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AUTONOMOUS VEHICLE USING COMPUTER VISION

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Abstract

Computer Vision in autonomous vehicles can lead to the designing and development of advanced and next-generation vehicles which can overcome driving obstacles while keeping passengers safe. Such vehicles can transport passengers to their destination, eliminating human involvement. The basic concept is taken from line following robot and Raspberry pi it is enhanced by image processing algorithms. The raspberry pi board is used to process image processing algorithms using open CV python coding, and ultrasonic sensor is also used to find obstacles. The vehicle moves on the road-based and Ultimately and on color lines identification. Ultimately the efficient autonomous vehicles can be designed using computer vision techniques. This method is used to reduce human involvement and to traffic collisions, to avoid major accidents which are made by human mistakes. If an obstacle may present on road the vehicle measures the obstacle distance with help of computer vision. Then automatically vehicle moves on the other side by the identification of white lanes which are present on roads the vehicle moves only on the black area on road. When the vehicle reaches white lane the vehicle automatically stops and takes direction on road.

Keywords—Artificial intelligence, Computer vision, Image processing, Object detection.

1. INTRODUCTION

Now-a-days in the field of automobiles, the technological improvement is based on Autonomous vehicles and peoples are using their own vehicles due to inconvenience of public transportation. Unfortunately, the traffic problem has been created, due to increment of heavy vehicles. To overcome this traffic problem, traffic rules are established. For that purpose we require an efficient vehicle to enhance safety and traffic less transportation those are Autonomous vehicles. Autonomous vehicle is the one and only most important innovation in the automotive industry. If we can improve this technology, we can control the most of the traffic problems like accidents and thus this result on both every individual and in the society. Due to human mistakes maximum accidents will be occurred. However autonomous vehicles are still in their infancy stage and cannot be deployed on urban traffic-filled roads for some time. Because even a minor defect in designing or development of this vehicle can cause fatal accidents and life risks. Researchers and professionals are applying computer vision technology to autonomous vehicles to make it safer for passengers and pedestrians as well. The technology can be used in the following manner in an autonomous vehicle. Autonomous vehicle will consist of up to 75% of the cars on the roads. A huge number of individuals have lost their lives in the previous 10 years because of heavy traffic accidents. The purpose of this project is to create a safe self-driving vehicle that could help huge number of people every year. Practically all the .0traffic accidents are occurred by human faults. Unfortunately, according to statistical analysis, in the future 10 years the number of lives lost each year will likely be doubled. To avoid such type of problems we are moving towards Autonomous vehicles.

2. LITERATURE REVIEW

According to research every year, 1.35 million people are killed on roadways around the world. Every day, almost 3,700 people are killed globally in road traffic crashes involving cars, buses, motorcycles, bicycles, trucks, or pedestrians. Our project mainly focuses on automatic vehicles. We have compared our vehicle with different types of vehicles:

A. Use of Computer Vision for White Line Detection for Robotic Applications: According to the paper [1], The automatic vehicles are still not implemented they just implemented a vehicle which is capable to travel in a grassy-area with the help of white line detection for this implementation they used the open computer vision with the python and, image processing with white line detection to recognize the white line detection process, task by the vehicle they used various methods of image processing such as color space, image filtering, blurring, histogram, equalizing, edge detection etc. For this process they used the pre-recorded video and a camera attached to the vehicle. For the detection of the white line, they placed some objects to know whether the camera implemented by the image processing have the capacity to.

