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Automated Car: Intelligent Maneuver

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Abstract: ***Automated vehicles are rapidly evolving to meet the demands of modern transportation systems, aiming for enhanced safety, efficiency, and user experience. Autonomous vehicles are also a big part of these technologies. The most important action of a driver has to do is to follow the lanes on the way to the destination. This research presents Intelligent Maneuver, a sophisticated framework integrating four key functionalities crucial for automated car navigation: object avoidance, traffic light detection, self-parking, and lane detection. Leveraging advanced computer vision techniques and sensors fusion our framework enables vehicles to navigate complex urban environments autonomously.***
Keywords: Raspberry PI, Lane Detection, Canny Edge Detection, Region of Interest (ROI), Image Processing.

I. INTRODUCTION

The project, aptly named "Intelligent Maneuver," represents a significant stride in this direction, integrating cutting-edge technologies to create a car with autonomous capabilities. The key Functionalities that focus of the proposed work is on four pivotal functionalities are: A. Object Avoidance [6],[8] with sensors, allows it to detect and respond to obstacles in real-time. Whether it's a pedestrian crossing the road or an unexpected roadblock. B. Self-Parking System [4] can identify available parking spaces, and seamlessly parks itself. C. Lane Detection [2], [7] with the help of advanced line detection algorithms are employed to identify the lanes precisely. D. Traffic light detection identify signals and then suitable actions are performed briskly.

II. HARDWARE DESIGN

A. Hardware Modules

1) Raspberry PI (4B Model)
2) Ultrasonic Sensors
3) Jumper Cables (all types)
4) Car Chassis
5) 4 wheels with Motors connected
6) Motor Driver (L293N)
7) Power Bank, LEDs
8) PI Camera module

B. Hardware & Software Description:

1) *Raspberry PI (4B Model):* It acts as a computer which is debit card sized. It has a quad core processor of 64 bit. It has inbuilt camera module. It has in built Bluetooth facility for connection of remote device. It consists 8GB of LPDDR4 RAM along with Gigabit Ethernet and USB.
2) *Ultrasonic Sensors:* It is also called as a Distance Sensors. It is used to find distance between vehicle and an object in front of it. The Ultrasonic Sensor passes echo signal and receive trigger after the object was found. Using this signals the Ultrasonic sensors find the distance.
3) *PI Camera module:* It is camera that used to take high defined photographs as well as Videos. It is used to detect the traffic light and the Lane Detection.
4) *Debian Buster OS:* It is a new version of the Raspbian. This makes a way for less security breach. It allows the user to comfortable in security.
5) *Python:* It is a strong programming language i.e., Object Oriented Programming Language. It consists vast number of libraries which provide wide opportunities to build the models. These built-in modules make a way for shorten the implementation for the programmer.

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6) *GPIO Library (RPi.GPIO):* It is used to collect the input from the connected devices and process it then to perform the certain actions based on the process.
7) *OpenCV:* It is an openly available resource to process on the video stream and photographs. It is majorly used in vast sectors for classifying the images in to different formats. The OpenCV has large number of built-in functionalities to process quickly with minimum number of statements.

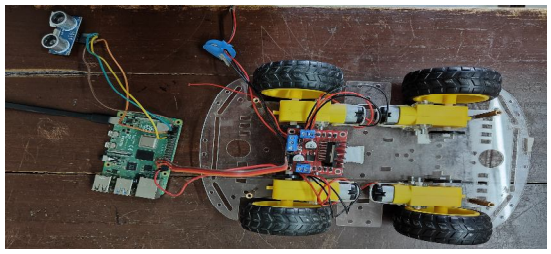


Fig. 1 Hardware Connection with the hardware requirements.

III. LANE DETECTION

The most important aspect of project was Lane detection. The input for the lane detection was taken from the PI Camera. This was processed using the following steps:

1) Convert input image to gray scale and then remove noise using guassian filter.
2) Apply Canny Edge detection then take ROI.
3) Detect right and left sided lines from ROI based on the slope.

Lane detection [13] was possible with the usage of cv2 module from the OpenCV library and Numpy library. Guassian filter can be obtained with the GuassianBlur class by passing the arguments of gray scale image, width, height, standard deviation. Pass the obtained image to the Canny class to get Canny edge detector. This make a path to get the ROI. The outcome of this module is here.



Fig. 2 The outcomes of each step of the lane detection.

IV. OBJECT AVOIDANCE

The Object avoidance is one of crucial part of the system. In general we observe our households automated vaccum cleaners which moves around the room without any object collision. Object Avoidance help to avoid the accidents during the collision. The object avoidance was implemented using the GPIOZero and GPIO module from RPi library. The Robot class from gpiozero module takes the motor pins of left and right respectively. The DistsanceSensor class from gpiozero takes the echo and trigger pins to calculate the distance between the object and the ultrasonic sensor.

