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Autonomous vehicle using Machine Learning

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Abstract: In modern time, vehicles are more in an automated manner to make the drivers more easy driving and relaxation. In the automobile industry there are various aspects that make a vehicle to an autonomous vehicle. This automatic vehicle is mainly focusing on using fewer resources and low cost to develop a highly efficient self-driving vehicle. It includes Artificial Intelligence (AI), Machine Learning (ML), and robotics. The system is based on an ARM-based low-power Low-cost CPU (P.C) which is mostly in mobile architecture. The vehicle is designed and built in such a way that it not only detects simple obstacles but also detects all kinds of kind of signs, and obstacles only with the help of a simple camera and an ARM PC. The vehicle performs all these by the Machine Learning algorithm in PC. Thus, a highly efficient automatic vehicle is built.

Index Terms **– Autonomous vehicle, IoT, Robotics, Machine Learning.**

I. INTRODUCTION

Automatic vehicles are the ones that travel without human intervention. There are a lot of automatic cars running in the industrial markets these days. But all projects are overloaded with many expensive sensors like lidar, sonar, etc. In addition to using all these sensors, one needs an expensive PC, which uses high power CPU inside the car to process all the data in real-time. Therefore, the total cost of the project has already gone up. Here comes this project. The project is based on the concept of switching all sensors and high cost, high power PC with one camera and ARM PC. The processor delivers into the Machine Learning algorithm in PC and makes the necessary decision. The automatic vehicles currently available on the market today cannot be afforded by everyone. In this project, the vehicle not only finds simple obstacles but also understands many obstacles, traffic lights, road signs and makes the necessary decisions with precision. in all of this, we use light cameras and a simple CPU with low power and low power. By reducing sensors and installing an expensive CPU, a self-driving vehicle can be afforded by ordinary people so the self-driving vehicle will be the vehicle of the future.

II. REVIEW OF LITERATURES

[1] The purpose of this paper is an independent vehicle operating through the Convolutional Neural Network. There are a lot of cars in existing infrastructure related projects. But the inaccessibility of these V2I frameworks has led to the transfer of other technologies in the private car sector. Also, Traffic Light recognition and route identification will still be a difficult task in the case of automatic vehicles. In this paper, using the Convolutional Neural Network these activities are performed. Neural networks can take many highlights and create an unmixed image. In image processing YOLO (Looks Once) the image algorithm is used. YOLO proves to be one of the fastest ways to process images. Instead of dividing a single item into an object, it identifies different classes so that the driver needs only a little attention while driving. With the help of ultrasonic sensors, the distance from the vehicle to the object is calculated. To find the line, the Canny edge detection algorithm is used in this paper.

The purpose of this paper is [2] a method for detecting auto-occurrence using a V21 connection. Here, there will be RSUs (Road Side Infrastructure Units) located at the same distance from the road. RSUs will collect information from vehicles and send the distance from the vehicle to the traffic light and other road signs in the vehicle. RSUs will always serve as wireless access points. When vehicles enter the RSU compliant cover, it connects to RSU as a mobile terminal. A connection is established between RSU and vehicles using lighting systems. The problem with this paper is that it is limited in certain cases only. That is, these RSUs must be regularly installed on a road limited only to a specific road infrastructure or local road infrastructure.

This paper [3] reviews and compares various vision-based algorithms used to locate vehicle lines in self-driving vehicles. Route detection and tracking are often regarded as an important function in private vehicles. Vision-based methods and techniques are very easy to find obstacles on the roads. In this paper, the camera is used to detect line detection. Line acquisition mainly shows up as a way to find road signs and translate this information into any clever system. It basically involves searching for and obtaining white or yellow horizontal markings on the surface of a painted road and marking the boundaries on them in order to minimize these routes. This is followed by a trail of trail. These acquired route markers adjust themselves according to the model and then use interlocking interactions for the purpose of following the parameters in line sequence. After that the direction of the vehicle is completed. It means finding the position of the vehicle and the position of the vehicle within these boundary boundaries. Light Detection and Evaluation (LIDAR) are the most widely used solutions for route detection and road detection. Geographical details are widely used.