B. Ways for Improving Efficiency of Computer Vision for Autonomous Vehicles and Driver Assistance Systems:

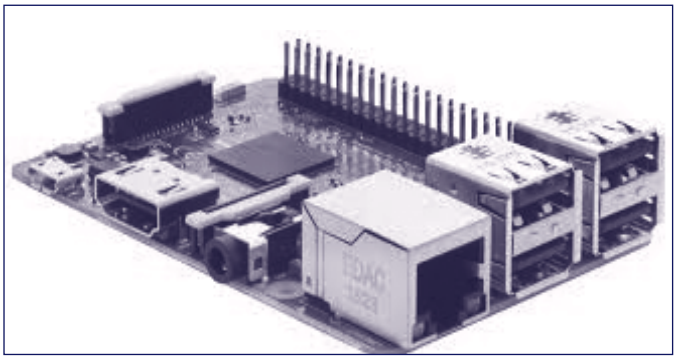
According to the paper [2], it explains about the way to improve the automatic vehicles with the help of computer vision in the driver observation. This paper gave the Analysis of, about the human vision and features which are used for the development of the computer vision the human eye have some effects and defects. When the vehicle is in traveling the field vision should be according to the camera vision. The vision of the driver can be changed depending on and in the situations. So that they used binocular vision the system of automatic vehicles is used to decrease the accidents risk especially at high speed, light brightness, darkness, fog, etc. The majority of the drivers that does not have the capability to see at the nighttime due to cloudy, whether changes, darkness, overcast, etc. because the vision of the people's eyes are limited. The chances will be more when the speed increases the vision will be decreased. The minimal interval distance between the two eyes is called visual separation the eye ability to see the two point separation is just 1 angle minute. The vision of the human eye will be changes from age to age. The vision moves from road to road of speedometer, from previous position. The eyes will be closed in in-regular intervals of time. The vehicle movement from road to road has to be observed by the driver and it is necessary to measure the corresponding road situation. In the artificial illumination condition if the speed increases on every 16km/h the vision of the human will be decreases per 6m. People who are having congenital defect called color blindness don't have the permission for driving. The rectangle conventional area size of concentration and the size of the conventional rectangle area from the driver's vision is totally different. There are some rules that what colors should be painted in the interior of the vehicle yellow, green, blue are the colors which have to be painted in the vehicle. These are the cool colors which the eye will not be affected to such colors. To convert the driver's vision into computer vision all these necessary suggestions have to consider.

3. METHODOLOGY

3.1. Hardware Details: The below knowledge illustrates the options of hardware elements employed in the project.

A. Raspberry Pi: Raspberry pi is the heart of the project as it acts as a mini computer for the whole project. 5V power supply is required for raspberry pi. It has RAM 1 GB and 1.2 GHz quad core ARM cortex A-53. It has 40 GPIO pins. It has four USB ports which we can connect keyboard, mouse and camera module. The languages used in the raspberry pi 3are python, shell script, C programming. The major advantage of the raspberry pi 3 when to the Arduino is it has inbuilt WiFi module, audio jack, video port, wireless local area network , HDMI port, DSI port and Bluetooth. It has 40 General Purpose Input Output pins. It runs on Raspbian OS and the OS can be stored in a Secure Digital cards. SD cards can also be used to store program memory. The operational speed of raspberry pi 3 varies from 700MHz to 2 GHz and its On-board memory varies in between 56MB to 1GB RAM.

Fig.1: Raspberry Pi 3 b module

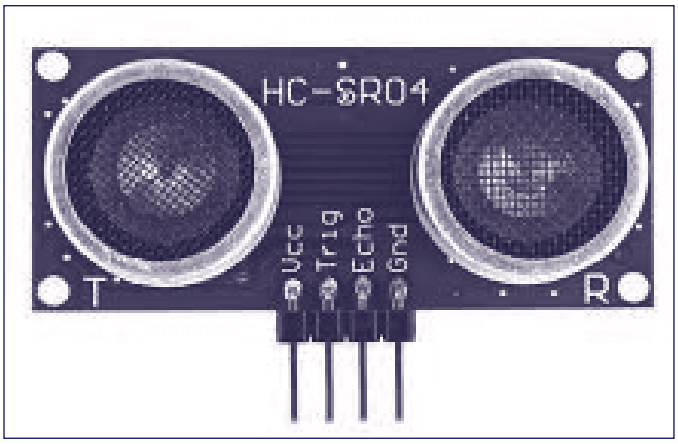


B. USB Camera: In this project the resolution of the camera is 640x480. It is able to capture picture up to 24mega pixels. The USB web camera is used to detect the path i.e., road and also obstacles can be detected.

