Artificial Intelligence Based Self-Driving Car

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Abstract
In this modern era, the Automobile Industry is getting updated day by day with the implementation of the latest technologies in vehicles. Artificial Intelligence and Machine Learning are some of the best trending and useful technologies in the world. Google, the expert in technologies, working on such projects since 2010 and continuously making modifications to it to date. In this paper, we focus on the implementation of all these advanced technologies in the vehicle to make the vehicle automated. Vehicles can detect and analyze their surroundings with the help of OpenCV by which vehicles can take decisions according to the surrounding conditions and drive on itself without human aid. Machine Learning helps the vehicle to understand the traffic signals and signboards so that a vehicle can drive according to it. These technologies help the vehicle to drive in rush traffics to minimize the use of clutch and brake. Since there is no human interaction, the human error will not be there and hence it will strictly follow the traffic rules and also minimize the percentage of accidents. Again with the help of IoT (Internet of Things) technology, the vehicle can notify all emergency stations (like a police station, fire station, etc.) about any emergency (like an accident). Hence by using all the latest technologies, our vehicle is increasing the efficiency of roads, fuel, emergency stations, etc. It also makes a better driving experience by giving relaxation to the driver.

***Keywords:** Self Driving Car, Raspberry Pi, OpenCV.*

INTRODUCTION

In this 21st century, technology is overtaking the classical way of working. Artificial intelligence is one of the most useful technologies among all and machine learning is a subset of it. The biggest industry is getting updated day by day with the help of the latest technologies (ex. MG Hector comes with advance AI system). The multinational tech companies like Google, IBM, Tesla, Wyamo are trying to be the pioneer in the field of self-driving cars since 2010. These companies making continuous upgrades to the self-driving car and making it more accurate to drive on roads. This project introduces you to the prototype of an autonomous car with OpenCV is a library that acts as a vision to the computer and can process images and frames in real-time. Automobile industry the implementation of Artificial Intelligence, Machine Learning, and the Internet of Things (IoT). An autonomous vehicle can decide heavy traffic by decreasing the continuous use of clutch and brakes with an increase in the efficiency of fuel. Having the greatest advantage of thinking independently, the human interactions are negligible hence accidents which are the results of human errors will decrease drastically with an increase in the efficiency of roads. RADS (Realtime Accident Detection System) can detect the accident condition with the help of sensors and inform the emergency services (like a police station, Hospitals, Fire station, etc.) about the accidents immediately.

LITERATURE REVIEW:

[1]For a vehicle to work on its own or to follow the path ahead of it, it needs to recognize the exact lanes including maintaining the distance between two lanes. This all functioning is done using OpenCV but yet it doesn't include the detection of signboards and signals which is the necessary component while following the lanes. Here, we are using the OpenCV for the detection of lanes, signboards and also for the traffic signal.

[6]The security which essential part of transportation has a huge impact on the programming of the system. This includes the privacy of an individual and the cybersecurity of the system that are important for sustainable development. Using this idea as our base, we have developed the RADS (Realtime Accident Detection System) which gives the notification if an accident has occurred and informs the emergency services for quick treatment along with the details of the vehicle.

[8]This paper includes the autonomous driving car using Arduino where it introduces the interaction between the human and the computer system. The use of a low-cost robot and the programmed Arduino together follows the instructions given to it through programming. Arduino has some limitations while working on advanced programming but the usage of raspberry pi gives the advantage to use various sensors and high-level programming. In addition to that, it doesn't have the camera module which implies the surrounding objects and the program according to them as they are identified using Open CV. As well as we are using deep learning and machine learning for the thorough mechanism of the self-driving car.

PROPOSED METHODOLOGY:

The hardware components which are prerequisite in this prototype consists of Raspberry pi 4 (1GB ram), Raspberry pi camera module, motor driver (L298N), DC motor, Node MCU, vibration sensor.

A) Component required

1) Raspberry Pi 4 (with the camera module) –

Raspberry Pi 4 is a small single-board computer that comes with Broadcom BCM2711 CPU which is based on Quadcore Cortex A72 64-bit SoC @ 1.5GHz with 1GB of RAM, WIFI, Ethernet. It contains 40 GPIO pins, two 5V pins, two 3.3V pins, and 8 ground pins. The GPIO pins of raspberry pi can also produce the PWM (Pulse Width Modulation) signals. Raspberry pi can also be used with a 5MP camera module to provide vision to the computer. The Raspberry Pi can use to run the python programs and can be used in various projects.