This work [4] aims to illuminate the robot and signal detection using a process of image processing of independent vehicles. Traffic recognition systems are used for a variety of purposes such as traffic control, driver warning etc. This is a virtual reality project where the input is video data, where these input images are sent to the webcam continuously. The webcam is connected to the Raspberry Pi PC here. Hue color space, saturation & value (HSU) model with the techniques used here for the purpose of image processing in obtaining traffic light. Obtaining road signs in the region (ROI) is selected. And, for the same purpose, the HSV color space model and Contour Algorithm are also used. This paper focuses on assisting the driver and providing audio instructions. It accurately detects traffic light colors, i.e., Signs in red, green and turn left, turn right and go back. And it works exactly when the car needs to take a turn and start / stop depending on the robots. After testing, the result shows that the system works very efficiently even in complex situations.

III. RESEARCH METHODOLOGY

This project is mainly based on the purpose of reducing the expenses of manufacturing an autonomous vehicle. A normal autonomous vehicle that is currently available in the market cannot be affordable by all people. By reducing the sensors and by replacing the expensive CPU, the vehicle can be affordable to normal people and hence autonomous vehicles are going to be the vehicles of future.

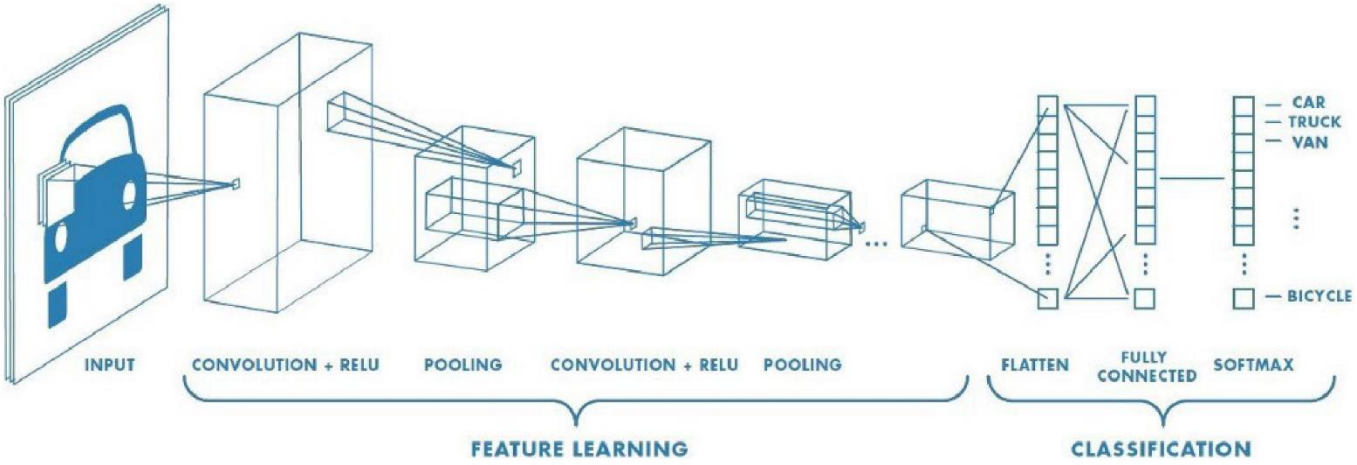
This paper is mainly based on the idea of building an autonomous car with less manufacturing expense. The future scope of this project is really high as autonomous cars are going to be the vehicles of the future. The vehicles can be turned in to mobile businesses, an assistance to senior citizens as well as physically unable people etc.

Autonomous vehicles are mainly manufactured to reduce traffic congestions, vehicle accidents due to human error, obey traffic rules and to relax the driver. But every time the manufacturing costs are already skyrocketed due to the unwanted sensors and expensive CPU.

3.1 System Design

Fig(a) Block diagram of Autonomous Vehicle

3.2 CNN



Fig(b) The architecture of Convolutional Neural Network

CNN is always known for taking a greater number of highlights from given raw RGB picture and it is one of the best option for image processing related situations and best suitable for autonomous vehicle. Using CNN, the input image data is processed by extracting both simple and the complex information from that live input feed thereby helping the system to work efficiently since image processing is the major part in the system.