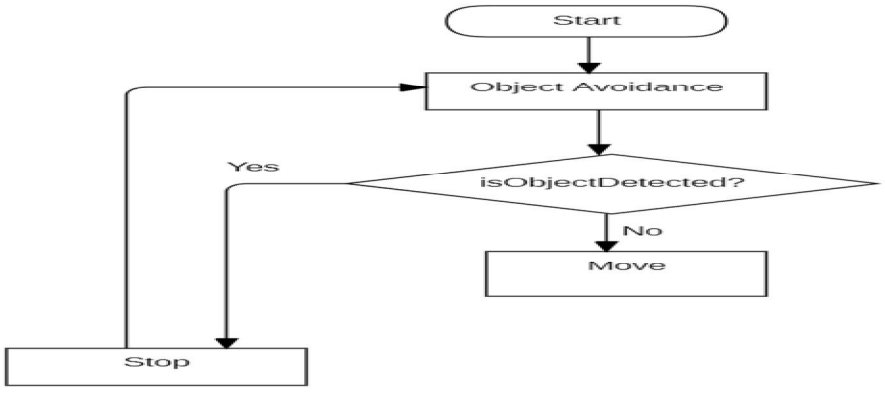


Fig. 3 Flow chart of the object avoidance.

V. SELF-PARKING

The parking is difficult task in real time. In order to it a system will make effective dynamics to the vehicle automation. The self-parking module was implemented using the ultrasonic sensors by comparing the width and length of the car. The ultrasonic sensor uses gpiozero and GPIO modules from RPi library. The Robot class controls the motor drive for wheel movement. The outcome of the module is here.

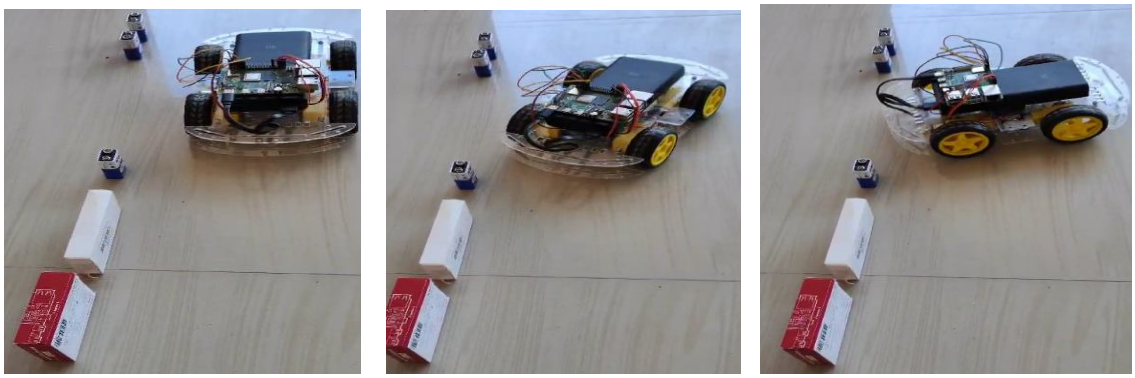


Fig. 4 Self-Parking Implementation

VI. TRAFFIC LIGHT DETECTION

Traffic Light was a great advisory for having the less traffic congestion. This system guide not to violate the signal jumping, We had implemented the traffic light detection using the CV2 to detect the light. On knowing colour the action that stop or move.

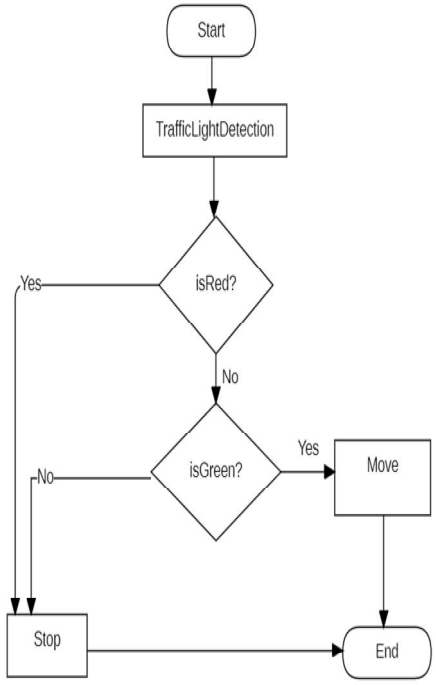


Fig. 4 Flow chart for Traffic Light Detection.



Fig. 4 Traffic Light Detection.

