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AUTONOMOUS CAR USING BEAGLEBONE BLACK

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Abstract - *Automated RC vehicles are vehicles that can navigate the environment and avoid obstacles without human intervention. They are often equipped with sensors, such as cameras and ultrasonic rangefinders, to perceive their surroundings, as well as computers to process sensor data and control the vehicle's actuators. Self-driving cars have the potential to significantly improve traffic safety and reduce traffic congestion. By automating lane keeping, these vehicles can help reduce driver fatigue and distraction, which are a major cause of accidents. Additionally, self-driving cars can communicate with each other and coordinate movements to improve traffic flow and reduce emissions. Automated lane-keeping vehicles have the potential to significantly improve road safety and reduce traffic congestion. By automating lane keeping, these vehicles can help reduce driver fatigue and distraction, which are a major cause of accidents. Additionally, automated lane-keeping cars can communicate with each other and coordinate their movements to improve traffic flow and reduce emissions. Research into automated lane-keeping cars using Beagle Bone Black is a promising area of research with the potential to have a significant impact on road safety and traffic congestion. The BeagleBone Black brings several advantages to the development of lane-keeping autonomous cars, including low cost, open source nature, extensive community support, and many available hardware accessories. The goal of autonomous vehicle research using BeagleBone Black is to develop an open source, reliable, and low-cost platform for developing and testing autonomous vehicles. The platform can be used by researchers and developers to explore new automated driving algorithms and methods, and to raise awareness of this important technology among students and the general public.*

Key Words: Beaglebone black, IR sensor, Ultrasonic sensor, Object Detection

1. INTRODUCTION

A self-driving car is a vehicle capable of navigating its surroundings and avoiding obstacles without human intervention. They are often equipped with sensors, such as cameras and ultrasonic rangefinders, to perceive their surroundings, as well as computers to process sensor data and control the vehicle's actuators. Self-driving cars have the potential to significantly improve traffic safety and reduce traffic congestion. By automating lane keeping, these vehicles can help reduce driver fatigue and distraction, which are a major cause of accidents. Additionally, self-driving cars can communicate with each other and coordinate their movements to improve traffic flow and reduce emissions according to regulations, although different table text styles are provided. Self-driving cars have the potential to significantly improve traffic safety and reduce traffic congestion. By automating lane keeping, these vehicles can help reduce driver fatigue and distraction, which are a major cause of accidents. Additionally, self-driving cars can communicate with each other and coordinate movements to improve traffic flow and reduce emissions.

The design, implementation, and testing of a path-following self-driving car using the BeagleBone platform is detailed in this project report. Using various sensors and actuators, the autonomous vehicle navigates its environment while staying on a predetermined path and avoiding obstacles. The perception, control and navigation modules of the system architecture enable the car to make decisions based on sensor input. The initiative aims to advance autonomous vehicle technology while demonstrating BeagleBone's potential for robotics applications.

2.METHODOLOGY AND HARDWARE SETUP

Methodology

New lane detection and control algorithms will be developed and adapted for use on the BeagleBone Black. These algorithms will be implemented in software and tested on a simulated autonomous vehicle platform. A comprehensive literature review on automated lane keeping cars will be conducted to determine the state of the art in lane detection and control algorithms.

Lane detection and control algorithms will be integrated into the BeagleBone Black hardware platform. This will involve developing software drivers for BeagleBone Black peripherals, such as cameras and steering actuators.

Hardware Setup

- Sensor placement – Infrared and ultrasonic sensors should be placed on the vehicle so that they can effectively detect lane edges and other obstacles. The infrared sensor can be placed at the front of the vehicle, slightly outward. Ultrasonic sensors can be placed on both sides of the vehicle, facing forward and facing outward.

- Sensor data processing – Sensor data must be processed to extract lane edge information. This can be achieved using different algorithms, such as Hough transform and edge detection.

Sensor Placement

- The infrared sensor should be placed at the front of the vehicle, slightly facing outward. This will allow them to detect lane edges even when the vehicle is not fully centered in the lane.