3.4 ARM Architecture CPU

For computer processors, ARM is a family of minimized command-setting structures (RISC). These processors are widely available in the design of mobile phones. For this project Raspberry Pi 4 is used. A mind-blowing concept for the entire Robot. All processing, and calculation is done within the Raspberry pi. All software requirements are included within the Raspberry pi, and then Raspberry pi performs the calculations and considers further actions in the next module. As the Pi 4 is faster, it can cut any 4K video, and save faster with USB 3.0, and faster network connectivity with real Gigabit Ethernet, and there are other options as well. IP can use a wide variety of applications, including the official Raspbian OS, Ubuntu Mate, Snappy Ubuntu Core and can run Windows 10 IoT Core, which is very different from the Windows desktop version.

3.5 OpenCV

In this project, an important factor is image processing. Image processing is done using OpenCV. OpenCV (Open-Source Computer Vision Library) is a software library that focuses on image processing. As the library has more than 2500 algorithms, these algorithms can be used to detect and detect faces, to identify various objects, to distinguish human actions with recorded videos, to track camera movement, to track various moving objects, etc. OpenCV will be one of the best options available to us. Using the OpenCV library the image classification is done on the basis of qualified data. Therefore, a variety of factors are identified and ongoing decisions are made based on these considerations.

3.6 Cascade Classifier

In the proposed program, various items are available in OpenCV using the Haar Cascade classification. Cascading is a form of learning based on a subdivision club, using data and other information collected from extracts from another separator provided as additional information for subsequent classification in the cascade. With this, one will first capture various signboards, robots and other obstacles for training purposes. We need two types of data. Good samples and bad samples. The two types of data are good samples and bad samples. Both fine samples and data samples are captured and stored separately in folders. After splitting the separator can be applied to the image region and detect the object in question. Searching for an item is private, the search window can be moved to the whole image. This information is provided for training in the Cascade separator. The cascade separator uses the feature detection method and finally detects the type of obstacle, robots, sign boards etc.

IV. IMPLEMENTATION

4.1 Hardware Assembling

Hardware assembling is the first step that has to be done. It first includes gathering of all hardware that has to be mounted on the body of the vehicle and attaching to it. The wheels are controlled using motors and the power is regulated using voltage controllers and these are mounted on top of the smart car chassis board. The raspberry pi and all other hardware are mounted on the car chassis board along with the power supply

4.2 Arduino Programming

Arduino Programming is the next step. It is done for the purpose of wheel controlling. Various commands for the wheels to rotate in different directions are done in Arduino Uno board and flashed into the system. Thus the wheels are programmed to rotate according to the situation.

4.3 Distance calculation for stopping

$$y = mx+c$$
$$15 = 82m + c$$
$$30 = 68m + c$$

$$D=15$$
$$P2 - P1 = 82$$

$$D = 30$$
$$P2 - PI = 68$$

$$m= -1.07$$
$$c=102.857$$

4.4 Training and Testing

Training is another most important part in the proposed system. In this case, training is done on the track that has been built for the purpose of training and testing. The camera which is set on the vehicle is used to capture the images of track and other image set for the purpose of training. Positive samples and negative samples are taken for the purpose of training. These data set are given to cascade classifier for the purpose of image classification.

Testing is done as soon as training is done. Once the training is done for a particular class of data, testing is done very soon on the track. Live testing is best suited for real time automatic working systems.

V. RESULTS AND DISCUSSION

Autonomous vehicle designed using CNN and Haar cascade classifier is working well in all cases including traffic light detection, obstacle recognition, traffic sign detection and all other obstacles on the prepared track. The Haar cascade classifier, which is used for image classification works well in this case. Using canny edge detection, the edges are detected smoothly and perfectly.

PARAMETERS	VALUES
Stop distance when detects obstacle	Distance = 10
Stop distance when detects sign board and traffic light	Distance = 14
Frames Per Second	fps = 10
Frame width	Width = 400
Frame Height	Height = 240
Brightness	50
Contrast	50
Saturation	50
Delay after a U-turn	Delay = 3000ms
Line width of Region of interest	255mm

VI. CONCLUSION

This project is based on the goal of reducing the cost of making a self-driving vehicle. The normal self-driving vehicle available now on the market cannot be afforded by everyone. By reducing sensors and installing an expensive CPU, a car can cost ordinary people so private cars will be the cars of the future. Therefore, we are able to build an automatic vehicle that not only works like any other automatic vehicle, but also at a lower cost.

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