VII. CONCLUSIONS

In this project paper, we worked on the prototype model which focuses on the Object Avoidance, Traffic Light detection, Lane Detection, Self-Parking system. This complete prototype helpful to process all the pivotal functionalities in to the car. This system showed that it requires less energy usage and more time saver. It provides wide safer journey to all the users. System helps in increasing the mobility for the elderly and disabled people. Project provides safe transportation and helps in reducing the road accidents.

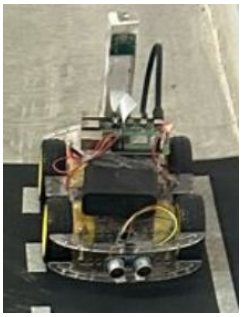


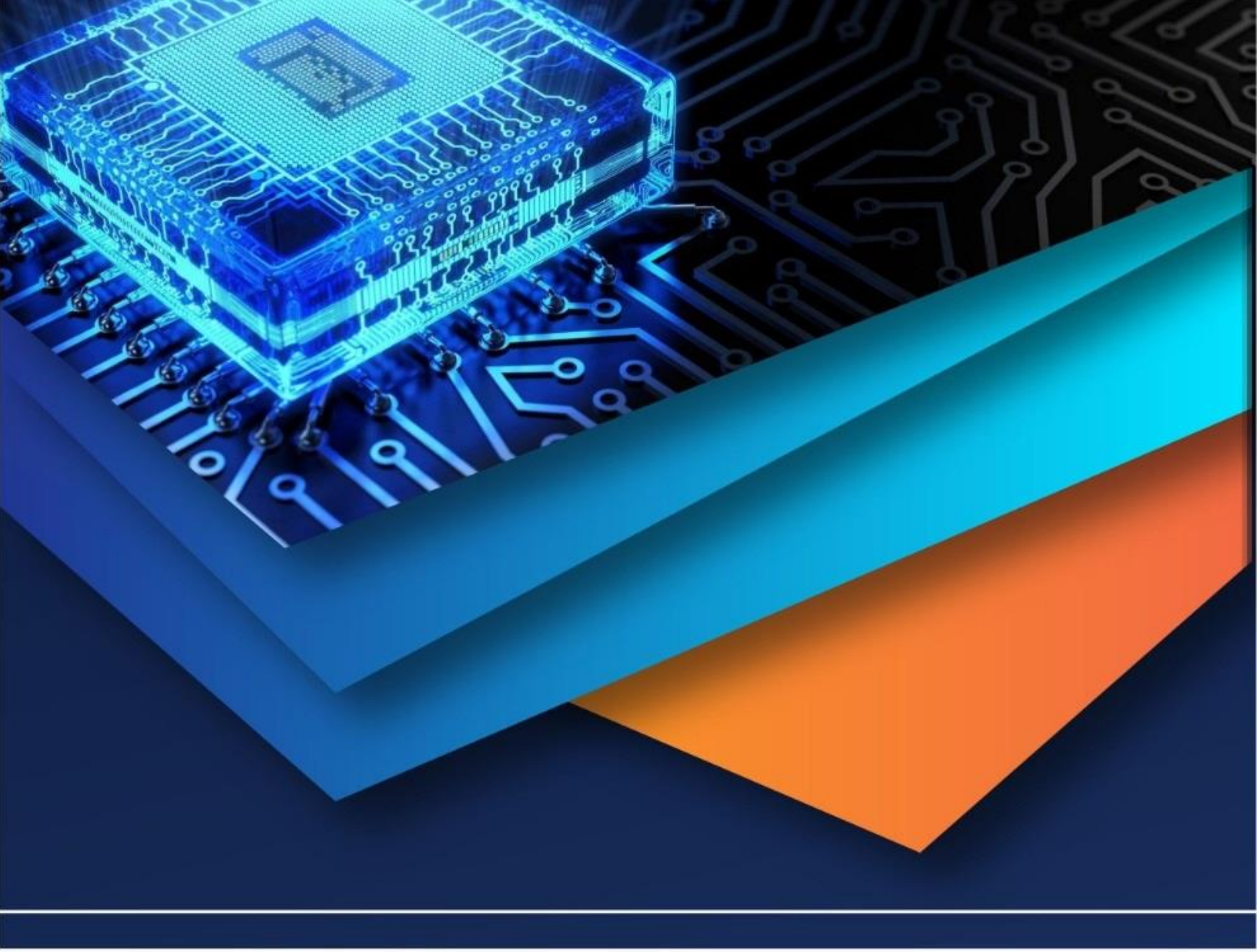
Fig. 5 Automated Car: Intelligent Maneuver

VIII. ACKNOWLEDGMENT

It is impossible for developing without these great inventions of raspberry PI, Ultrasonic Sensors and other components. All the resources played a crucial role in making a successful prototype. Python had an outstanding open-source libraries which led to make on more computations and processing with it for future safety. I would like to thank all other people who show cased all their willingness and alertness in designing and processing of this system successfully.

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