Fig.2: USB Camera

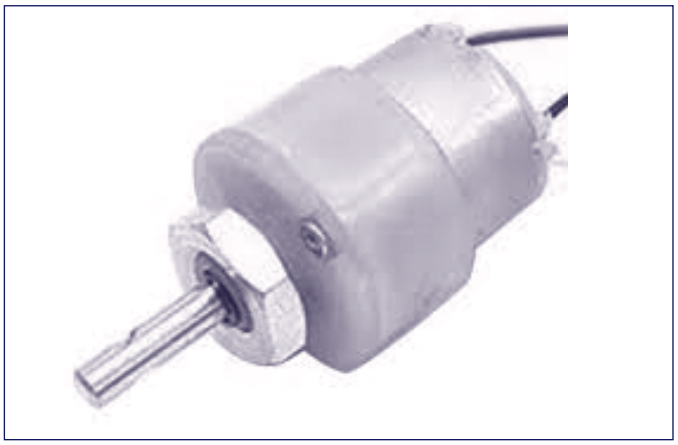
C. Ultrasonic sensor: Ultrasonic sensor used in this project is HC-SR04. It has four pins. There are Trigger pin, Echo pin, power supply pin, Ground pin. The working frequency used for sensor is 40Hz. The maximum range of the ultrasonic sensor is 10cm to 400cm. It can find the obstacles can find the distance between other vehicles or obstacles.

Fig.3: Ultrasonic sensor



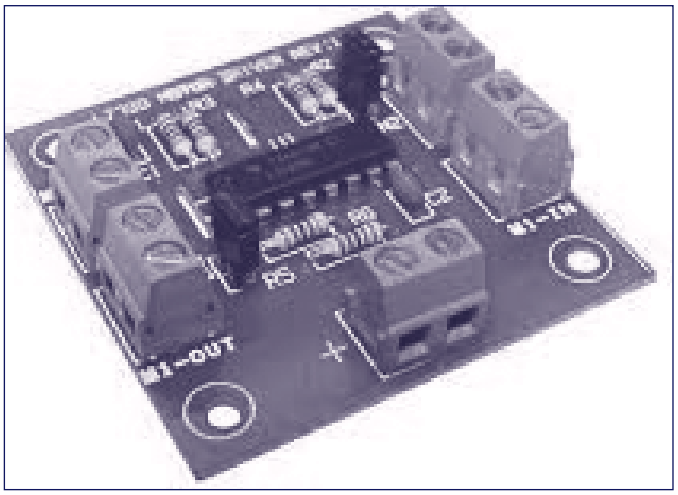
D. DC gear motor: A Dc gear motor is combined with both motor and gear box and this gear head reduces the speed when increases the torque output. These motors are used for moving of vehicles i.e., forward,backward,left and right conditions. The speed of the motors are 10 rpm with gear box and power supply required is 12V. It has 6mm shaft diameter with internal hole. The weight of the motor is 125gm. As the operating voltage of DC gear motor is 9V and above so raspberry pi cannot the DC gear motor so the motor driver is used to control the DC gear motor. It works on the principle of Flemings' left hand rule. The DC gear motor is shown in the below figure.

Fig.4: DC gear motor



E. Motor driver: Motor driver is required to drive motors. The power supply used for motor driver is 12V battery. In our project we use L293D motor driver. It drives in either direction and it has 16 pins, which can drive two motors. L293D IC has 9 pins. It is used to drive high current motors using digital circuits. It can be used to drive stepper motors also.

