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AUTONOMOUS ELECTRIC VEHICLE

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Abstract- Autonomous vehicles are the future smart cars anticipated to be efficient and crash-avoiding ideal urban vehicles of the future. The purpose of this project is to build a vehicle that can move with and without any driver. It only requires a command from the user, and then starts moving towards the destination. This project aims to build an autonomous vehicle prototype using a Raspberry Pi processor. Sensor interfacing provides the necessary data from the real world to a vehicle. The vehicle can reach a given destination safely and intelligently thereby avoiding the risk of human errors. Many existing algorithms, such as traffic light detection, obstacle detection, and speed control are combined to provide necessary control to the car. The technology that autonomous vehicles and "connected vehicles" use would allow vehicles to communicate with roadside infrastructure, such as traffic lights and road congestion, and then use this information to significantly curtail fuel consumption and emissions.

Keywords: *Speed control, Human Input, Human error, Obstacle detection.*

Introduction

According to a World Health Organization (WHO) report published in June 2022, approximately 1.3 million people die yearly from road traffic accidents. As a human driver, it is hard to remain in the correct lane and to keep following the proper gap with the front vehicle, as the driver needs to focus on the road for an extended time. Moreover, humans are prone to driver fatigue, sleepiness, inattention, and drowsiness. Besides that, using technologies in vehicles such as smartphones, entertainment, and navigation systems may interrupt the driver and compromise safety while driving. Therefore, the costs of road traffic accidents to society are expensive in terms of human injury and economic loss. The development of passive and active safety systems for automobiles has resulted from the concern mentioned above. Seat belts and airbags are examples of passive safety systems These were developed to decrease the risk of injury to the driver and passenger from the impact of accidents. These systems have become the standard safety gear for vehicles but are only utilized after accidents occur, but it would be far better if the casualties were entirely prevented. As a result, active safety technologies are becoming a talking point among automakers and researchers. The evolution of autonomous cars started in Europe around 1986.

and avoid accidents. Many car manufacturing companies have already started this revolution of manufacturing autonomous vehicles. Major companies like Tesla, Waymo, Nissan, Nvidia, and UBER are upgrading their versions of autonomous vehicles to capture the market demand. Nowadays the prices of fuels like petrol, diesel, and gas, are increasing rapidly day by day. To overcome this situation we use electric charge as the fuel to the vehicle. As electric charge is quite cheaper than other fuels that we are using these days. The vehicle can be provided in-built charging port.

The following are important topics of this paper:

Lane Detection: The designed vehicle can detect the lane or road by using the Raspberry Pi camera connected to the Raspberry Pi module.

Obstacle Detection: The designed vehicle can detect the obstacle at a certain distance from the vehicle and overcome the obstacle by moving either left or right.

Traffic Signal Response: The designed vehicle can respond to traffic signals whether the signal light is green or red.

Battery Management: The designed vehicle reminds the user about the battery condition i. e; power, voltage, current, and battery charge level on the LCD.

Proposed Block Diagram

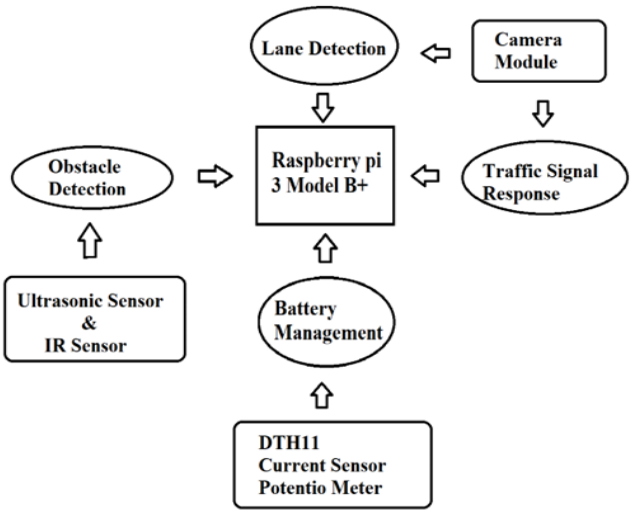

Fig.1: Block Diagram of Autonomous Electric Vehicle

In autonomous vehicles, there are various kinds of features like GPS navigation, Bluetooth, and Camera. It has a wide range of sensors and modules to run the vehicle

Proposed Process

Lane Detection

According to the images acquired by the webcam module, this module will detect the lane, allowing the car to stay within the lane and retain its position in the center. The Input Frames, which are primarily camera data, are first converted to grayscale for image pre-processing. The input image is then warped; which is the technique of digitally altering an image so that any shapes can be significantly deformed. The lane's edges are just the locations where the intensity of the values changes rapidly. As a result, for all such pixels, determining the mismatch between a pixel and all of its neighbors is required. The Canny Edge Detection technique was used to find these locations. It finds places with a significant gradient in the grayscale image. There must be a direct relation between each point in an image space and a line in the Hough space, and vice versa. As a result for every edge pixel detection, a subsequent line in the Hough space is drawn. In the original image space, the intersection point of the majority of these lines is selected as a single line, which defines the lane observed on the road. Figure (2) explains that the camera module identifies the black lane across the path and the vehicle moves along the black lane.

