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Title : Deep Learning Based Pothole Detection

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Vasu Sena Gunda

E-Mail : gundavasusena1234@gmail.com

Gokaraju Rangaraju Institute of Engineering and Technology
Hyderabad

Group Members

- D Rohit Rajan
- Neha Nandal
- Mohammad Khaja Faizan
- Rajinikanth Kundelu
- Vasu Sena Gunda

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Introduction

The strain on the infrastructure has increased as the world's population has grown. Traffic on the roads is at a record high. It has been harder and harder to control this traffic. This is the main driving force behind creating a car with enough intelligence to help the driver in several ways. Road conditions getting worse is one of the issues that are getting worse for the roadways. The road is challenging to drive for a variety of reasons, including rain, traffic accidents, or normal wear and tear. Unexpected obstacles on the road could lead to more collisions. Additionally, the vehicle's fuel usage rises as a result of poor road conditions, wasting valuable gasoline. Due to these factors, learning about such dangerous roads is crucial.

The purpose of a pothole detection system is to alert drivers to the uneven potholes and roadways in the route.



Literature Study

Summary of the literature study

Pothole detection and reporting using image processing using a Raspberry Pi microcontroller(IEEE 2018) by Mae M. Garcillanosa [1]	The potholes are detected using the sensors. The main processing is done by the Raspberry Pi and when a pothole is detected the model car will stop before crossing the pothole
Accelerometer Sensor Network For Reliable Pothole Detection by Teodor Kalushkov [2]	The potholes are detected using the Accelerometer . They have the Raspberry Pi to process the information given by the Accelerometer and provide the results. Here once the pothole is detected , the system sends the alert using a buzzer.

Pothole Detection with Image Segmentation for Advanced Driver-Assisted Systems by H. K. I. S. Lakmal [3]	The algorithm used is Image segmentation for the pothole detection. Once the potholes are detected the system alerts the driver using buzzer.
Automated Detection and Notification of Pothole to Aid Driver by Bhagyashree Ghodake [4]	The potholes detected using the faster RCNN algorithm. This algorithm is very accurate for the detection of the potholes but works very slow to provide the result.
Intelligent Deep Learning-based Pothole Detection and Reporting System by Rohitaa r [5]	The algorithm used to detect the potholes is SSD. Once the pothole is detected the model car will stop before crossing the pothole indication the pothole has been detected

Research Gap

Most of the research paper published on the pothole detection are using the Hardware sensors to detect the potholes. The solution we have approached is a software based.

- In other words we use the software to detect the potholes.
- The algorithm we use is the fast in terms of the reading the FPS(frames per second) from camera and producing the results

Algorithm : YOLO

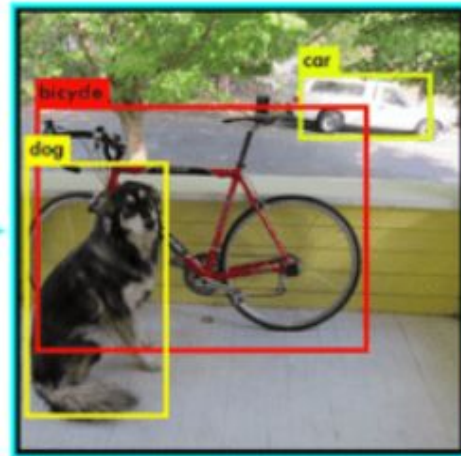
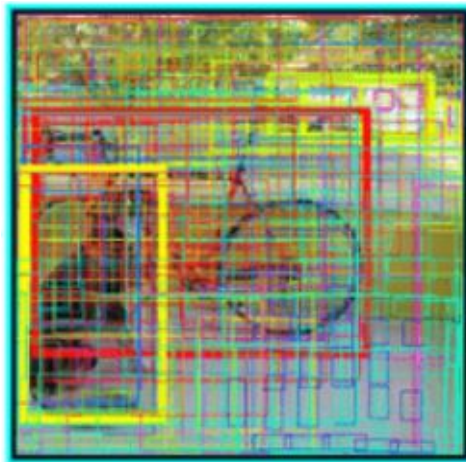
The algorithm used for the pothole detection is YOLO. YOLO is a SOTA (state-of-the-art) model for real-time object detection.