Fig.5: Motor Driver



3.2. Software Details:

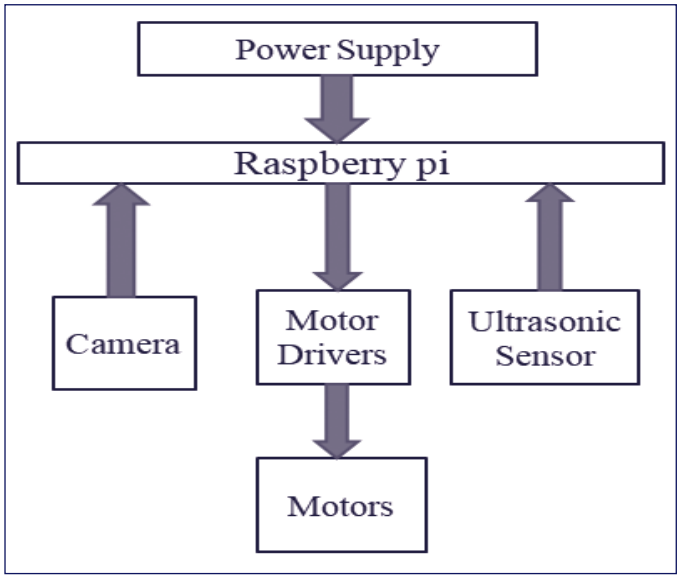
A. Raspbian OS: In this project Raspbian Jessie OS is used. As it is easily understandable to everyone and it is default programming OS for raspberry pi. There are two types of OS which are frequently used for raspberry pi. They are Raspbian Jessie and Raspbian Stretch. As raspbian stretch is used in deep learning and Raspbian Jessie is mostly used OS. Raspbian Jessie depends on Debian.

B. Python: Python was developed by Guido Van Rossun in 1989. Python is a platform independent language i.e., irrespective of processor and OS and it can runs anywhere when compared to C, C++. It is simple, easy to learn and easily to understandable. It has highly security. The code written in python will have few lines. The program for this project is written in open CV python. Python supports web based, desktop based, graphic design, scientific and computational applications.

C. Open CV: Open CV is Open Source Computer Vision. It is study of programming functions which mainly focuses on real time computer vision applications. It is cross-platform. The languages written using this platform is C, C++ and Python. It supports some of the areas are motion tracking, object identification, human computer interaction, deep neural networks etc. It runs on the some of the desktop operating systems are Windows, Linux, macOS, and openBSD.

4. DESIGN AND IMPLEMENTATION

Fig.6: Block Diagram



Here is simple block diagram of autonomous vehicle which describe to the actual structure of project. As shown in figure, the raspberry pi is the heart of the project, where the main components are attached to raspberry pi. Camera attached to raspberry pi which capture the video, image and detect the obstacles on the roads. Ultrasonic is added to the raspberry pi which measure the vehicle to vehicle distance. Motors are attached to raspberry pi; motor drivers are required to drive the motors. And when it is connected to the cloud vehicle location can be tracked and speed can be detected.

5. RESULTS

This comprises of object detection and obstacle detection

Object detection

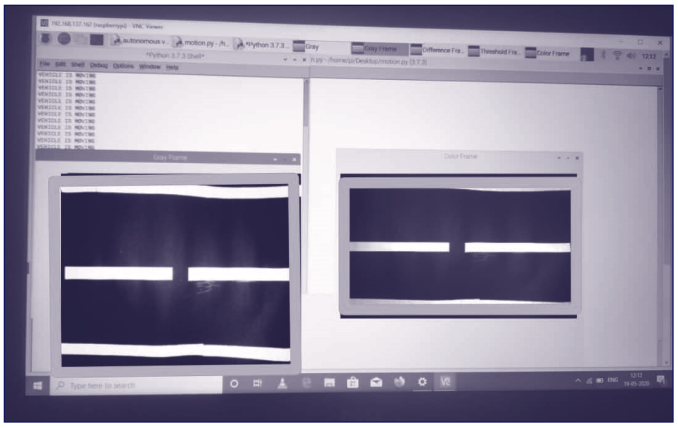
Object detection is a key behind advanced automatic driver assistance systems that enable cars to detect to improve road

safety. Object detection is also useful in applications such as video surveillance cameras or image retrieval detecting systems**.**

Case 1: Detect road as object

In this case the road is considered road as object. While considering the object it provides bounding boxes for objects. After finding of object i.e., road then the vehicle moves on road.

Fig.7: Objection detection using camera



Case 2: Obstacle detection

In this case the vehicle detects obstacles and it overcomes the obstacle by using camera. The vehicle will moves only in the particular path i.e., black area on road and does not moves on the white lanes which are present on roads.

