INVESTIGATION OF SOLUTIONS FOR 2D OBJECT DETECTION MODELS WITH ORIENTATION INFORMATION USING YOLO ARCHITECTURE

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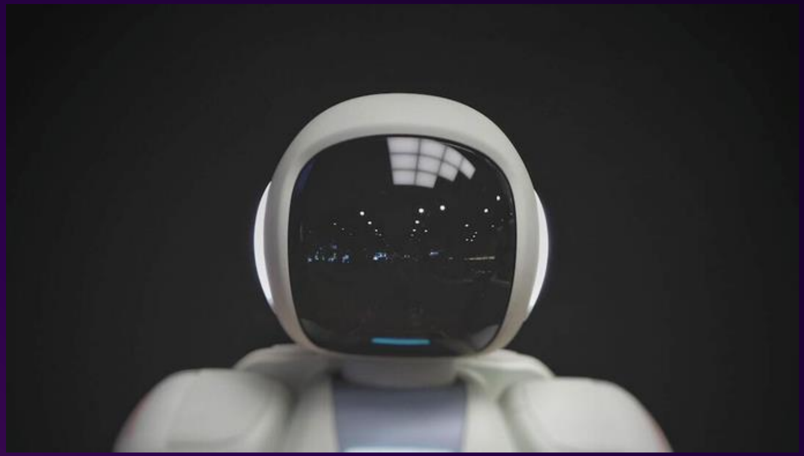
AGENDA

1. Introduction
2. Technical advancements
3. Application
4. Architecture
5. MOBILNET
6. YOLOv5 result
7. Further plans

INTRODUCTION TO YOLOV5



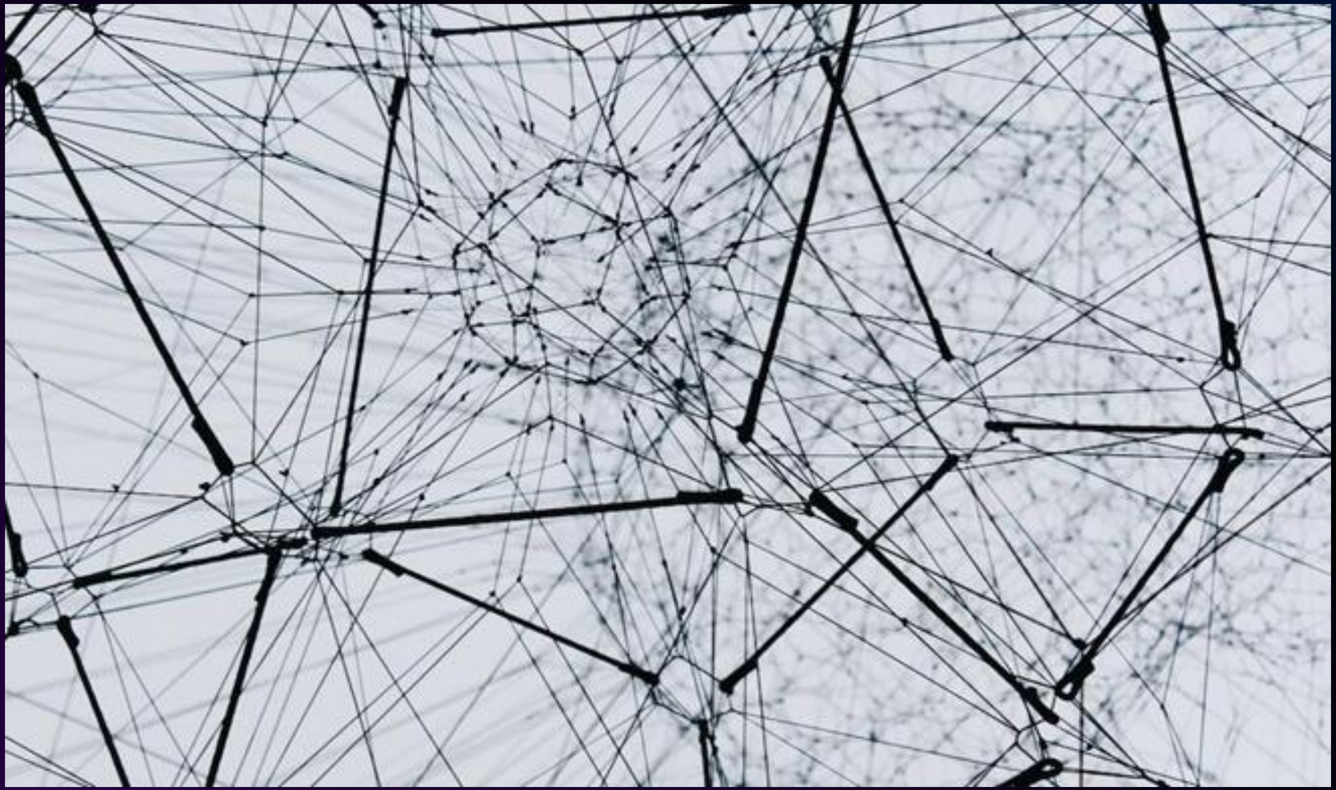
What is Object Detection?: Object detection is a computer vision technique for identifying and locating objects within digital images and videos. It serves as the basis for many applications, from security surveillance to autonomous driving.

