Collision Avoidance Based on Obstacle Detection Using OpenCV

Dr. S.S. Lokhande[1], Sonal Darade[2], Pranjali Deshmukh[3], Neha Joshi[4]

[1]Professor, Dept. of Electronics and Telecommunication, Sinhgad College of Engineering, Pune, India
[2]Student, Dept. of Electronics and Telecommunication, Sinhgad College of Engineering, Pune, India
[3]Student, Dept. of Electronics and Telecommunication, Sinhgad College of Engineering, Pune, India
[4]Student, Dept. of Electronics and Telecommunication, Sinhgad College of Engineering, Pune, India

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Abstract – *This paper present obstacle detection using OpenCV and collision avoidance of the vehicle by controlling the motor speed according to the distance of the obstacle measured by the ultrasonic sensor. Firstly, the object is detected using the Caffe model for DNN while simultaneously the distance of obstacle is measured with the help of ultrasonic sensor and according to the distance of obstacle the motor movements are controlled with the help of PWM controller.*

Key Words: Collision Avoidance, Autonomous vehicle, Caffe model, DNN, Obstacle detection, Raspberry pi, Ultrasonic sensor

1.INTRODUCTION

Technological changes have led to rapid advancement in automation domain. Autonomous vehicles are the best example of this change. As we are aware of the accidents occurring due to human carelessness and negligence, driverless vehicle proves to be efficient in this aspect of safe driving. The main aim behind this concept is to keep the driver out of the control loop and relieve his efforts. One of the important aspects involved in Autonomous Vehicle is Collision avoidance and it mainly comprises of obstacle detection. For obstacle detection various machine learning and deep learning algorithms are used. Here we have used caffe model based on DNN for object detection. Caffe is a deep learning framework developed by BAIR. By using camera module, we can collect the data and accordingly detects the presence of the obstacle and classify it into defined classes with the help of pretrained model. The commonly used sensors for distance measurement are IR sensor, ultrasonic sensor and optical distance measurement sensor. Here we have used the ultrasonic sensor which measures the distance between the vehicle and the obstacle. Depending on the distance between the obstacle and the vehicle motor movement is controlled.

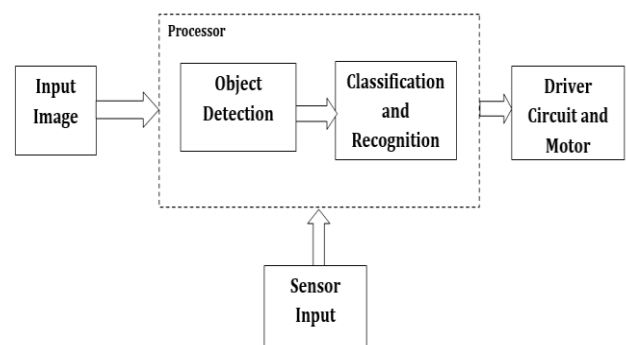## 2. PROPOSED BLOCK DIAGRAM

Fig -1: Proposed Block Diagram

The major components of the system are Microprocessor, Camera Module, Distance Measurement Sensor, Chassis, Gear motors.

The camera will capture the image/video which will be explored and analyzed by the processor. Processor will search for any obstacle present in front of the vehicle. If any obstacle is detected in that frame then the sensor will calculate the distance of the vehicle from the obstacle. Meanwhile the processor will use machine learning algorithms to classify the obstacle into subtypes like person, car, animal etc.

If the distance is too close the motor will stop i.e., the vehicle will stop at that point itself and if the distance is moderate the speed will reduce with the help of PWM controller for the motors.

3. HARDWARE AND SOFTWARE COMPONENTS

Different hardware and software components used in the proposed model are as follows

3.1 Raspberry Pi 3 B+

Raspberry Pi 3 B+ is the latest version of the Raspberry Pi series. It has 1GB RAM, 64-bit quad core processor running at 1.4GHz, 4 USB 2.0 ports, in built Wi-Fi and Bluetooth, Extended 40-pin GPIO header. It supports Micro SD format for loading operating system and data storage. It supports MPEG-4 decode (1080p30).