Fig.8: Obstacle Detection

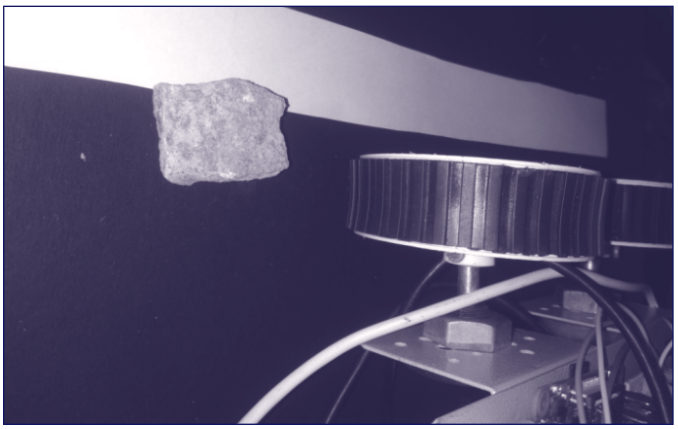
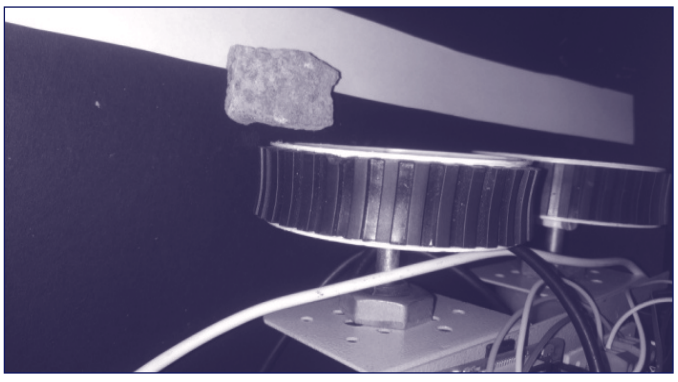


Fig.9: Obstacle Overcome

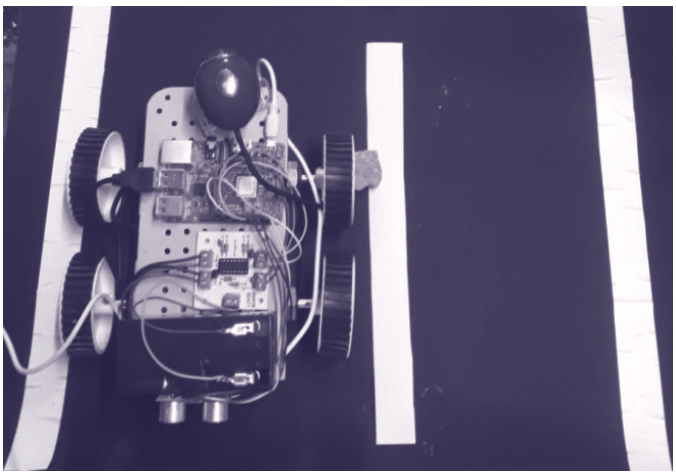


Case 3: Measurement of obstacle

In this case the obstacle is how much far away from the vehicle is measured and it displayed in the console window. This measurement can be detected by using ultrasonic sensor which is attached to the vehicle.

Fig.10: Measurement of obstacle

Fig.11: Prototype of the vehicle



6. CONCLUSION

The proposed methodology can be implemented in real time and autonomous vehicles are reliable. And because of the usage of image processing technique, a visual representation can also be captured and it can be further used to reduce traffic collisions. Autonomous vehicles are nothing but the vehicle will moves without any human involvement and this may lead to reduce accidents. Development of these types of vehicles may too easy and efficient transportation without interaction of human. In this paper a method is described for marked edges i.e., white lanes present on roads. By comparing the white lanes the vehicle will moves on the particular path i.e., black area present on roads . In this paper the computer vision based vehicle is implemented successfully in the prototype of Autonomous vehicle using Computer vision which is used to measure distance of obstacle.

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