ARMY INSTITUTE OF TECHNOLOGY PUNE
DEPARTMENT OF INFORMATION TECHNOLOGY

Project Based Seminar (Oral) Presentation

on

Road Damage Detection using Region of CNN and YOLO

By

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Guide

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Introduction to Seminar Topic

- In this study we will assimilate two deep learning models i.e. Region of Convolutional Neural Network and You Only Look Once for detecting road damages.
- The main job of Object detedtion algorithm is to analyze the visual content of an image, recognize instances of a certain object category, then outputs the category and location of the detected objects.

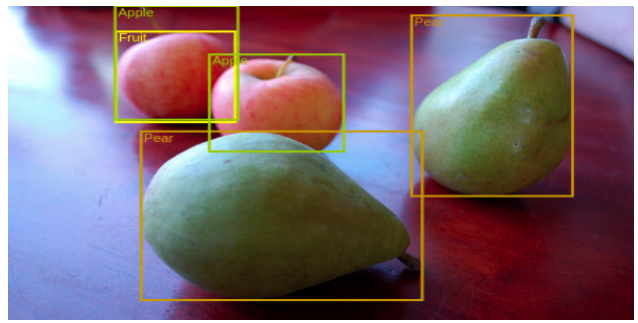

Figure: 1. Object Detection in images.

- Both RCNN and YOLO have their own methodology to detect the damages on the roads. We will study them one by one.

Literature Survey

"Crack Detection in concrete structure by measuring their natural frequencies"

- Here, Author has considered natural frequencies with different rates to determine the cracks on the structure.
- Graph between position of the structure and the eigen vales B for different rate of natural frequency is drawn.

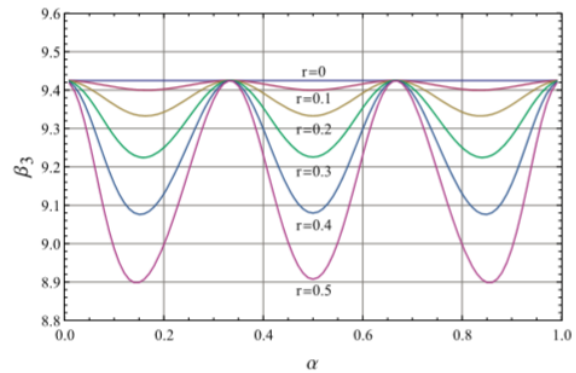

Figure: 2.Eigen Values vs Position

- The absolute error for finding the position of the crack is 4.7% and error in finding the depth is upto 12.5%.

Literature Survey

"A deep Learning Approach for Road Damage Detection from SmartPhone Images"

- Author has divided the road damages into eight types for better perception of the road damages.
- Object detector is created by the Darknet model using YOLO framework.
- Model is trained up to 70k iterations. For every test image YOLO generated a set of predicted boxes with confidence score.
- Low prediction confidence score boxes were removed for better performance.

Literature Survey

"Detection of Pothholes using a Deep Convolutional Neural Network"

- Two different models were integrated in conducting the training the dataset.
- First model uses Darknet architecture of YOLOv2 [5], contains 31 layers.
- Second model is the modified version of first model with 27 layers.
- The final result shows that second model is better than first model while being smaller in size and faster in computation speed.

Literature Survey

Sr. No.	Author Name	Title	Findings	Publisher
1	G.D. Ercolani, D.H. Felix, N.H. Ortega	Crack Detection in Prestressed concrete structures by measuring their natural frequencies	Frequency of vibrations is used to find out cracks on pavement. Both position and Depth of the cracks are being identified.	Journal of Civil Structural Health Monitoring 2018
2	Abdullah Alfarrarjeh, Dweep Trivedi, Seon Ho Kim, Cyrus Shahabi	A deep Learning Approach for Road Damage Detection from SmartPhone Images	The Study decribe the use of YOLO over R-CNN algorithm for training a model. It is used to detect various types of road damages.	2018 IEEE International Conference On Big Data
3	Lim Kuoy Suong, Kwon Jangwoo	Detection of Pothholes using a Deep Convolutional Neural Network	Variations are brought in the parameters of the YOLOv2 in order to achieve high performance.	Journal of Universal Computer Science, vol 24, no. 9 (2018)

RCNN and YOLO

Region of Convolutional Neural Network

- Selective search algorithm is used in Region of CNN Object detection.
- We start with each individual pixel as its own group and calculate the texture for each group and combine two that are closest group first.