3.2 HC-SR04 Ultrasonic ranging module

HC-SR04 Ultrasonic ranging module is the commonly used distance measurement sensor. It works in the range 2cm-400cm. It has measuring angle of 15 degrees and works on 5V dc voltage.

3.3 Logitech c170 camera

It has 5-megapixel resolution for photo capturing and captures video at 1024x768 resolutions. Frame rate of 30fps is being provided.

3.4 L298N dual bridge motor driver module

L298N is the driver circuitry used to control the motor movement. It has two enable inputs used to enable or disable the device independently of input signals. This enable signals are used to set the duty cycle for PWM pulse.

3.5 Motors

Two DC motors of 150 rpm are being used here. There basics requirement of voltage and current is 12V and 1-2Amp respectively.

4. ALGORITHM

Initially the necessary packages required for OpenCV are imported. Simultaneously, the GPIO pin assignment for the motor driver as well as ultrasonic sensor if done.

Live video capturing is initialized and the frame per second counter is maintained. The corresponding frames are converted into blob which is the input parameter to the network.

The blob is compared with the pre-trained model; accordingly, the object is detected and classified.

The detection is compared with the specified threshold value i.e., 20% in our case. If it is less than 20% no detection is shown in the video frame and if the detection accuracy is greater than 20% then specified color box is drawn around the obstacle and the corresponding classified class name is assigned above the box.

Subsequently, when the obstacle is detected the distance of the obstacle with respect to the vehicle is calculated.

If the distance calculated is less than or equals to 30cm then a low signal is sent for both the motors through motors driver(L298N) and hence the motors are stopped to avoid the collision with the obstacle.

If the distance is greater than 30cm but less than 100cm then the speed of motors is reduced by changing the duty cycle of PWM pulse from 100% to 20% and continues monitoring of the distance is also carried out.

When both the cases do not satisfy; which implies than the obstacle is far away from the vehicle and hence it can move forward with its normal speed.

Thus, the collision avoidance is achieved by maintaining the speed of motor according to the location of obstacle.

4. RESULTS

Fig -2: Person and animal detected from internet generated image

As, seen from the above figure even though the second person is present is less amount of light still the system is able to classify it correctly.
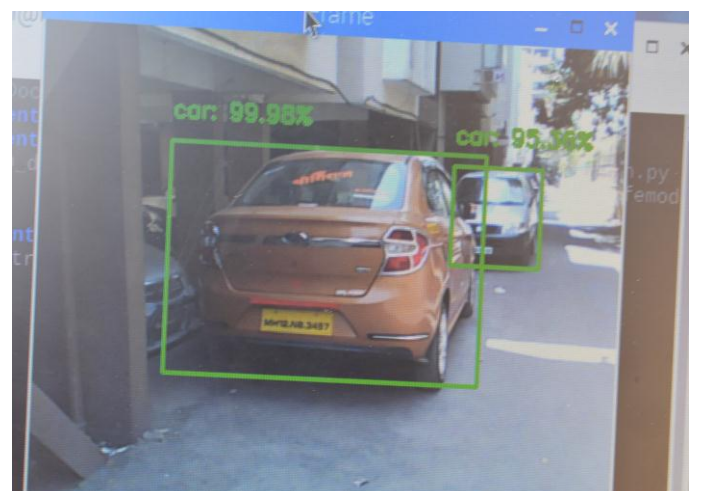

Fig -3: Cars detected in real time

From the above image it can be observed that though the second car has overlapping pixels with the first car still the system is able to detect the car with great accuracy.

4. CONCLUSION

The system will be useful in autonomous vehicle for driverless assistance. The system will acquire the images/video of the obstacle and the processor will determine whether the obstacle is present or not and the motor movement will be taken accordingly. The system will help in avoiding the involvement of the humans in driving which is one of the major causes of accidents these days.

Though the system has several advantages its major drawback is the processing speed of Raspberry pi which is bit slower. The system can be made more efficient by processing the data on GPU.

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