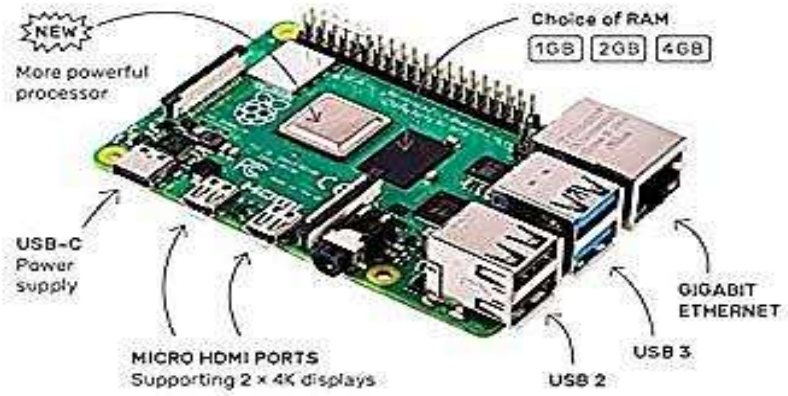


Fig.1: *Raspberry Pi 4*

Motor driver (L298N) –
Double H driver module requires ST L298N dual full-bridge driver which is an integrated monolithic circuit in a 15-lead multi-watt containing PowerSO20 packages. It has characteristics like high voltage, high current dual full-bridge driver which specifically designed to accept standard TTL logic levels and drive inductive loads.

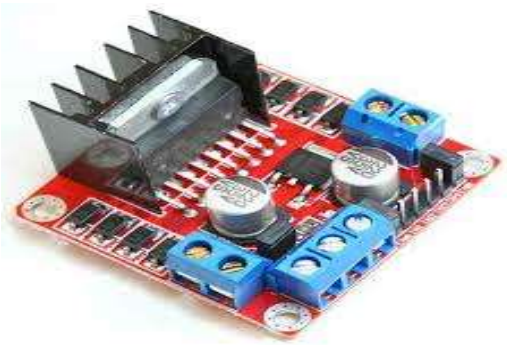


Fig.2: *Motor Driver*

DC motor -
It is an electric motor that works on direct current. It is the most common type of motor which is used in robotics. The motor which is used in the car is of 120 RPM and having the torque of 1.76 N.m. it works on 12 V DC with the rated current of 5500mA.

Fig.3: *DC Motor*

NodeMCU –
It is a low-cost microcontroller containing the Wi-Fi module which is mostly used for IoT platforms. The firmware of NodeMCU is based on ESP8266. It contains 11 GPIO pins, 1 Analog pin, 5 GND pins, 4 3.3V pins with 1 voltage input pin. It can be programmed with the Arduino IDE.

Fig.4: *NodeMCU*

Vibration Sensor –
A vibration sensor also called a piezoelectric sensor. It is used to measure the vibration in the system. It is used along

with nodeMCU in this car to detect accidents and notify the emergency stations about the emergency. The range of vibration sensors can vary from 10 mV/g to 100mV/g. The working voltage of that sensor is between 3.3v to 5v.

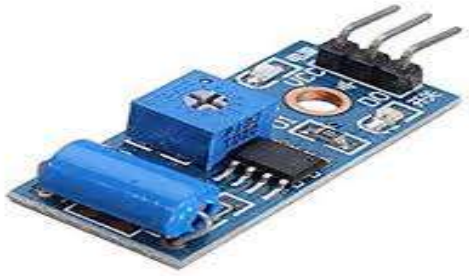


Fig.5: *Vibration Sensor*

MODULES

LANE DETECTION USING CANNY EDGE DETECTION ALGORITHM

Canny Edge detection algorithm is an Edge detection algorithm that is used to determine the edge between two distinct colors. The boundary between two different colors is considered as an edge.

