Centre of Competence in Visual Computing

Internship Presentation

Image Analysis for Identifying potholes on highways

Under the Guidance of

Prof. Swetha S

Dr. Hemavathy R

Team Members

1RV19CS008-AKSHAT BANSAL

1RV19CS044-DENCY N PATEL

1RV19CS134-SAGARIKA MD

1RV19CS147-SHASHWAT SAHU

Profile of the Organization

- Internship is carried out under Centre of Competence in Visual Computing in collaboration with Bhargawa Info Tech Solutions Pvt Ltd (BITS).
- Bhargawa Info Tech Solutions Private Limited (BITS) is a private firm incorporated on 18 November2019.Its classified as Non-government company and registered at Registrar of Companies, Bangalore. It is incorporated as a Type “A” Enterprise.
- It provides various services in the sector of home automation systems for different industries and Home purpose.
- Bhargawa Info Tech Solutions Private Limited's Annual General Meeting (AGM) was last held on 31 December 2020 and as per records from Ministry of Corporate Affairs (MCA), its balance sheet was last filed on 31 March 2020. Sudhanva Belle and Shailaja are the directors of BITS who leads products and service sectors of the company

Activities of the department

- The Center of Excellence in Visual Computing provides computing facilities for students, research scholars, and faculty members.
- The objective of the center is to bring the students and faculty of various disciplines together to execute interdisciplinary projects. The center facilitates the execution of computationally intensive research work in various state-of-the-art domains including Edge Computing, Parallel Programming, Artificial Intelligence, and Machine Learning.
- The center offers internships, and training and facilitates skill enhancement in the areas like image/video analytics, Mobile Application Development, Internet of Things, Natural Language Processing.
- The motive of the visual computing Centre is to bring the students and faculty of various disciplines together to execute interdisciplinary projects.
- It allows students work on state- of-the-art multidisciplinary projects, sharpen experimental, analytical, and numerical skills, and learn the applicability of technologies in diverse fields.

Introduction

- Roads are an essential means of transportation. It carries a major percentage of passenger traffic in every country.
- However due to the high number of potholes present in the country almost 5,626 people have lost their lives as per recent government data.
- Thus locating potholes and repairing them is essential, but it has always been a time consuming task to the authorities.
- Through this project we aim to develop a Pothole Detection System which can assist the authorities to locate the potholes efficiently and alert the commuters.

Objectives

- Proposes a pothole detection method based on the mobile sensing.
- Building a model that will detect the potholes in its path.
- Highlighting the potholes so that the person is alerted.

Methodology

1. Downloading the dataset

2. Pre-processing of dataset

3.Downloading the YOLO V5 model files

4.Preparing the annotated files

5.Preparing the train, validation and test sets

6.Implementing the training process

7.Executing the inference process using the trained model

Dataset Description

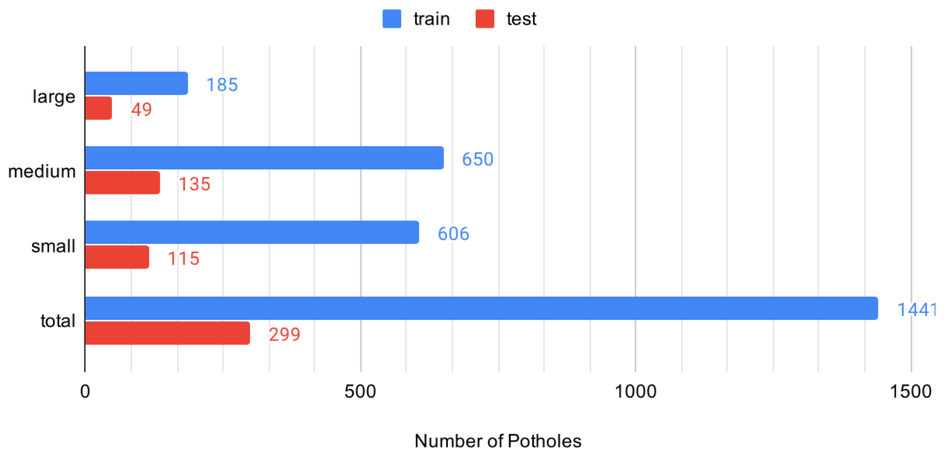
Describe the available datasets:

- This dataset contains 665 annotated images of potholes. Bounding box annotations are provided in the PASCAL VOC format.

