ABSTRACT

Accidents, collisions and close calls happen every year with vehicles and road traffic. Thus, to prevent these, we developed an automatic vehicles speed control device that detects the presence of objects in the path of the vehicles, calculates the distance using ultrasonic sensor and automatically controls the speed thus avoiding collision.

This comes as an emergency breaking device for vehicles that are manually driven by drivers. To automatic vehicles, it comes as a permanent feature that constantly reads the road path and controls the speed to drive the vehicle safely.

In this project, we focus on automatic speed Vehicle control based on object detection. We use various sensors like ultrasonic sensor and algorithms like yolo to detect an object and control the speed of the vehicle motor to slow or stop the vehicle.

This device can be very useful in assisting drivers to serve as a form of emergency breaking and also can be integrated in automatic driving vehicles

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LIST OF SYMBOLS

S.NO	SYMBOL	MEANING
1	Hz	Hertz

LIST OF ABBREVIATIONS

S.No	ABBREVIATION	EXPANSION
1	YOLO	You Only Look Once
2	v3	Version 3
3	KHz	Kilo Hertz (1000Hz)
4	GPU	Graphic processing unit
5	FPS	Frames per second
6	RCNN	Region-based Convolutional Neural Network

Chapter 1
INTRODUCTION

1.1 INTRODUCTION

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Taking a tram as an example, it is quite frequent for such a vehicle to have close calls and accidents as it runs close to road traffic and are constantly threatened by road vehicles or pedestrians, Thus, by integrating this equipment with the tram and its motor, we can improve the safety of the tram and the road traffic.

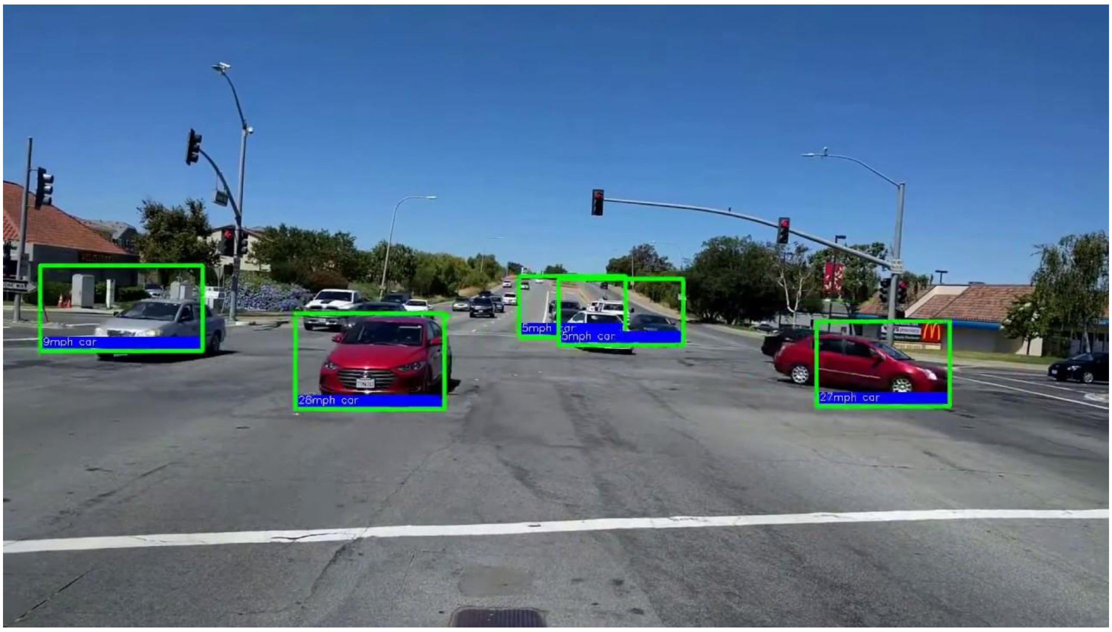

Fig 1

1.2 REASON FOR DUAL SENSING

For the proper and efficient functioning of this device, we use dual sensors, i.e ultrasonic sensor and Camera sensor (data of which gets processed by YOLO).

Either of the sensors could work solely and detect the presence of an object in the path of the vehicle but in order to improve the device's accuracy and efficiency, we use two sensors whose data are double checked with each other and only then the speed control mechanism of the motor is triggered.