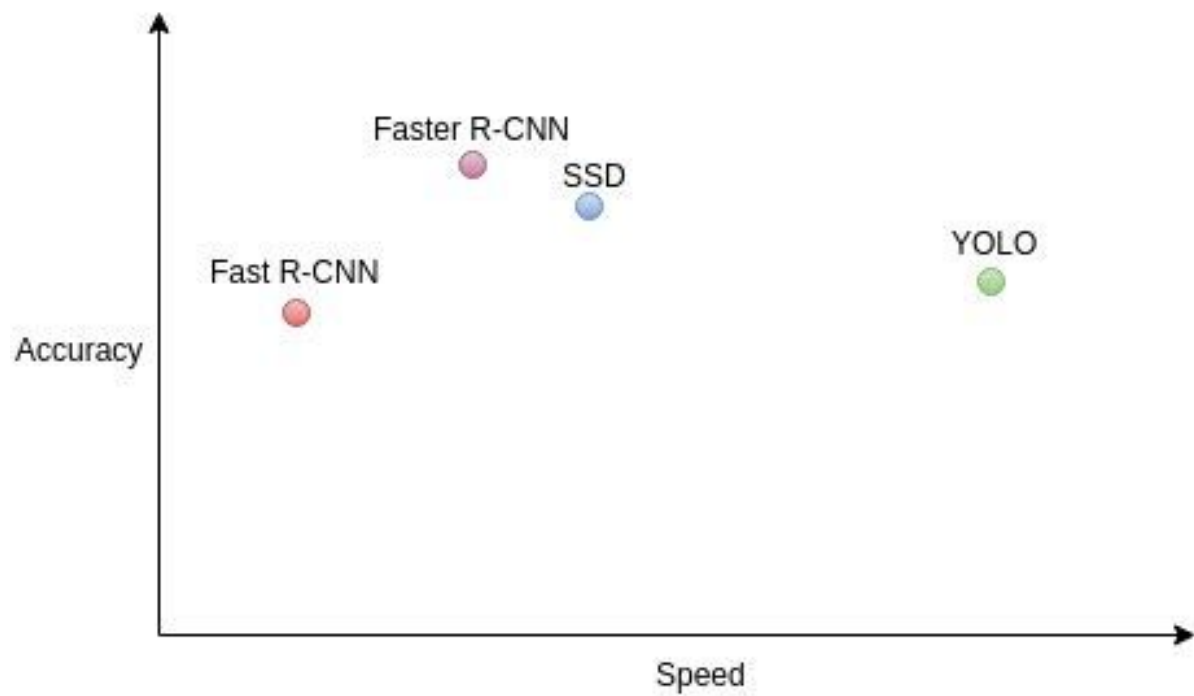
- The one-step method is one of the two main modern methods used for object detection tasks where speed of completion is important.
- In the one-step detector model, the ROI (Region of Interest) is removed and classes and bounding boxes are predicted for the entire image.
- So this makes them faster than two-stage detectors.
- Another example is FCOS RetinaNet and SSD. The first version of YOLO was written in the Dark Net Framework (which is a high-performance open-source framework for implementing neural networks written in C and CUDA).

YOLO

- DarkNet is usually the main network.
- It divides the object detection task into a regression task followed by a classification task.
- Regression predicts the class and bounding box for the entire image in one direction and helps identify the positions of objects.
- Classification defines the class of objects.