Reason for selecting a particular dataset:

- We chose this particular dataset because firstly the number of images present in it were appropriate to train our model also the quality of the images was also very good which is essential in increasing the accuracy of our model.

Dataset Visualization:



Data Preprocessing

The techniques adopted for dataset preprocessing are:

- Images have been resized to 416x416 pixels.
- Since the images in the dataset were annotated so we separated the images and annotations in different folders.
- Dataset was split into 60:40 for training-testing purpose.

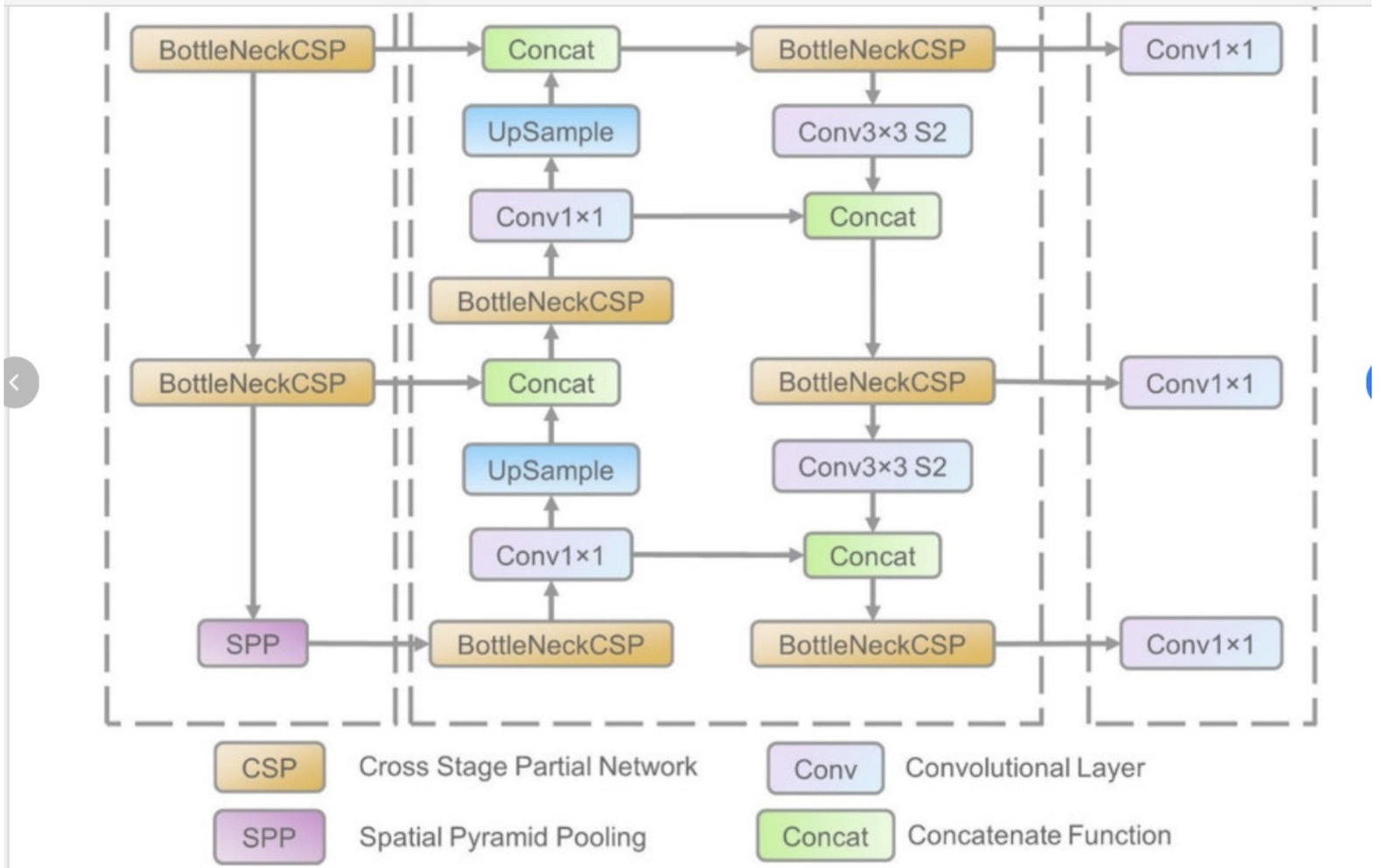
Model Architecture

YOLOv5 is a family of compound-scaled object detection models trained on the COCO dataset, and includes simple functionality for Test Time Augmentation (TTA), model ensemble, hyperparameter evolution, and export to ONNX, CoreML and TFLite.