Figure: 3. Selective Search in Roads [3]

RCNN and YOLO

Diagrammatic representation of Pothole detection in RCNN

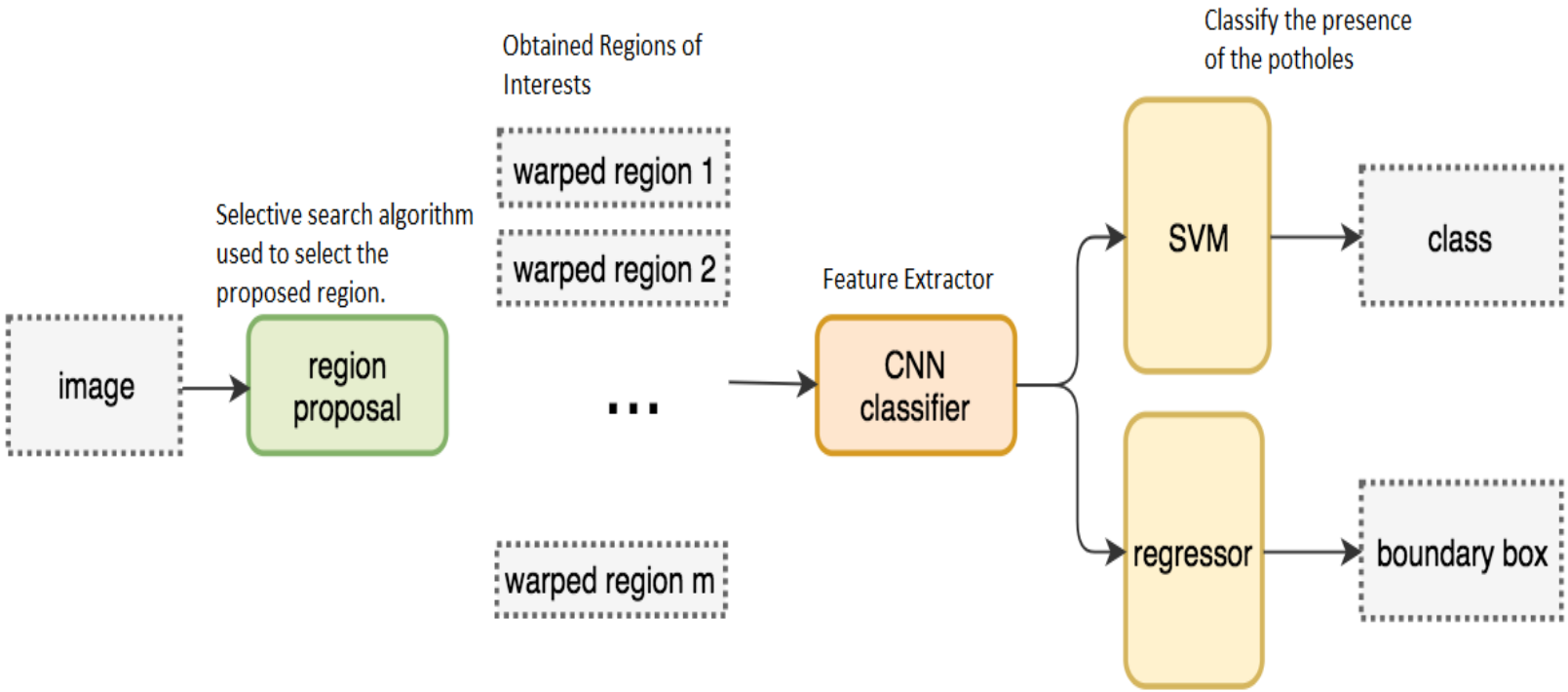

Figure: 4. Block Diagram for R-CNN [4]

RCNN and YOLO

You Only Look Once - A differnt approach

1. YOLO has a totally different approach for the object detection. Instead for selecting region for prediction, it take complete image and use it for the prediction.
2. YOLO take an image as an input and split it into an S*S grid cells.

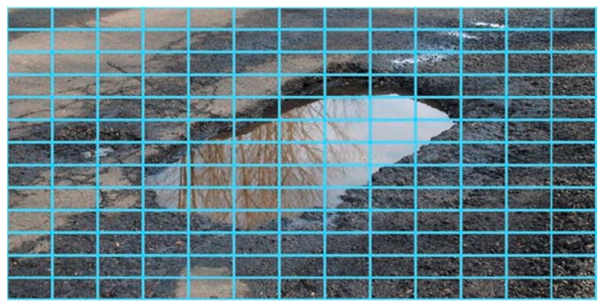

Figure: 5. 13*13 grid cell of YOLOv2 [2]