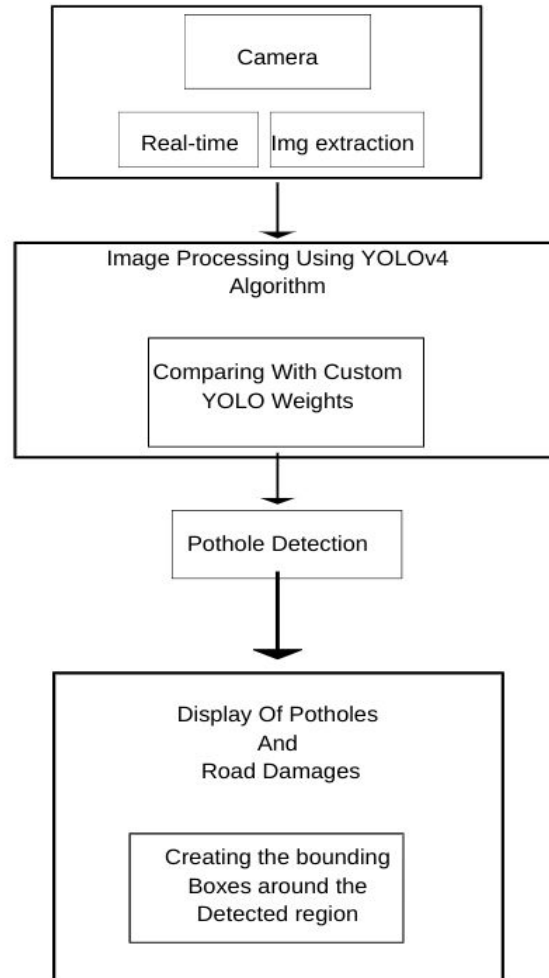
YOLO





Methodology

- Firstly the video from the camera is taken and processed to get the frame by frame images
- Every image is processed by the YOLO algorithm to detect the pothole in the image.
- After a pothole is detected the output is presented with a bounding box around the region of the detected pothole.
- Finally the algorithm invokes the method to alert the driver just after detecting the pothole.

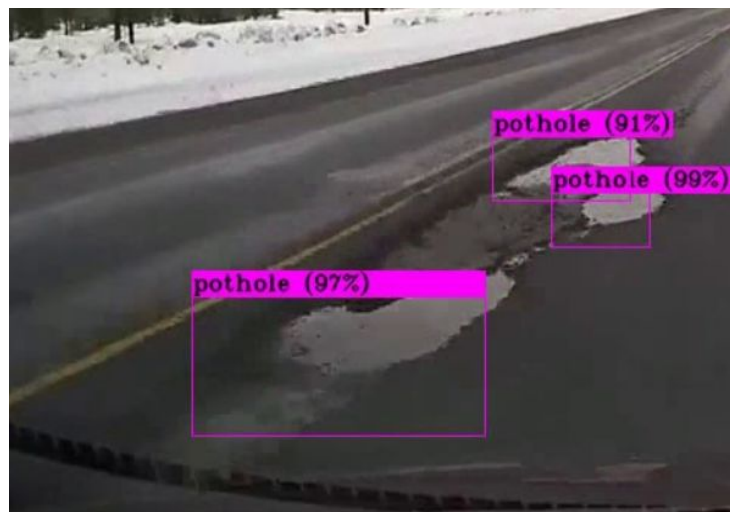
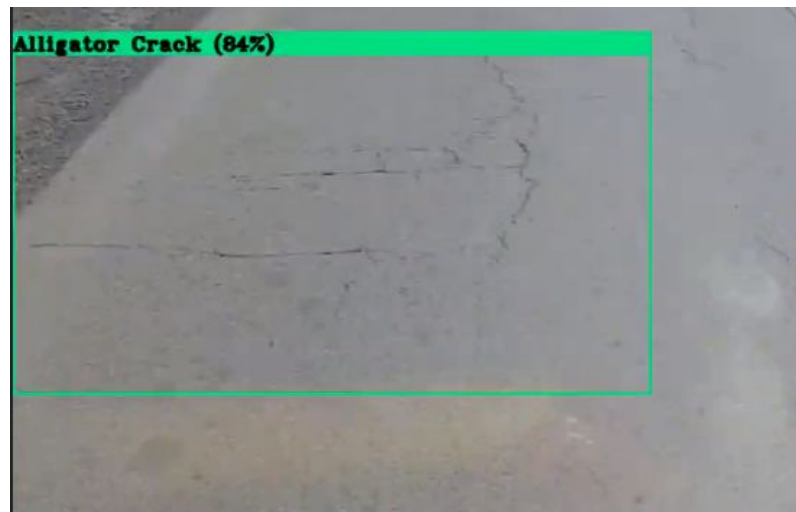


Results

After the execution of the entire program the following results are shown:

Every pothole or road damage detected will be framed under a coloured box (Bounding Box) with the accuracy of the detected potholes.





Conclusion

In this work, a model is created that is capable of detecting potholes which are present on the road. The tests performed in this research made use of a dataset that included photos of potholes that were captured under various lighting situations, on various types of roads, and with various shapes and sizes. Our model is capable of predicting potholes at higher speed with great accuracy.

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Thank You