Key Concepts: Involves detecting the presence, location, and classification of multiple objects in an image using predefined categories.

Applications: Widely used in face recognition, traffic control systems, and real-time threat detection

TECHNICAL ADVANCEMENTS IN YOLOV5

1. Architecture Improvements: YOLOv5 introduces a more streamlined architecture that increases the inference speed while maintaining high accuracy, making it suitable for real-time applications.
2. Performance Metrics: It excels in both speed and accuracy metrics, achieving impressive benchmarks on standard datasets like COCO, with significant improvements over its predecessors.
3. Model Scalability: The model is designed for scalability and efficiency, offering various sizes (small to large) to accommodate different computational and accuracy needs.



APPLICATIONS OF YOLOV5

Automotive Industry: YOLOv5 is deployed for real-time vehicle and pedestrian detection to enhance safety features in advanced driver-assistance systems (ADAS).

Security and Surveillance: In security, YOLOv5 aids in efficient monitoring and threat detection by recognizing suspicious activities or unauthorized individuals quickly.

Industrial Automation: Factories utilize YOLOv5 for defect detection and assembly line monitoring, significantly reducing errors and increasing production efficiency.

YOLOV5: ARCHITECTURE

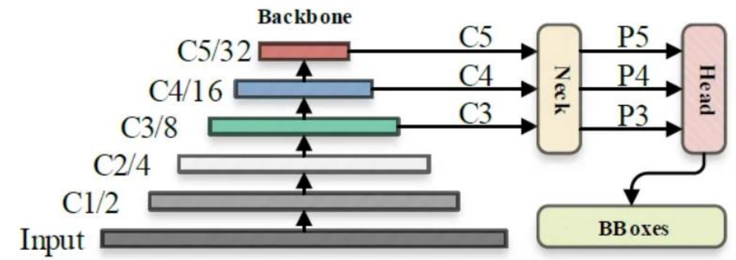


Figure 1. The default inference flowchart of YOLOv5.

YOLOv5: Overall Architecture

1. **Initial Processing:** The image passes through an input layer and a backbone network that extracts varying sizes of feature maps.

2. **Feature Fusion:** These features are fused into three key maps (P3, P4, P5) by the neck network, enabling detection of objects of different sizes.

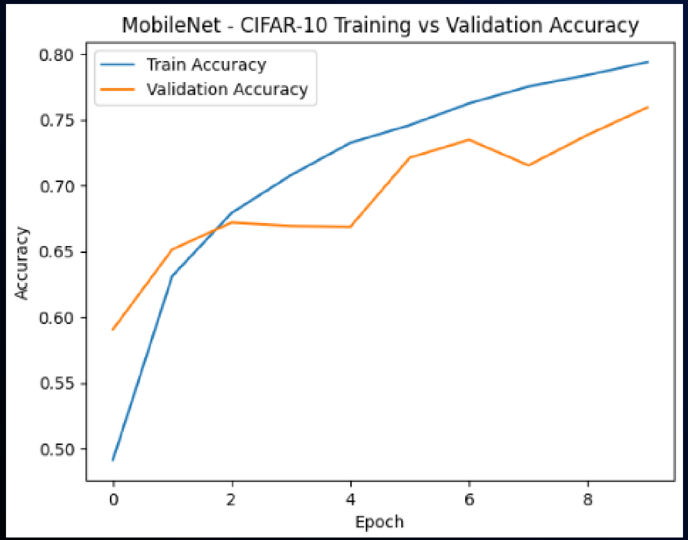
3. **Detection and Analysis:** The feature maps proceed to the prediction head for confidence scoring and bounding box calculations, producing a detailed array of detection data.

4. **Refinement:** Settings filter irrelevant data, and non-maximum suppression (NMS) finalizes the output by eliminating overlapping detections.

