

Self Driving Car using Raspberry-Pi and Machine Learning

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Abstract - The paper aims to represent a monocular vision autonomous car prototype using the Raspberry-Pi as a processing chip. The pi-camera module along with an ultrasonic sensor is used to provide necessary data from the real world to the car which would then pass the data on to the raspberry-pi. The car is capable of reaching the given destination safely and intelligently thus avoiding the risk of human errors by responding to the real time traffic and obstacles. Many existing algorithms like lane detection, obstacle detection and traffic light recognition are combined together to provide the necessary control to the car. This would prove out to be a boon in the automobile industry as it would help in reducing the concentration required and strain put up on brain while driving also minimizing the probability of accidents due to careless or disobedient driving.

Key Words: Raspberry-pi, Pi-Camera, Machine learning, Image processing

1. INTRODUCTION

With the growing needs of convenience, technology now tries to seek automation in every aspect possible. Also, with the growth in the number of accident in the recent years due to increased number of vehicles and some amount of carelessness of the drivers, it now seems necessary to seek automation in vehicles as well. Hence to achieve the merit above mentioned problems, we present an autonomously drive car which would eradicate human intervention in the field of driving. The car would drive itself from one place to the other on its own it would possess integrated features like lane-detection, obstacle-detection and traffic sign detection. This features would help the car drive itself to the mentioned destination on the track properly, avoid collisions, provide live streaming of the view in front of it with the help of camera mounted over the car and detect traffic signs and obey them accordingly so as to avoid accidents caused due to disobeying the traffic rules. This would ensure safer, easier, updated and more convenient mobility, hence providing out to be a revolutionary step in the field towards automation and mobility.

1.1 Block Diagram

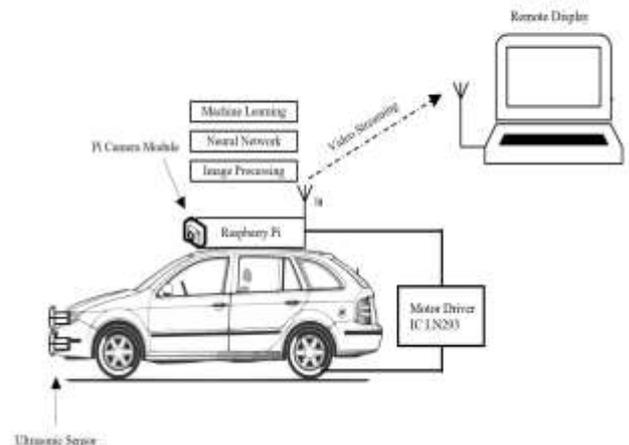


Fig.1.1 Block diagram

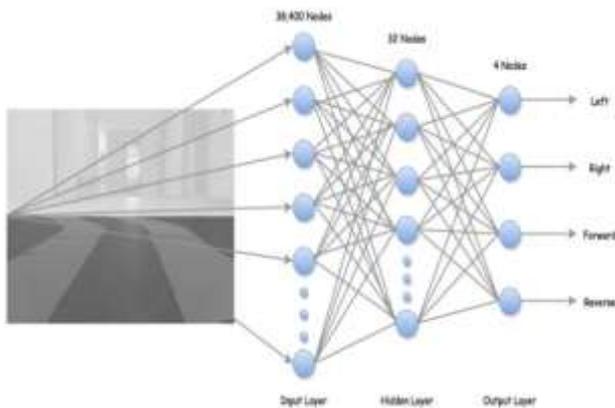
1.2 Working

As it can be seen in block Diagram, the raspberry-pi which is the central controller would be mounted on the car. The ultrasonic sensors would be placed on the front bumper of the car, while the pi-camera module would be placed on the roof of the car. The motor-driver ICs are responsible for the operation of motors and thus the motion of the car.

The ultrasonic sensors placed at the bumper of the vehicle would be used to detect any obstacle in front of the car and take according actions. Whenever there is any obstacle in front of the car and lies within the pre-determined distance from the car, the raspberry-pi orders the motor driver ICs to stop supplying power to the wheels and hence stops the motion of the car depending upon the proximity of the obstacle. The distance measured is also displayed on the output window of the program. The next step is detection of lane and traffic signs. For these, we use the principles of image processing. For detection of the traffic signs, HAAR-cascade classifier was used in Open CV. As we know, Open CV provides classifier as well as a detector.