RCNN and YOLO

Diagrammatic representation of pothole detection in YOLOv2

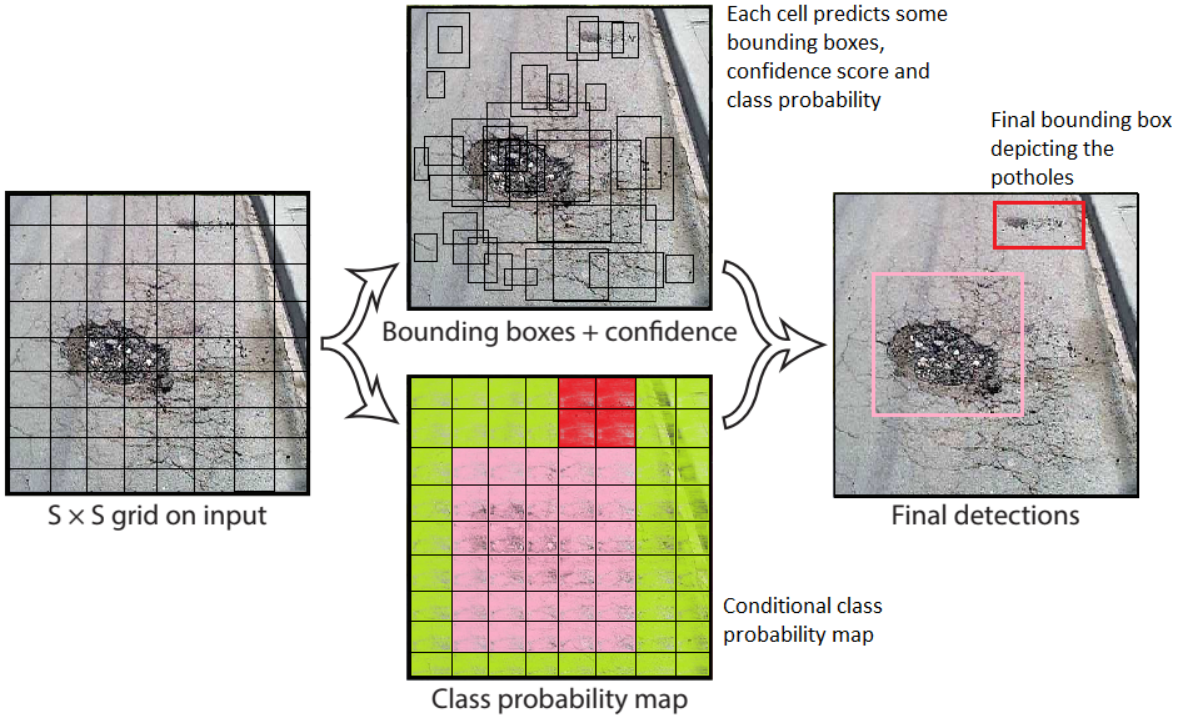

Figure: 4. Pothole Detectionn in YOLOv2

$$confidence = Pr(pothole) * IOU$$

RCNN and YOLO

Implementation in YOLO

- Darknet framework [5] of YOLO can be used for the implementation purpose. Training will be performed on desired GTX with desired RAM.
- The learning rate of the model will be variable to reduce loss and achieve finer granularity.
- The threshold value for the confidence score will help in reducing the false results or the results with low prediction.

Advantages and Applications

1. In the application for real time detection of potholes using smart phones YOLO will be having more advantages over RCNN.
2. RCNN still takes a huge amount of time to train the network as one would have to classify thousands of region proposals per image.
3. It cannot be implemented real time as it takes around 47 seconds for each test image [7]. Thus YOLO has one advantage over RCNN.
4. Also in YOLO, it is nearly impossible to detect small damages. RCNN has this advantage over YOLO.

Conclusion

- RCNN uses regions to localize the object within the image. The network does not look at the complete image.
- YOLO is an object detection algorithm much different from the region-based algorithm like RCNN and look the whole image at once. Hence YOLO is preferred over RCNN.
- New Radical concepts are arriving each year in various conferences which are moving us forward to the better performances of AI.

References I

[1] 2018 IEEE International Conference on Big Data A Deep Learning Approach for Road Damage Detection from Smartphone Images

[2] Journal of Universal Computer Science, vol 24, no. 9 (2018) Detection of Potholes Using a Deep Convolutional Neural Network

[3] Robotics Institute, School of Computer Science Carnegie Mellon University Vision for Road Inspection

[4] 2018 IEEE International Conference on Big Data Road Damage Detection And Classication In Smartphone Captured Images Using Mask R-CNN

[5] Darknet: Open Source Neural Networks in C, http://pjreddie.com/darknet/

[6] Journal of Civil Structural Health Monitoring 2018 Crack Detection in Prestressed concrete structures by measuring their natural frequencies

[7] Towards Data Science, https://towardsdatascience.com/r-cnn-fast-r-cnn-faster-r-cnn-yolo-object-detection-algorithms-36d53571365e