The camera sensor with the help of YOLO can detect the presence of an object and even its type but can't calculate the distance between the object and sensor (vehicle). Thus, can't calculate the breaking distance.

The ultrasonic sensor on its own can sense the presence of an object and can even calculate its distance from the sensor but the data can contain a lot of inaccuracies. Even a small bee could trigger this sensor and present itself as an 'object' causing the whole vehicle to break for apparently no reason.

Thus, by using two sensors, we use one sensor to assist the other, and eliminates the drawback feature of each other. The YOLO with camera sensor's drawback of distance measurement can be eliminated by ultrasonic' s distance calculation capability and the ultrasonic sensor's drawback of detecting non-dangerous objects leading to dubious triggers can be eliminated by YOLO which accurately detects the type of object can allow the vehicle breaking for only certain objects only.

2 MATERIALS AND PROGRAMS

2.1 ULTRASONIC SENSOR

The Ultrasonic Sensor works on the basic principle of doppler effect. Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they reflected back as an echo signal to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo.

Ultrasonic sensors can measure the distance to a wide range of objects regardless of shape, color or surface texture. They are also able to measure an approaching or receding object. Ultrasonic transducers operate at frequencies in the range of 30–500 kHz for air-coupled applications. As the ultrasonic frequency increases, the rate of attenuation increases. Thus, low-frequency sensors (30–80 kHz) are more effective for long range, while high-frequency sensors are more effective for short range.

For our device , this sensor is placed at the front of the vehicle to calculate the distance between the sensor (vehicle) and any object in the path.

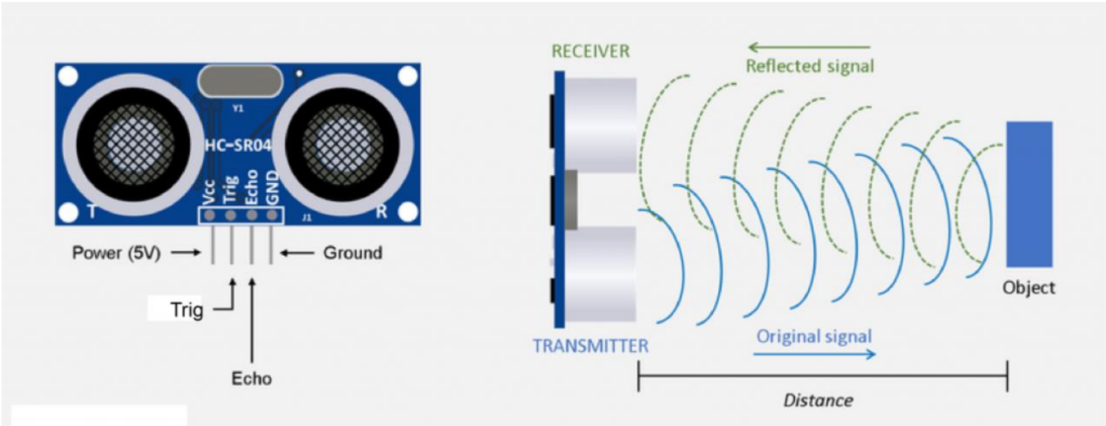

Fig 2

2.2 CAMERA SENSOR

It is a sensor that is placed at the front end of the vehicle and constantly captures the image of the path. This image data is sent to YOLO for it to process and determine the objects and its name and type that are present in the given image.

Fig 3

2.3 YOLO

YOLO is an algorithm that uses neural networks to provide real-time object detection. This algorithm is popular because of its speed and accuracy. It has been used in various applications to detect traffic signals, people, parking meters, and animals. A single convolutional network simultaneously predicts multiple bounding boxes and class probabilities for those boxes. YOLO trains on full images and directly optimizes detection performance. This unified model has several benefits over traditional methods of object detection. First, YOLO is extremely fast. Since we frame detection as a regression problem we don't need a complex pipeline. We simply run our neural network on a new image at test time to predict detections. Our base network runs at 45 frames per second with no batch processing on a Titan X GPU and a fast version runs at more than 150 fps.

Fig 4

2.3.1 YOLOv3

To improve YOLO with modern CNNs that make use of residual networks and skip connections, YOLOv3 was proposed.

YOLOv3 uses a much more complex DarkNet-53 as the model backbone— a 106 layer neural network complete with residual blocks and up sampling networks.YOLOv3's architectural novelty allows it to predict at 3 different scales, with the feature maps being extracted at layers 82, 94, and 106 for these predictions..