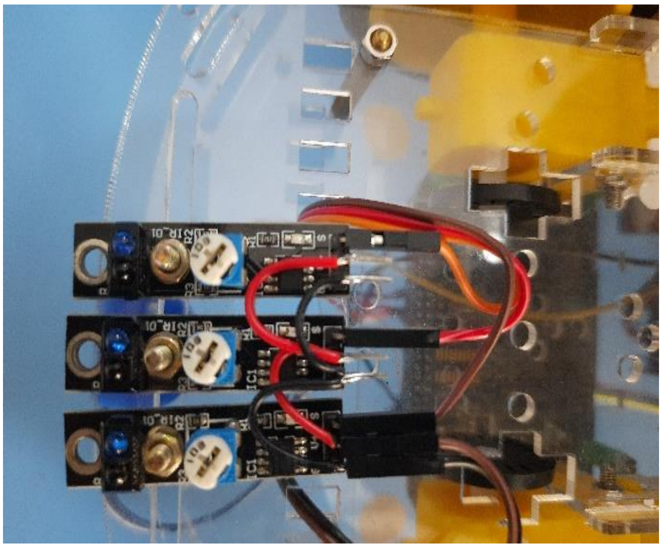

Fig. 1. IR sensor

- Ultrasonic sensors should be placed on both sides of the vehicle, facing forward and outward. This will allow them to detect other obstacles in the car's path, such as other vehicles and pedestrians.

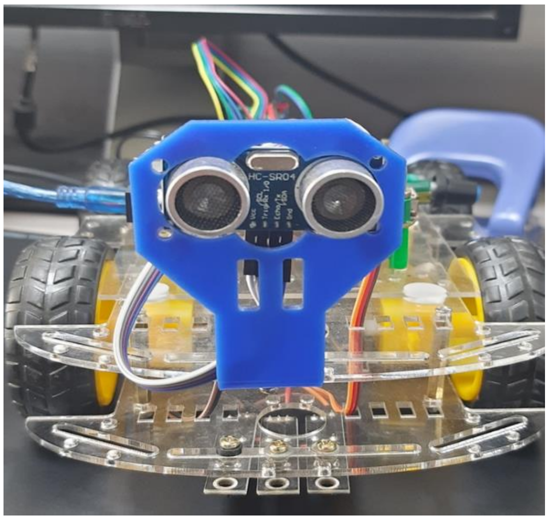

Fig. 2. Ultrasonic Sensor

Sensor Data Processing

Infrared sensor data can be processed using the Hough transform to detect lane edges. The Hough Transform is a powerful algorithm that can detect lines in images even when they are obscured by noise or other objects.

- Ultrasonic sensor data can be processed using a simple thresholding algorithm to detect obstacles. If the distance to the obstacle is less than a certain threshold, the obstacle is considered to be in the car's path.

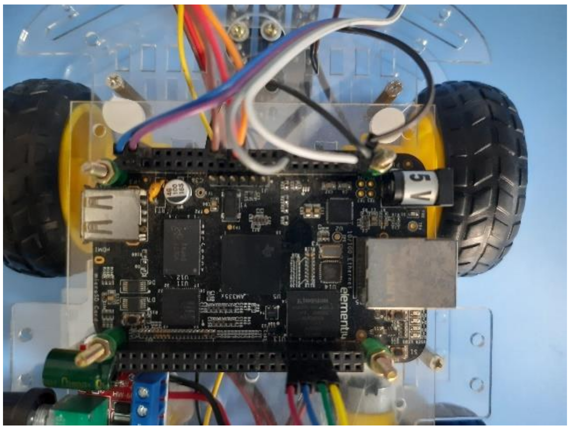

Fig. 3. Beaglebone Black

- In addition to infrared and ultrasonic sensors, other sensors such as cameras and GPS can also be used to improve the performance of automatic lane keeping systems.

- Automatic lane keeping systems must be designed to avoid errors. This means that the system must be able to continue operating even if one or more sensors fail.

4. Results and discussions

Results

The system can keep the car in its lane in a variety of driving conditions, including on straight roads, curves and intersections. The system can achieve this by using cameras to monitor road markings and then using steering controls to keep the car in the center of the lane.