YOLO an acronym for 'You only look once', is an object detection algorithm that divides images into a grid system.

Each cell in the grid is responsible for detecting objects within itself.

YOLO is one of the most famous object detection algorithms due to its speed and accuracy



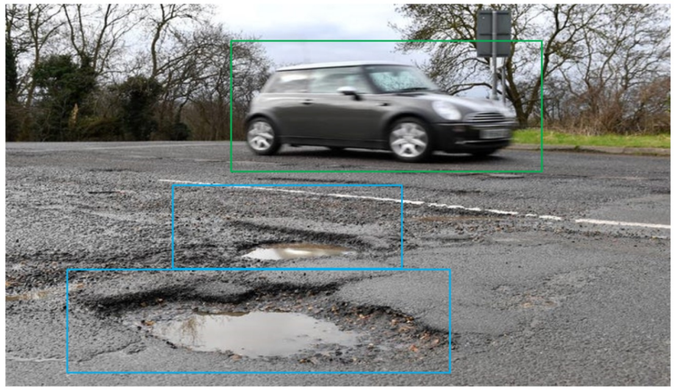
The network architecture of Yolov5. It consists of three parts: (1) Backbone: CSPDarknet, (2) Neck: PANet, and (3) Head: Yolo Layer. The data are first input to CSPDarknet for feature extraction, and then fed to PANet for feature fusion. Finally, Yolo Layer outputs detection results (class, score, location, size).

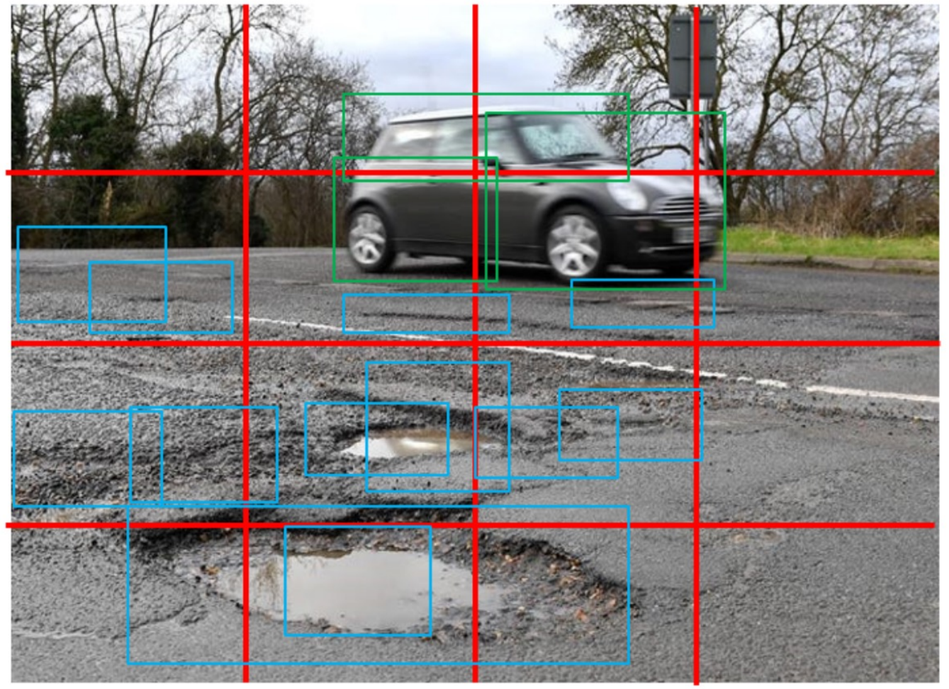
The start of the process in YOLO is to divide the image into a S x S grids. Here S can be any integer value. For our example let us take S to be 4.

Each cell would predict B boxes with a confidence score. Again B can be decided based on the number of objects that can be contained in a cell. An important condition that needs to be met is that the center of the box should be within the cell. These B boxes are called the anchor boxes.

In our case, let us consider that B = 2. So each cell will predict 2 boxes where there is some probability of an object. This process of predicting boxes happens for every cell within the image. In the course of this step multiple overlapping boxes will be predicted across all the grids of the image.

The class probability maps enables the network to assign a class map to each of the bounding boxes. Finally non maxima suppression is applied to reduce the number of overlapping boxes and get the bounding boxes of only the objects we want to classify.