By detecting features at 3 different scales, YOLOv3 makes up for the shortcomings of YOLOv2 and YOLO, particularly in the detection of smaller objects. With the architecture allowing the concatenation of the upsampled layer outputs with the features from previous layers, the fine-grained features that have been extracted are preserved thus making the detection of smaller objects easier.

YOLOv3 only predicts 3 bounding boxes per cell (compared to 5 in YOLOv2) but it makes three predictions at different scales, totaling up to 9 anchor boxes.

2.3.2 YOLO VS OTHERS

YOLOv3 is extremely fast and accurate. In mAP measured at .5 IOU YOLOv3 is on par with Focal Loss but about 4x faster. Moreover, you can easily tradeoff between speed and accuracy simply by changing the size of the model, no retraining required

In addition to increased accuracy in predictions and a better Intersection over Union in bounding boxes (compared to real-time object detectors), YOLO has the inherent advantage of speed.

YOLO is a much faster algorithm than its counterparts, running at as high as 45 FPS.

While algorithms like Faster RCNN work by detecting possible regions of interest using the Region Proposal Network and then perform recognition on those regions separately, YOLO performs all of its predictions with the help of a single fully connected layer.

Methods that use Region Proposal Networks thus end up performing multiple iterations for the same image, while YOLO gets away with a single iteration.

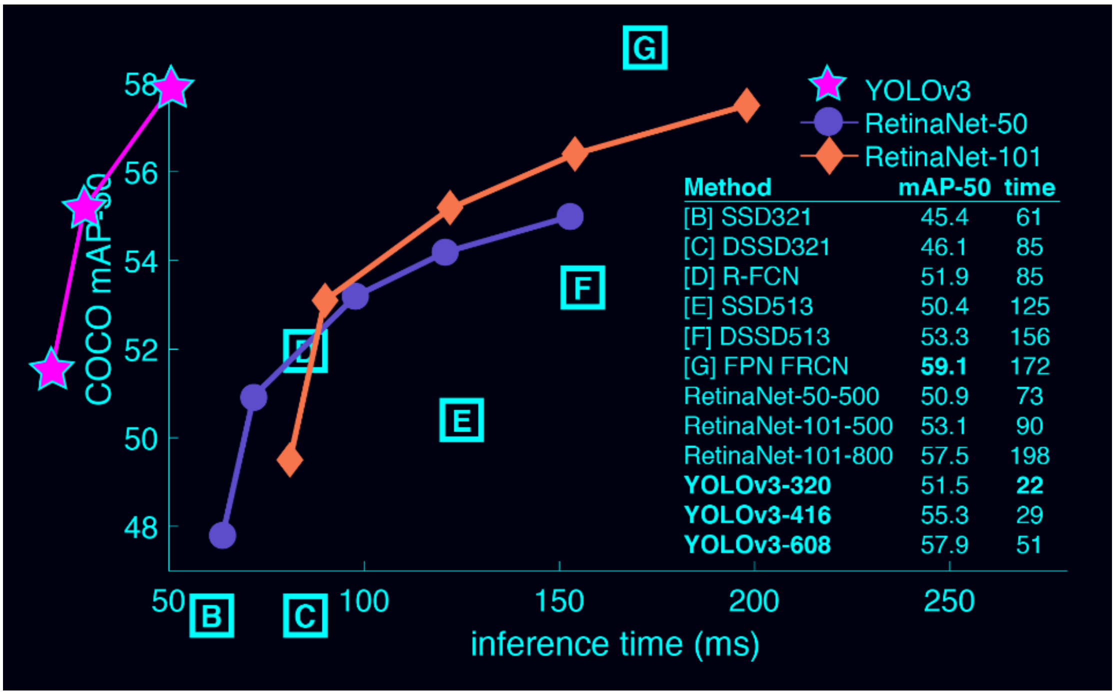

Fig 5

2.4 MOTOR

Here, the component Motor references to the motor in the vehicle that can control the speed of the vehicle or the wheels, for a locomotive. The desired speed or speed reduction signals are sent to this motor which acts accordingly to change the speed of the vehicle according to the situation.