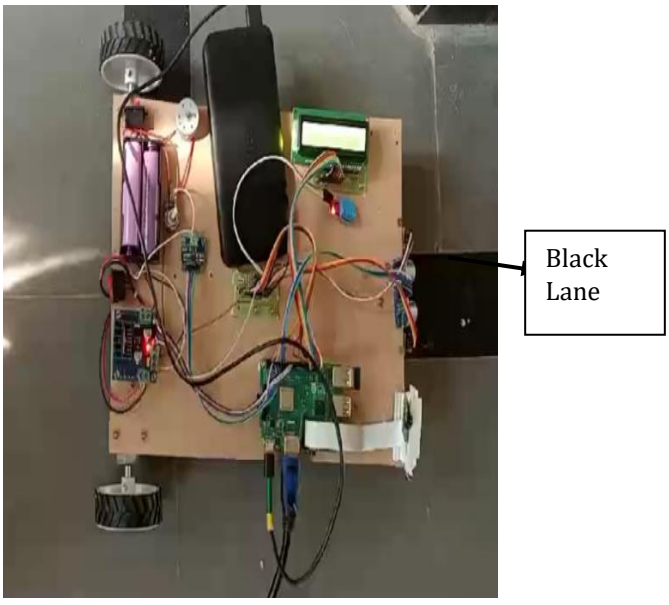

Fig.2: Lane Detection Using Camera Module

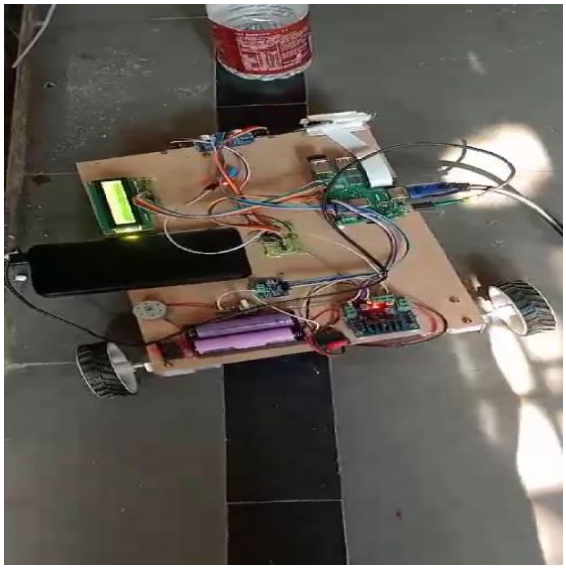

Fig.3: Obstacle Detection using Ultrasonic Sensor and IR Sensor

Traffic Signal Response

The Raspberry Pi camera module is used for the traffic signal response, The camera captures the image of traffic lights by using image processing techniques camera processes the image and identifies whether it is red or green. After detection of the signal light Raspberry Pi passes the command if it is green it passes the command to the motor drivers to move or if it is red it passes a command to the motor driver to stop. This is the continuous process of the Raspberry Pi camera module to process the image and accordingly pass the command to the motor drivers. As shown in Figure (4) and Figure (5) depict that the camera module detects the green light and red light respectively.

Obstacle Detection

The below Figure (3) explains the obstacle detection process using sensors**.** In obstacle detection, we mostly use ultrasonic sensors and infrared sensors. These two sensors calculate the obstacle distance from which the vehicle moves over the obstacle and continues its path in the same lane. Object/obstacle detection detects the presence of an obstacle and then calculates the distance between the vehicle and the obstacle. If the distance is less than 20 cm, as determined for our demonstration, it determines whether to swap lanes or stop if the following lane is not empty.