Generate B bounding boxes and confidence scores

Hyper parameter Tuning

Hyper Parameters:

Epochs:

- One Epoch is when an ENTIRE dataset is passed forward and backward through the neural network only once.
- We have done 100 epochs.

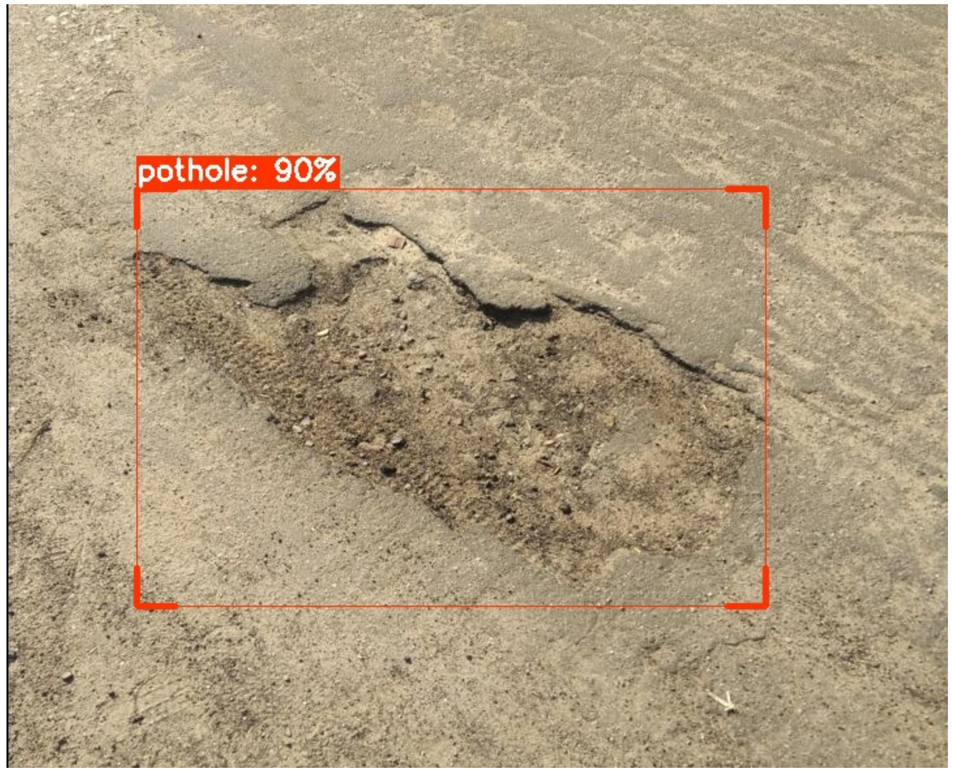
Batch Size:

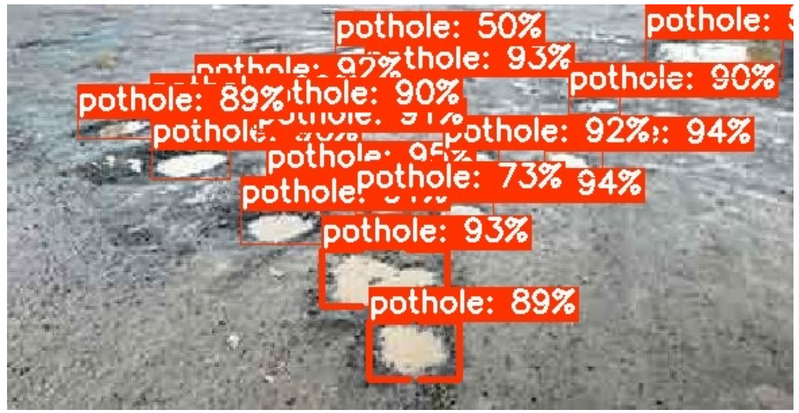
- Our batch size is 16.