3 WORKING

3.1 WORKING

The whole device gets turned on once the vehicle is turned on. The camera sensor and ultrasonic sensor constantly captures the outside image and distance respectively. The data from the sensors is sent to the microcontroller where the YOLO program takes the data and does the object detection and that data is sent back to the microcontroller's main algorithm. The distance between the vehicle and the object is also constantly sent by the ultrasonic sensor to the microcontroller. The current motor speed data is also constantly sent to the microcontroller. The main algorithm then processes data from YOLO, ultrasonic sensor and motor and decides if it is necessary to break immediately (refer Table 1). If it is deemed to be necessary then the algorithm instructs the motor to reduce its speed. Thus, preventing a possible collision.

Table 1 shows the conditions and data types under which motor behaviour is being changed by microcontroller. This shows how the microcontroller processes data that are being received from ultrasonic sensor and YOLO. The microcontroller sends data signals to motor to control speed in specific manner.

Object placed	Distance placed	Object detected (YOLO trained objects)	Ultrasonic sensor (Threshold = 1 meter)	Motor
Yes	1 meter	Yes	Triggered	Motor slows down
Yes	> 1 meter	Yes	No	Motor runs at the rated speed
Yes	< 1 meter	No	Triggered	Motor slows down
No	> 1 meter	No	No	Motor runs at the rated speed

Table 1

Block Diagram:

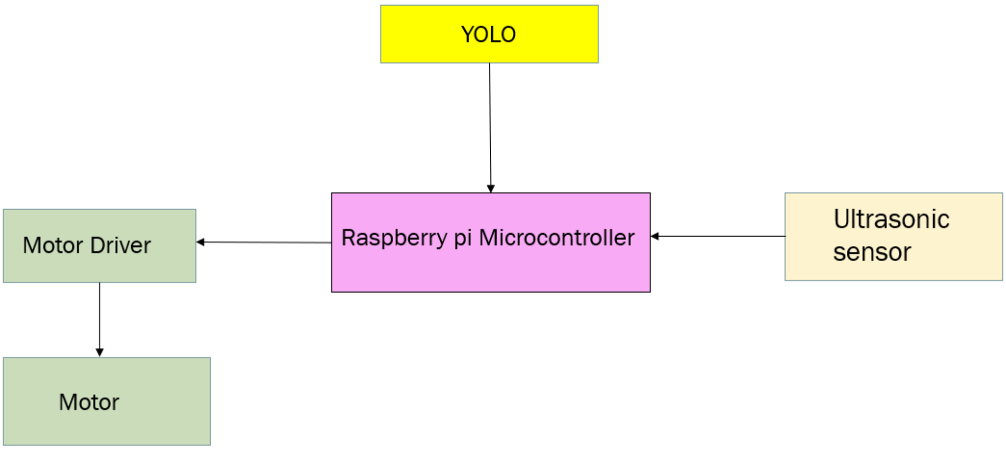

Fig 6

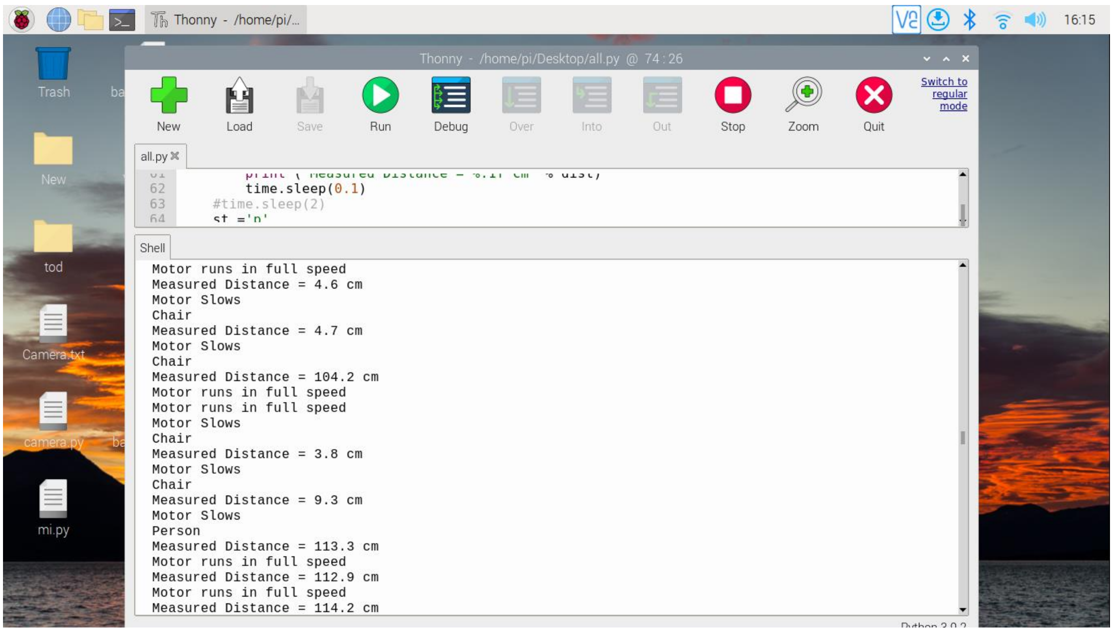

Fig 7

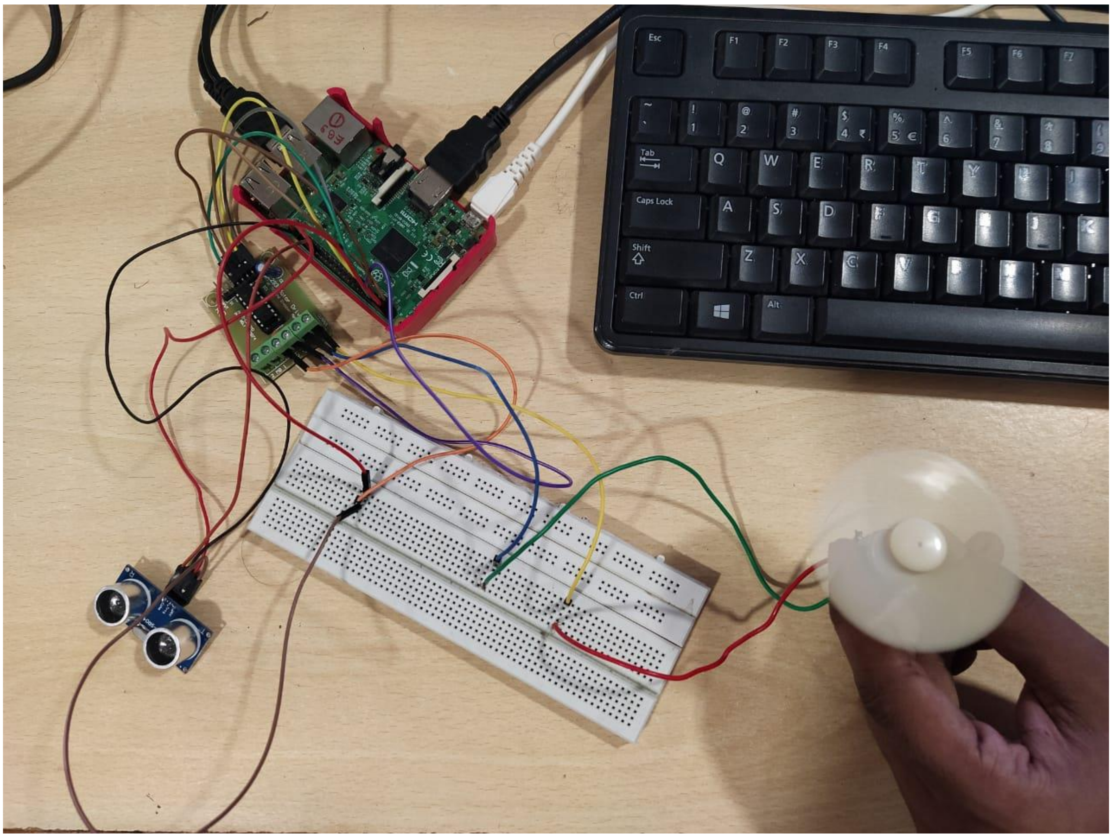

Fig 8

3.2 APPLICATIONS IN REAL LIFE

This device can be used in many vehicles like trams, cars,carts ,etc. This comes as an emergency breaking device for vehicles that are manually driven by drivers. To automatic vehicles, it comes as a permanent feature that constantly reads the road path and controls the speed to drive the vehicle safely. It gives a wider range of scope for ideas and creation for automatic vehicles. It also needs further more detailing and accuracy.

4 CONCLUSION

Technology is all about making human lives a little better than before. The device we designed is supposed to prevent accidents and will also act as stepping stone for many modern automated driverless vehicles. Bringing this devices into the world could save countless lives and collateral damages.

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