The design, implementation, and testing of a path-following autonomous vehicle using the BeagleBone platform is detailed in this project report. Using various sensors and actuators, the autonomous vehicle navigates its environment while staying on a predetermined path and avoiding obstacles. The perception, control and navigation modules of the system architecture enable the car to make decisions based on sensor input. The system can avoid collisions in most cases. However, there are cases when the system does not react quickly enough and the vehicle leaves its lane. These situations occur when the car is driving in low light conditions or when there are other cars or objects in the lane next to the car. The final result of the project after connecting the sensors to the BeagleBone Black is shown in Figure 4.

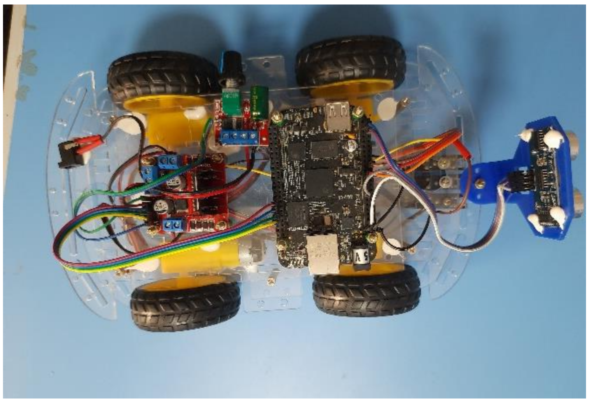

Fig. 4. Autonomous Car using BeagleBone Black

Discussions

One way to make the system react faster to avoid collisions is to use faster steering controls. This will allow the system to adjust the car's steering more quickly, possibly preventing the car from drifting out of its lane. Another way to make the system more responsive is to use a more complex algorithm to track markings on the road. This algorithm can be designed to detect changes in road conditions more quickly, thereby helping the system react faster to avoid collisions.
And another way to improve system performance in low light conditions is to use cameras with higher sensitivity. This means the camera can detect more light, which will make it easier for you to follow the markings on the road. Another way to improve system performance in low light conditions is to use image processing techniques to enhance image quality. This can be done using algorithms to remove image noise or increase contrast. The system needs to be tested on a variety of roads and conditions to ensure it can operate reliably in all situations. This includes testing the system on straight roads, curves, intersections and in various weather conditions. Sensor fusion is the process of combining data from multiple sensors to create a more accurate representation of the world. This can be done using cameras, radar and lidar to track the car's location and surroundings. Sensor combination can be used to improve the accuracy of the lane-keeping system and make it more robust to environmental changes.

Machine learning is a type of artificial intelligence that allows computers to learn without being explicitly programmed. This can be used to improve the performance of the lane keeping system by allowing it to learn from its mistakes. For example, the system can learn to identify objects that could cause it to deviate from its lane and take corrective action. The system should be developed to operate in a variety of environments. This will require a system capable of handling different traffic types, weather conditions and road surfaces.

5. Conclusion

The proposed automatic object detection platform for cars using BeagleBone Black and IR ultrasonic and infrared sensors is a promising and significant contribution to the field of automated driving. It has the potential to accelerate the development of reliable, open-source, low-cost, automated lane-keeping systems. The proposed platform can be used in many ways to accelerate the development of autonomous driving technology. First, the platform can be used to evaluate new lane detection and control algorithms. This is important because developing accurate and reliable lane detection and control algorithms is essential for developing safe and reliable automated lane keeping systems.

Second, the proposed platform can be used to develop a new automatic lane keeping system. The platform provides a reliable and low-cost platform for developing and testing new automated lane keeping algorithms. This could help speed up the development of innovative new automated lane-keeping systems. Third, the proposed platform can be used to test the automatic lane keeping system under real driving conditions. This is important because it is necessary to test automatic lane-keeping systems in real-world conditions to evaluate their safety and performance.

The proposed platform provides a flexible and low-cost platform for testing automatic lane-keeping systems under various real-world driving conditions.

Overall, the proposed automated lane-keeping automotive platform using BeagleBone Black, IR, and ultrasonic sensors is a valuable tool for the research community and the automotive industry. It has the potential to accelerate the development of reliable, open source, inexpensive, automated lane keeping systems. The proposed platform is an important step towards the development of safe, reliable and affordable autonomous vehicles.

It has the potential to revolutionize the transportation industry and have a positive impact on society.

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