- Convert original image into a gray scale

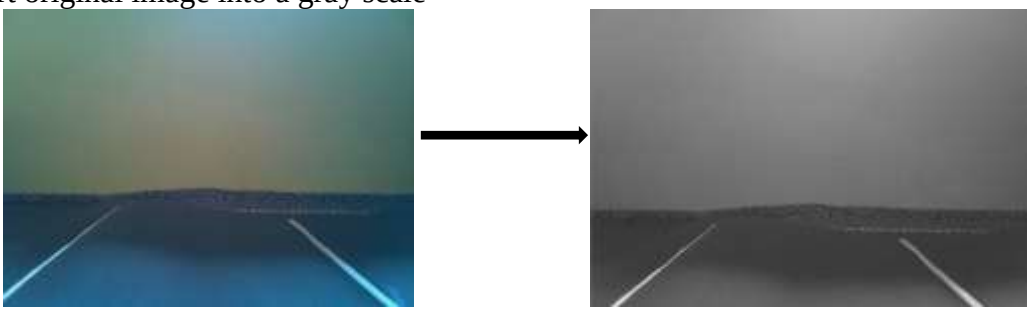


Fig.6: *Original Image*

Fig.7: *Gray Scale Image*

- Remove noise using Gaussian blur

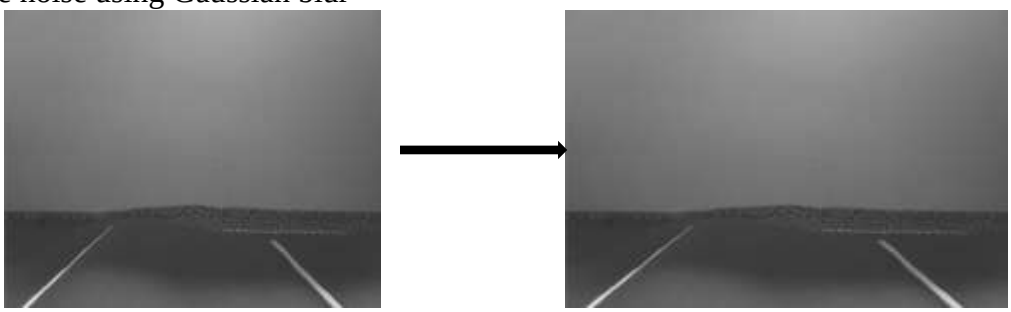


Fig.8: *Gray Scale Image*

Fig.9: *Gaussian Blur Image*

- Edge detected using canny

Fig.10: *Gaussian Blur Image*

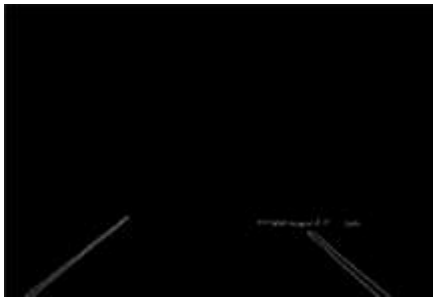


Fig.11: *Canny Edge* Detection

- Selecting Region of Interest

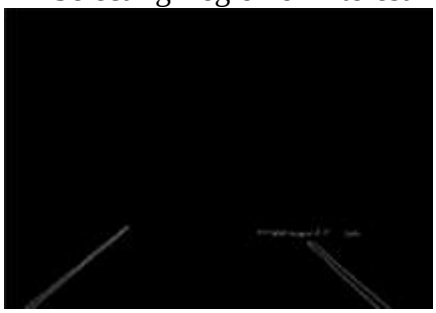


Fig.12: *Canny Edge Detection*

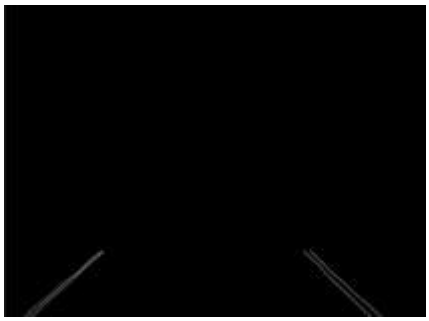


Fig.13: *Cropped Region of Interest*

- Applying Hough Transform

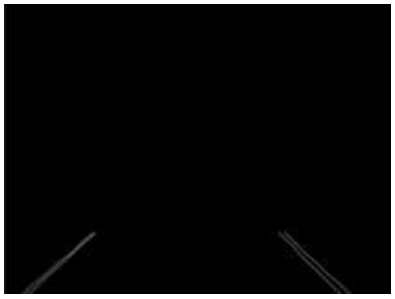


Fig.14: *Cropped Region of Interest*

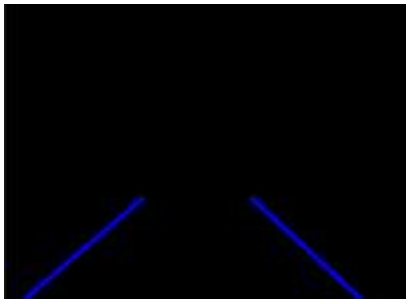


Fig.15: *Hough Transform*

- Lane Detected

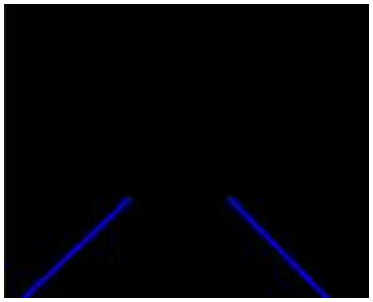
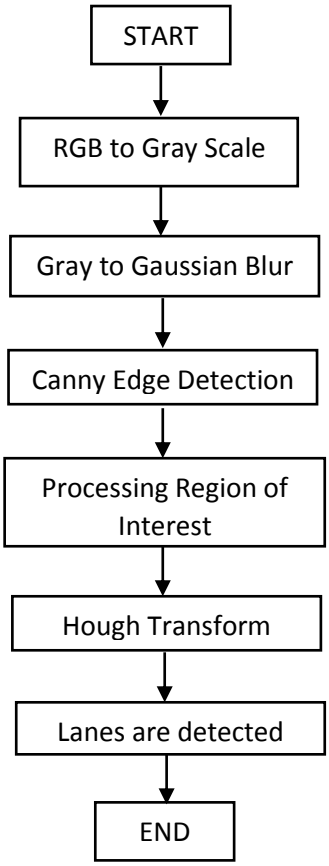


