You Only Look Once

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- Deep Learning-Based Localization and Orientation Estimation of Pedicle Screws in Spinal Fusion Surgery
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“You Only Look Once” (YOLO) is a deep learning object detection algorithm. It's a real-time object detection system that can detect multiple objects in an image or video stream and outline them with bounding boxes. YOLO is known for its speed and accuracy, making it a popular choice in computer vision applications.

Here are some key points about YOLO:

Real-Time Object Detection: YOLO was designed for real-time object detection, which means it can process and detect objects in images or video frames at a rapid rate, typically in milliseconds per frame.

Single Pass Detection: YOLO takes a single pass through an input image or frame to detect and classify objects. This is in contrast to some other object detection methods that require multiple passes.

Bounding Box Prediction: YOLO not only detects objects but also predicts bounding boxes around them. These bounding boxes specify the location and size of the detected objects.

Class Prediction: In addition to bounding boxes, YOLO predicts the class of each detected object. For example, it can distinguish between different types of animals, vehicles, or objects.

Anchor Boxes: YOLO uses anchor boxes to help predict the bounding boxes' dimensions and aspect ratios. These anchor boxes are predefined and assist in accurately localizing objects of various shapes.

Multiple Scales: YOLO operates at multiple scales or resolutions within an image, which enables it to detect objects of different sizes.

Architecture Versions: YOLO has seen multiple versions and improvements. YOLOv1, YOLOv2 (YOLO9000), YOLOv3, YOLOv4, and YOLOv5 are some of the notable iterations, each offering enhancements in terms of accuracy and speed.

Applications: YOLO has a wide range of applications, including object detection in autonomous vehicles, surveillance systems, robotics, and even in various consumer applications like smartphone cameras for real-time object recognition.

Open Source: Many implementations of YOLO are open source, making it accessible to developers and researchers for various computer vision projects.

YOLO is favored for its ability to provide both fast and accurate object detection, making it valuable in scenarios where real-time processing is crucial. However, the choice of which YOLO version to use depends on the specific requirements of a given application.

In magnetic resonance imaging (MRI), lumbar disc herniation (LDH) detection is challenging due to the various shapes, sizes, angles, and regions associated with bulges, protrusions, extrusions, and sequestrations. Lumbar abnormalities in MRI can be detected automatically by using deep learning methods. As deep learning models gain recognition, they may assist in diagnosing LDH with MRI images and provide initial interpretation in clinical settings. YOU ONLY LOOK ONCE (YOLO) model series are often used to train deep learning algorithms for real-time biomedical image detection and prediction. This study aims to confirm which YOLO models (YOLOv5, YOLOv6, and YOLOv7) perform well in detecting LDH in different regions of the lumbar intervertebral disc. Materials and methods: The methodology involves several steps, including converting DICOM images to JPEG, reviewing and selecting MRI slices for labeling and augmentation using ROBOFLOW, and constructing YOLOv5x, YOLOv6, and YOLOv7 models based on the dataset. The training dataset was combined with the radiologist's labeling and annotation, and then the deep learning models were trained using the training/validation dataset. Results: Our result showed that the 550-dataset with augmentation (AUG) or without augmentation (non-AUG) in YOLOv5x generates satisfactory training performance in LDH detection. The AUG dataset's overall performance provides slightly higher accuracy than the non-AUG. YOLOv5x showed the highest performance with 89.30% mAP compared to YOLOv6, and YOLOv7. Also, YOLOv5x in the non-AUG dataset showed the balance LDH region detections in L2-L3, L3-L4, L4-L5, and L5-S1 with above 90%. This illustrates the competitiveness of using non-AUG datasets to detect LDH. Conclusion: Using YOLOv5x and the 550 augmented dataset, LDH can be detected with promising both in non-AUG and AUG datasets. By utilizing the most appropriate YOLO model, clinicians have a greater chance of diagnosing LDH early and preventing adverse effects for their patients [1)].

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Prisilla AA, Guo YL, Jan YK, Lin CY, Lin FY, Liau BY, Tsai JY, Ardhianto P, Pusparani Y, Lung CW. An approach to the diagnosis of lumbar disc herniation using deep learning models. Front Bioeng Biotechnol. 2023 Sep 4;11:1247112. doi: 10.3389/fbioe.2023.1247112. PMID: 37731760; PMCID: PMC10507264.