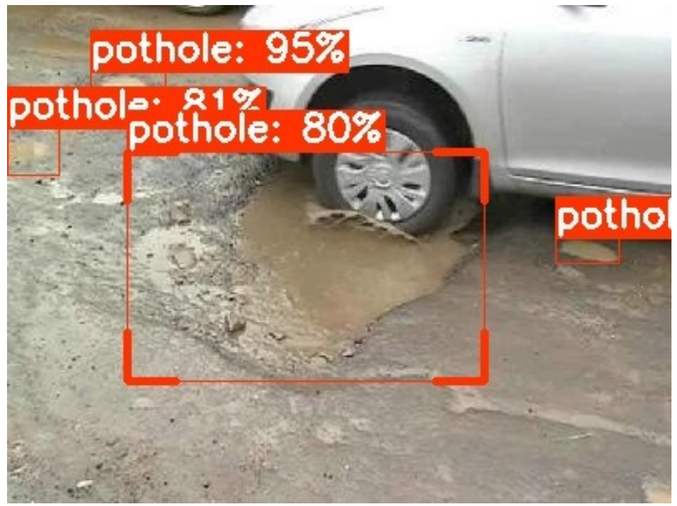
Tuning:

The tuning of the model is done by YOLOv5.YOLO, short for You Only Look Once, is a powerful real-time object detection algorithm that is trained on images to optimize detection performance.

Output


pothole: 90%


pothole: 50%
pothole: 93%
pothole: 90%
pothole: 89%
pothole: 90%
pothole: 92%
pothole: 73%
pothole: 93%
pothole: 89%


pothole: 95%
pothole: 80%

Future Scope

•Maps can be included in the android application for graphically showing the pothole location.

•Along with the existing voice notification There is pothole nearby go slow, Distance of the pothole can also be voice notified.

•A more complex prototype can be developed so as to control the speed of the vehicle when there is pothole ahead.

•More accurate and complex algorithm can be used to find the distance between two latitude and longitude.

Knowledge Acquired

TECHNICAL SKILLS:

- Learnt about Deep Learning algorithms such as YOLOv5
- Learnt about different python libraries
- Learnt how to use google collab

SOFT SKILLS:

- Worked together with teammates
- Learnt various skills and communicated well with guide
- Majorly focused on learning various skills with interest

References

1. Mg.Sc.Ing. Zaimis U, Prof.Dr.Sc.Comp. Jansone A, - “USE OF DRONE BASED IT SYSTEM FOR ROAD POTHOLE DETECTION AND VOLUME CALCULATION.” (2019). International Scientific Journals of Scientific Technical Union of Mechanical Engineering "Industry 4.0" Vol. 4 (2019), Issue 5, pg(s) 223-227
2. Shreya Viswanath et al - Terrain surveillance system with drone and applied machine vision . 2021 Journal of Physics Conf. Series 2115 012019
3. Saurabh Pehere, Prajwal Sanganwar, Shashikant Pawar and Prof. Ashwini Shinde, “Detection of Pothole By Image Processing Using UAV”, Journal of Science and Technology, Vol. 05, Issue 03, May-June 2020, pp101-110
4. HemaMalini B.H, Akshay Padesur, Manoj Kumar V, Atish Shet - Detection of Potholes on Roads using a Drone Year: 2021, DOI: 10.4108/eai.19-10-2021.171546
5. Hassan, S.-A.; Rahim, T.; Shin, S.-Y. An Improved Deep Convolutional Neural Network-Based Autonomous Road Inspection Scheme Using Unmanned Aerial Vehicles. Electronics 2021, 10, 2764. https://doi.org/10.3390/electronics10222764
6. I. Schiopu, J. P. Saarinen, L. Kettunen and I. Tabus, "Pothole detection and tracking in car video sequence," 2016 39th International Conference on Telecommunications and Signal Processing (TSP), 2016, pp. 701-706, doi: 10.1109/TSP.2016.7760975.
7. S. W. Lee, S. Kim, J. Han, K. E. An, S. -K. Ryu and D. Seo, "Experiment of Image Processing Algorithm for Efficient Pothole Detection," 2019 IEEE International Conference on Consumer Electronics (ICCE), 2019, pp. 1-2, doi: 10.1109/ICCE.2019.8661973.
8. A. Akagic, E. Buza and S. Omanovic, "Pothole detection: An efficient vision based method using RGB color space image segmentation," 2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), 2017, pp. 1104-1109, doi: 10.23919/MIPRO.2017.7973589.
9. K. Vigneshwar and B. H. Kumar, "Detection and counting of pothole using image processing techniques," 2016 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), 2016, pp. 1-4, doi: 10.1109/ICCIC.2016.7919622.
10. V. Pereira, S. Tamura, S. Hayamizu and H. Fukai, "A Deep Learning-Based Approach for Road Pothole Detection in Timor Leste," 2018 IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI), 2018, pp. 279-284, doi: 10.1109/SOLI.2018.8476795.

Thank You