To initiate the HAAR-cascade successfully, we uploaded positive and negative images of the data (traffic signal and stop sign). The positive image would be the image of the target data to be recognized and the negative image would be any image without the target data. On observing and

obtaining matches with the region of interest of the images, the signals and signs are identified. The region of interest is mainly the bounding box for the signs and signals. On feeding the necessary and appropriate data, the module is trained using the fundamentals of machine learning. Once the training is done, during the run, the decisions of lane observation, traffic sign and signal detection are carried by the use of neural networks to provide uninterrupted motion of the vehicle. For lane detection, monocular vision method is used as shown in the figure below:-

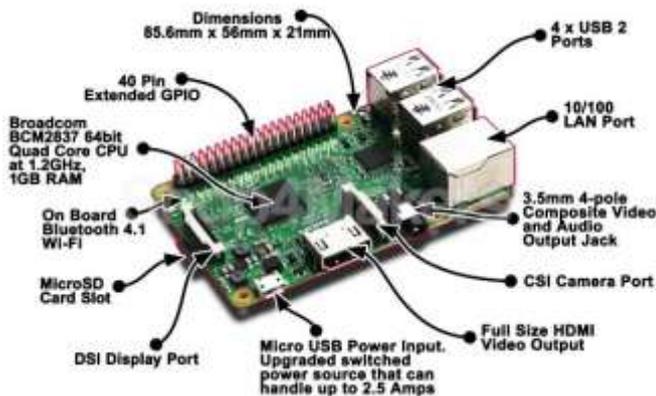


2. HARDWARE USED

1. Raspberry pi 3 B+
2. LN293 Motor Driver IC
3. Pi-Camera module
4. Ultrasonic Sensor

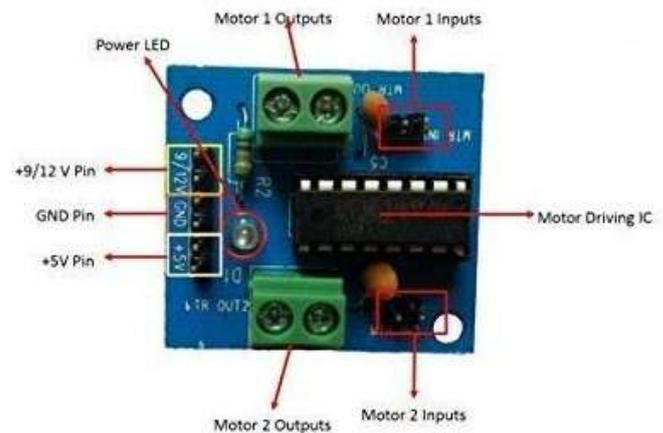
2.1 Raspberry Pi 3 B+

The processor used in this model is the Raspberry Pi B3+ model with a 1.4GHZ 64-bit quad-core processor. It possesses 1 GB of RAM and has extended 40 pin GP I/O header. It bears 4 USB 2.0 ports and a power input port of 5V 2.5A. It is used here as the main central processor to coordinate the functions, take appropriate inputs and then the decisions accordingly.



2.2 LN293 Motor Driver

The LN293D is the motor driver IC which is used to bridge the gap between the Raspberry-Pi and the motors of the car. The motor-driver IC receives signals from the Raspberry-Pi and then takes actions on the motors accordingly and facilitates their start-stop motion.



2.3 Pi-Camera Module

It is used for the live streaming of the feed in front of the vehicle and to capture images of the traffic signs and signals over which processing is done by the Raspberry-Pi later. It uses a Sony IMX219 8-megapixel sensor. It is connected to the Raspberry-Pi via a 15cm ribbon cable. It supports videos of 1080p30, 720p60 and VGA90 modes.



2.4 Ultrasonic Sensor

These are placed at the front bumper of the car to detect the obstacle in front and determine its distance. The distance is measured with the principle of echo of the ultrasonic waves. The safe distance after which the Raspberry-Pi orders the motor driver IC to stop the supply to the wheels and hence

the car is kept as 10cm. The ultrasonic sensor used has an efficiency of around 85%.



3. SOFTWARE USED

3.1 OPEN CV

OPEN CV is the abbreviation for open computer-vision and is a library and is helpful for real-time applications. It provides both, a trainer and a detector. Both, positive and negative samples are fed to obtain appropriate detection of the traffic signs.

3.1 HAAR Cascade

The HAAR cascade is a classifier used to identify the traffic signs and signals from the view present in front. The classifier compares the present image with the available image's region of interest from positive samples. The bounding boxes are considered as the region of interest in case of the traffic signal and then the Gaussian blur is applied to it to reduce the noise present in it. In the end, the red or the green lights of the signal are identified depending on the brightest point in the region of interest.

4. CONCLUSION

The autonomous car would surely prove out to be a boon in the automation industry and would be preferred over many traditional techniques. They could be used for patrolling and capturing the images of the offender. As they won't require any drivers, the accidents caused by the carelessness of the goods carrier vehicles would be reduced and would ensure better logistic flow. Buses for public transport would be more regulated due to minimal errors. Hence, due to greater autonomous nature and efficiency, an autonomous car of this nature can be practical and is highly beneficial for better regulation in the goods and people mover's section.

5. FUTURE SCOPE

To enhance the performance and ensure practicality of the car, the efficiency and processor speed need to be raised. A camera of better resolution would also be required as the scenes keep changing rapidly in the real world. Also the speed of the car should decrease gradually so that the passengers aren't hurt and the goods aren't damaged.

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