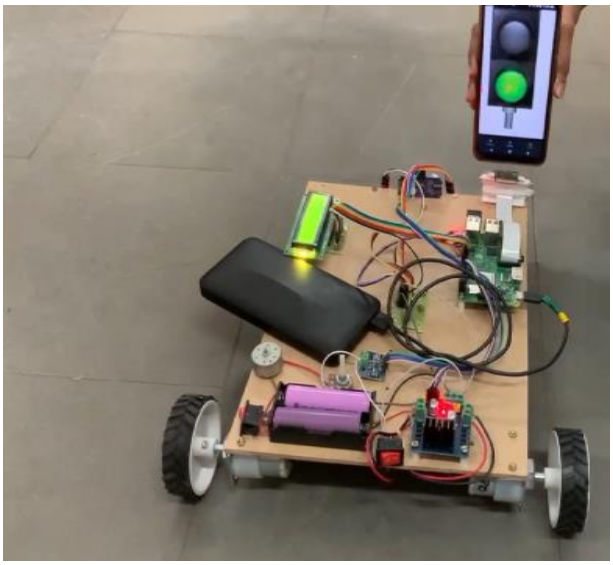

Fig.4: Traffic Signal Response When Signal Is Green Light Using Camera Module

Battery Management

The below shows the battery management design**.** As designing of the vehicle as an electric vehicle uses batteries as the power to run the vehicle. So the batteries need to be in good condition to get the user in trouble. In this project, the system is designed to measure the current, voltage, power, and temperature of the battery cells and it is displayed on the LCD screen for user convenience. In this, a potentiometer is also used for changing the threshold voltage of the battery we designed it as 3.5V. When it reaches less than 3.5V it reminds the user to charge the battery. In Figure (6) below LCD indicates the operating voltage as 7.36V, Operating current as 40.8012mA, Operating temperature as 32.0 °C, and power as 309.634mW.

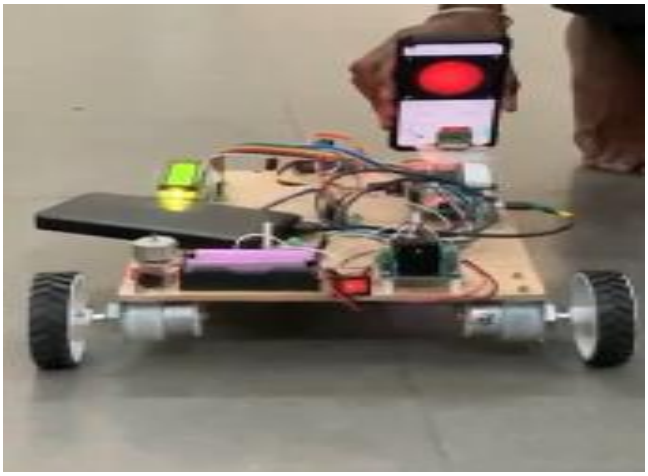

Fig.5: Traffic Signal Response When Signal Is Red Light Using Camera Module.

Fig.6: Battery Management Using DTH11, Current Sensor, Potentiometer.

Results

Figure (7) and Figure (8) show the overall entire system. In this project, the entire system is designed for lane detection whether the lane is suitable for the vehicle to travel using the camera module, to avoid accidents obstacle detection is also included using an ultrasonic sensor and IR sensor the vehicle detects the obstacle and turns to a side and continues its path, to detection the traffic signal camera module is used to recognize the signal light color when it is green vehicle moves and when it is red it immediately stops, finally to keep the batteries of the vehicle in good condition it requires some management and multiple checkups of the batteries condition by measuring the current using current sensor, temperature using DTH11, voltage using a potentiometer and also power in the batteries. These all features make the vehicle move successfully on the lane.