Fig.16: *Hough Transform*

Fig.17: *Lane Detection*

Flowchart:



SIGNBOARD DETECTION USING HARCASCADE

Haar cascade is a module which is used to detect a specific object in an image or video with the help of OpenCV. Haar cascade module training is a machine learning process in which a module is trained by giving the dataset of positive and negative images for a particular object. Ones the Haarcascade module is fully trained, it can be used to detect that particular object (example- signboards, traffic lights)

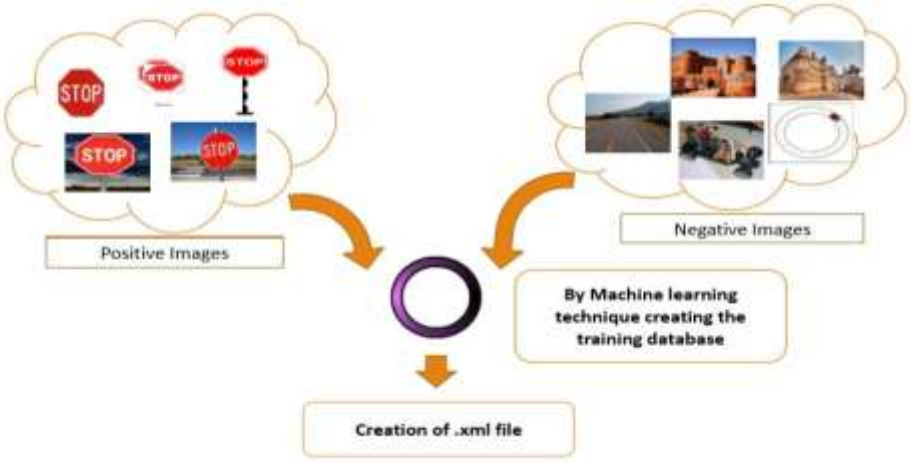


Fig.18: *Process of Haarcascade training*

Hence by following the above process the .xml file for haar cascade has created successfully.

Fig.19: *Sign Board detected with Harcascade*

RADS (Realtime Accident Detection System)

RADS is an advanced emergency safety service which can detect an accident and inform emergency stations (like a police station, ambulance, fire station, etc).

If any hazardous situation occurs the system can send a notification on the android app which belongs to the emergency station's officer with vehicle details and exact location of the accidents, therefore the rescue operation can perform immediately.

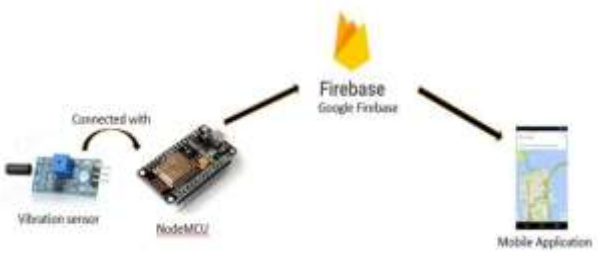


Fig.20: *Working of RADS system*

Fig.21: *User Interface of RADS Application*

RESULT

Lane Detection

As shown below, the device can detect the lanes of roads using a canny edge detection system which allows the device to follow the correct path to reach its destination.

Fig.22: *Car driving between lanes*

Sign Board detection

After detection of signboards according to instruction device acts and performs the functions which signboard imply. Such as the stop sign board instructs to halt the functioning of a moving device as well as the signal commands the manoeuvre of the device.

Fig.23: *Stop sign detected using HaarCascade*

RADS (Realtime accident Detection system)

When a vehicle experiences an accident this application informs rescue services to reach a location conveniently.

Fig.24: *Vehicle details and its location on mobile application*

CONCLUSION

The technology is reaching its high peak and so as it is appeasing human lifestyle. An Autonomous car is one of the examples. We have developed a self-driving car which makes human life easier. This car is providing great efficiency to the transportation system with big advantages like reduction in accident rates and relaxation for drivers in heavy traffic jams. We also implemented a RADS system for safety measures which will help quick execution in a critical situation. This way it covers all the important needs which affect transportation system in an enormous way.

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