MOBILNET

Cifar10

```python
class MobileNet(nn.Module):
    """MobileNet architecture for CIFAR-10."""
    def __init__(self, num_classes=10):
        super(MobileNet, self).__init__()
        self.conv1 = nn.Conv2d(3, 32, kernel_size=3, stride=1, padding=1)

        # First Inverted Residual Block
        self.block1 = nn.Sequential(
            DepthwiseSeparableConv(32, 64, kernel_size=3, padding=1),
            nn.ReLU(inplace=True)
        )

        self.block2 = nn.Sequential(
            DepthwiseSeparableConv(64, 128, kernel_size=3, stride=1, padding=1),
            nn.ReLU(inplace=True)
        )

        self.block3 = nn.Sequential(
            DepthwiseSeparableConv(128, 128, kernel_size=3, padding=1),
            nn.ReLU(inplace=True)
        )

        self.block4 = nn.Sequential(
            DepthwiseSeparableConv(128, 128, kernel_size=3, padding=1),
            nn.ReLU(inplace=True)
        )
        self.avgpool = nn.AdaptiveAvgPool2d((1, 1))
        self.fc = nn.Linear(128, num_classes)

    def forward(self, x):
        x = self.conv1(x)
        x = self.block1(x)
        x = self.block2(x)
        x = self.block3(x)
        x = self.block4(x)
        x = self.avgpool(x)
        x = x.view(x.size(0), -1)
        x = self.fc(x)
        return x
```




```
Epoch 1/10 - Train Acc: 0.491 - Val Acc: 0.591
Epoch 2/10 - Train Acc: 0.631 - Val Acc: 0.651
Epoch 3/10 - Train Acc: 0.679 - Val Acc: 0.672
Epoch 4/10 - Train Acc: 0.708 - Val Acc: 0.669
Epoch 5/10 - Train Acc: 0.732 - Val Acc: 0.669
Epoch 6/10 - Train Acc: 0.746 - Val Acc: 0.721
Epoch 7/10 - Train Acc: 0.762 - Val Acc: 0.735
Epoch 8/10 - Train Acc: 0.775 - Val Acc: 0.715
Epoch 9/10 - Train Acc: 0.784 - Val Acc: 0.739
Epoch 10/10 - Train Acc: 0.794 - Val Acc: 0.759
```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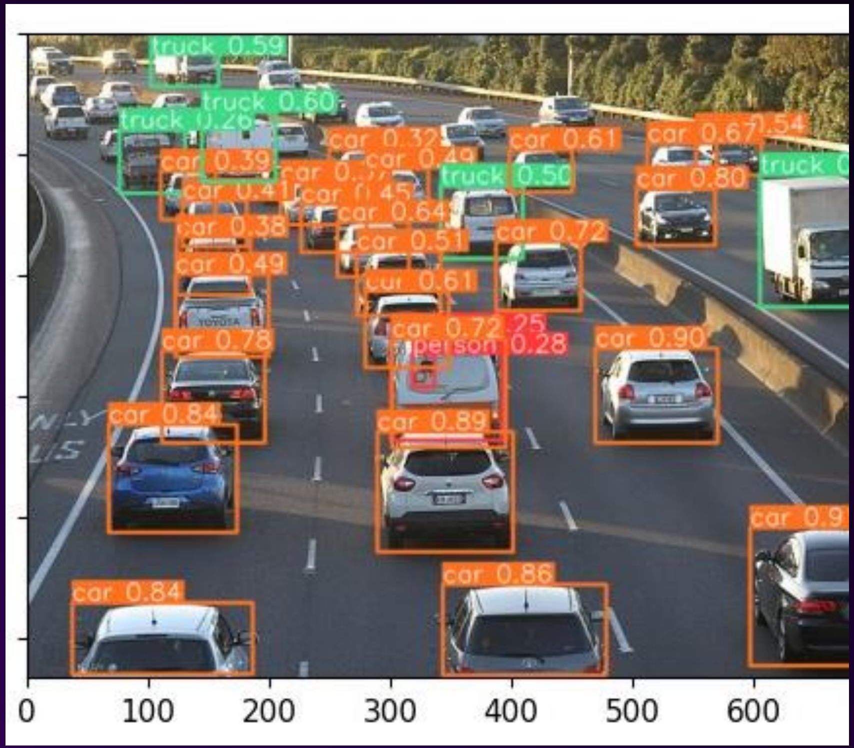
RESULT OF APPLICATION OF YOLOV5



FURTHER PLANS:

- Train the model on a custom dataset
- Calculate all metrics for different hyperparameters
- Add object orientation
- Calculate all metrics & define best result

THANK YOU

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