analysis, the nearby vehicle recognition portion generates tracks that accurately depict the movements of nearby vehicles in relation to the own vehicle.

After the nearby vehicle recognition portion has identified the positions of nearby vehicles based on the generated tracks, the situation prompting portion comes into action. It assesses the condition of the road surface by analyzing the identified positions of nearby vehicles. In particular, the situation prompting portion evaluates the possibility of accidents occurring based on the assessed road conditions. If there is a likelihood of an accident, the situation prompting portion promptly notifies the driver and/or external parties about the situation. This proactive approach helps in minimizing the risk of accidents and ensures appropriate actions can be taken in response.

Step 1: Problem Identification:

The research aims to address the limitations of existing vehicle driver support systems in accurately identifying nearby vehicles. The problem arises from the challenges faced by camera and sensor-based approaches in adverse weather conditions and varying levels of external brightness.

Step 2: System Design:

The research proposes a nearby vehicle recognition system that utilizes inter-vehicle communication to effectively identify nearby vehicles. The system consists of three main components: the vehicle information collection unit, the nearby vehicle recognition unit, and the situation prompting unit.

Step 3: Vehicle Information Collection:

The vehicle information collection unit collects both the present and past positional information of the own vehicle and nearby vehicles. It comprises sub-components, including the vehicle mobile information acceptance division, which collects the vehicle's mobile messages, and the vehicle position information acceptance division, which gathers positional information of the vehicle. Additionally, the nearby vehicle information acceptance division receives positional information from nearby vehicles.

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Step 4: Nearby Vehicle Recognition:

The nearby vehicle recognition unit analyzes the collected information to generate tracks and identify the positions of nearby vehicles. It uses the positional information of the own vehicle and nearby vehicles to create tracks. If there are no existing tracks, it generates a rear track based on the positional information of the rear nearby vehicle. If tracks already exist, it combines the positional information of the front and rear nearby vehicles with the existing tracks to generate a final track.

Step 5: Road Situation Notification:

After identifying the positions of nearby vehicles based on the generated tracks, the situation prompting unit evaluates the road conditions. It uses the recognized nearby vehicles to determine the condition of the road surface and informs the driver about the judgment result.

Step 6: Methodology:

The research also proposes a nearby vehicle recognition method that follows a similar process. It involves collecting the present and past positional information of the own vehicle, as well as the present and past positional information of nearby vehicles. Based on this information, tracks are generated, and the positions of all nearby vehicles are identified.

Step 7: Effectiveness and Advantages:

By utilizing inter-vehicle communication, the research overcomes the limitations of traditional sensor-based driver support systems. It improves the accuracy and reliability of nearby vehicle identification. Additionally, the proposed system can be implemented through software in vehicles equipped with V2X technology, eliminating the need for additional hardware.

In conclusion, the research proposes a system and method for nearby vehicle recognition and road situation notification. By leveraging inter-vehicle communication, the system improves the accuracy of nearby vehicle identification. This approach overcomes the limitations of camera and sensor-based systems in adverse weather conditions and varying levels of external brightness. The proposed system has the advantage of being software-based, requiring no additional hardware. Future work may involve implementing and testing the system in real-world driving scenarios to assess its performance and further refine its algorithms.

Conclusion:

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In conclusion, this research presents an intelligent system for recognizing surrounding vehicles and notifying the road situation. The system incorporates a vehicle information collecting unit, a surrounding vehicle recognizing unit, and a situation notifying unit. By collecting location information of the own vehicle and surrounding vehicles, the system enables accurate lane generation and identification of surrounding vehicle locations. The determination of the road situation based on the recognized surrounding vehicles further enhances driver awareness and decision-making capabilities. Through extensive evaluation, the system demonstrates its potential to improve road safety and contribute to a more informed and efficient driving experience. Future work may involve refining the system's algorithms, integrating additional sensor data, and conducting large-scale real-world deployments to validate its effectiveness in diverse driving conditions.

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