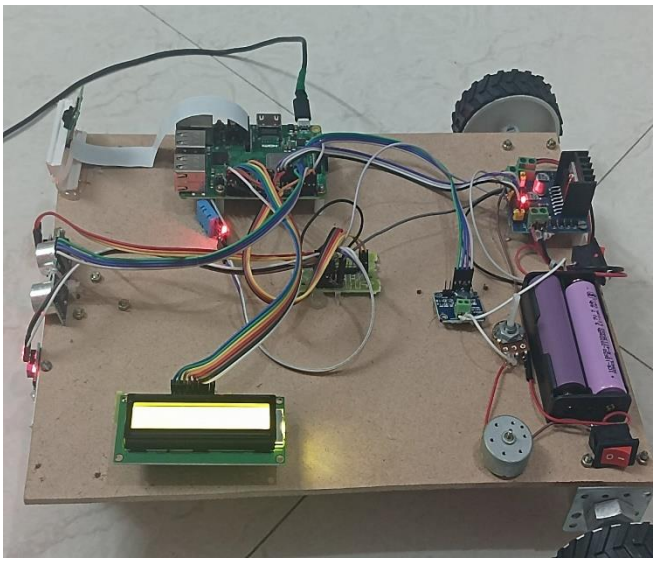

Fig.7: Overview of the Entire System

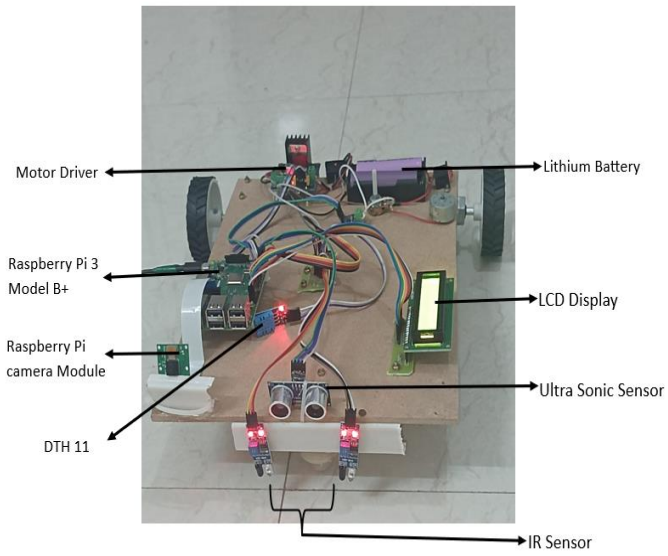

Fig.8: Final Output of the Project

Conclusion

In this project, a method to make autonomous vehicles is presented. The different hardware components and their assembly are clearly described. The driverless car revolution aims to develop autonomous vehicles for driverless transportation. For the economy, society, and individual business this autonomous technology has brought many broad implications. Cars that drive themselves will improve road safety, and fuel efficiency, and increase productivity and accessibility; driverless car technology helps to minimize loss of control by improving vehicle's stability as they are designed to minimize accidents by addressing one of the main causes of collisions: Driving error, distraction and drowsiness. The algorithm mentioned in this paper has been successfully implemented in a prototype of an Autonomous vehicle. The Python IDLE software was used for designing each module.

References

1. Vikrant Shahane, Hrushikesh Jadhav, Mihir Sansare, Prathmesh Gunjgur, "A Self-Driving Car Platform Using Raspberry Pi and Arduino" 2022 6th International Conference On Computing, Communication, Control And Automation (ICCUBEA), Pune, India, 2022, doi:10.1109/ICCUBEA54992.2022.100108414.

2. S.-W. Baek, M.-J. Kim, U. Suddamalla, A. Wong, B.-H. Lee, and J.-H. Kim, "Real-time lane detection based on deep learning" J. Electron. Eng. Technol., vol. 17, no. 1, pp. 655–664, Jan. 2022, doi:10.1007/s42835-021-00902-6.

3. D. Kavitha and S. Ravikumar, "Designing an IoT-based autonomous vehicle meant for detecting speed bumps and lanes on roads," J. Ambient Intell. Humans. Comput., vol. 12, no. 7, pp. 7417–7426, 2021, doi: 10.1007/s12652-020-02419-8.

4. N. M. Gohilot, A. Tigadi, and B. Chougula, "Detection of pedestrian, lane and traffic signal for vision base car navigation," 2021 2nd Int. Conf. Emerg. Technol. INCET 2021, pp. 1–6, 2021, doi:10.1109/INCET51464.2021.9456137.

5. S. Swetha and P. Sivakumar, "SSLA based traffic sign and lane detection for autonomous cars," in Proc. Int. Conf. Artif. Intell. Smart Syst. (ICAIS), Mar. 2021, pp. 766–771, doi: 10.1109/ICAIS50930.2021.9396046.

6. Manikandan Thiyagarajan, "Self-driving car" International Journal of Psychosocial Rehabilitation (IJPR), Vol.24, Issue 05, 2020, ISSN:1475-7192, doi:10.37200/IJPR/V24I5/PR201704.

7. L. Ding, H. Zhang, J. Xiao, C. Shu, and S. Lu, "A lane detection method based on semantic segmentation," Comput. Model. Eng. Sci., vol. 122, no. 3, pp. 1039–1053, 2020.

8. Mochamad Vicky Ghani Aziz, Hilwadi Hindersah, Ary Setijadi Prihatmanto. "Implementation of Vehicle Detection Algorithm for Self-Driving Car on Toll Road Cipularang using Python Language", 4th International Conference on Electric Vehicular Technology 2017.

9. Pascale-L. Blyth, Milos N. Mladenovic, Bonnie A. Nardi, Norman M. Su, Hamid R. Ekbia "Driving the Self-Driving Vehicle".IEEE 1 International Symposium on Technology in Society (ISTAS) Proceedings 2015.

10. Zehang Sun, G. Bebis, and R. Miller, "On-road vehicle detection: a review," IEEE Trans. Pattern Anal. Mach. Intell., vol. 28, no. 5, pp. 694–711, 2006, doi: 10.1109/TPAMI.2006.104.