Chapter 12
Introduction of Object Detection
(Theme 3)

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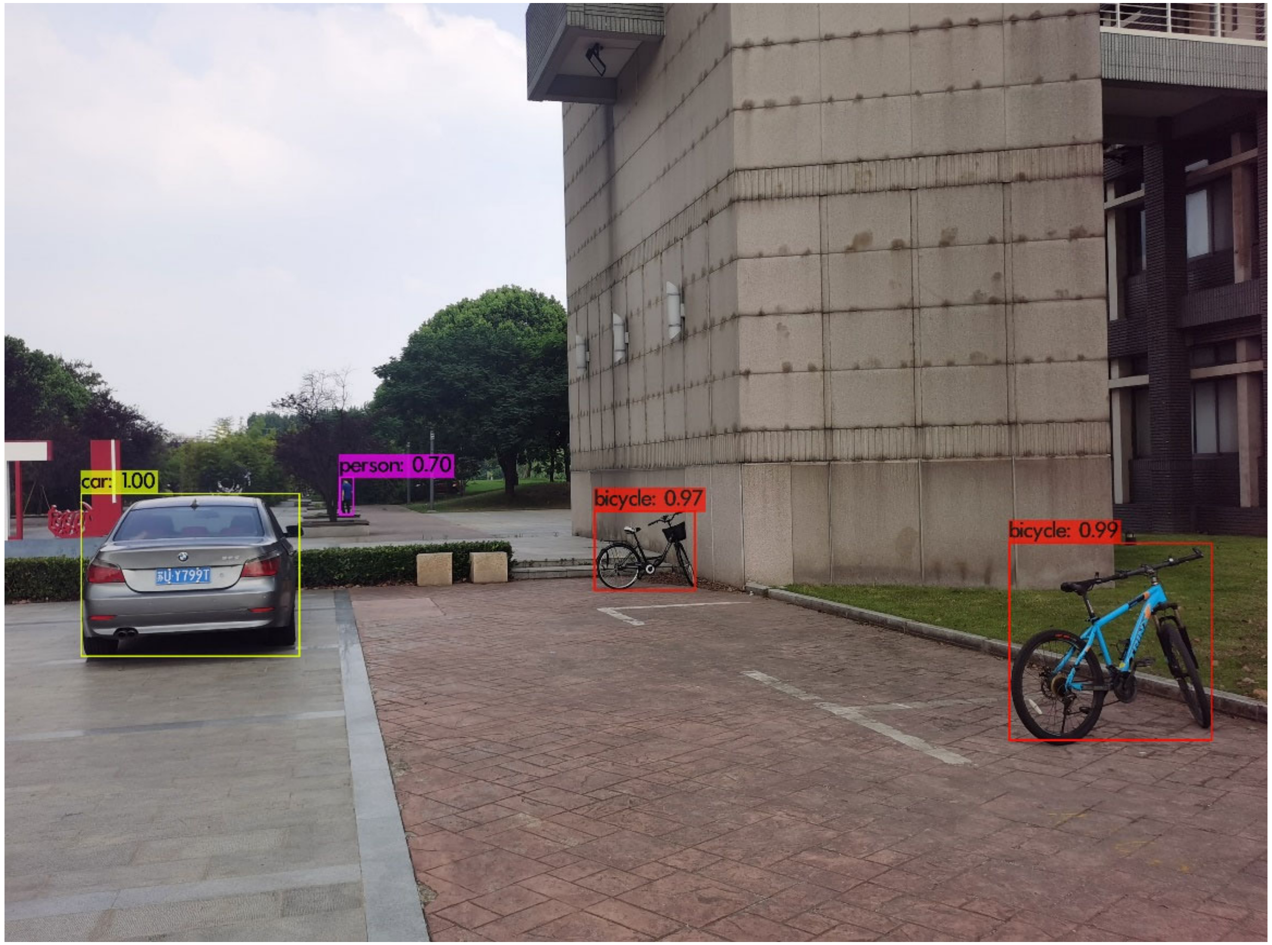
Problem definition of object detection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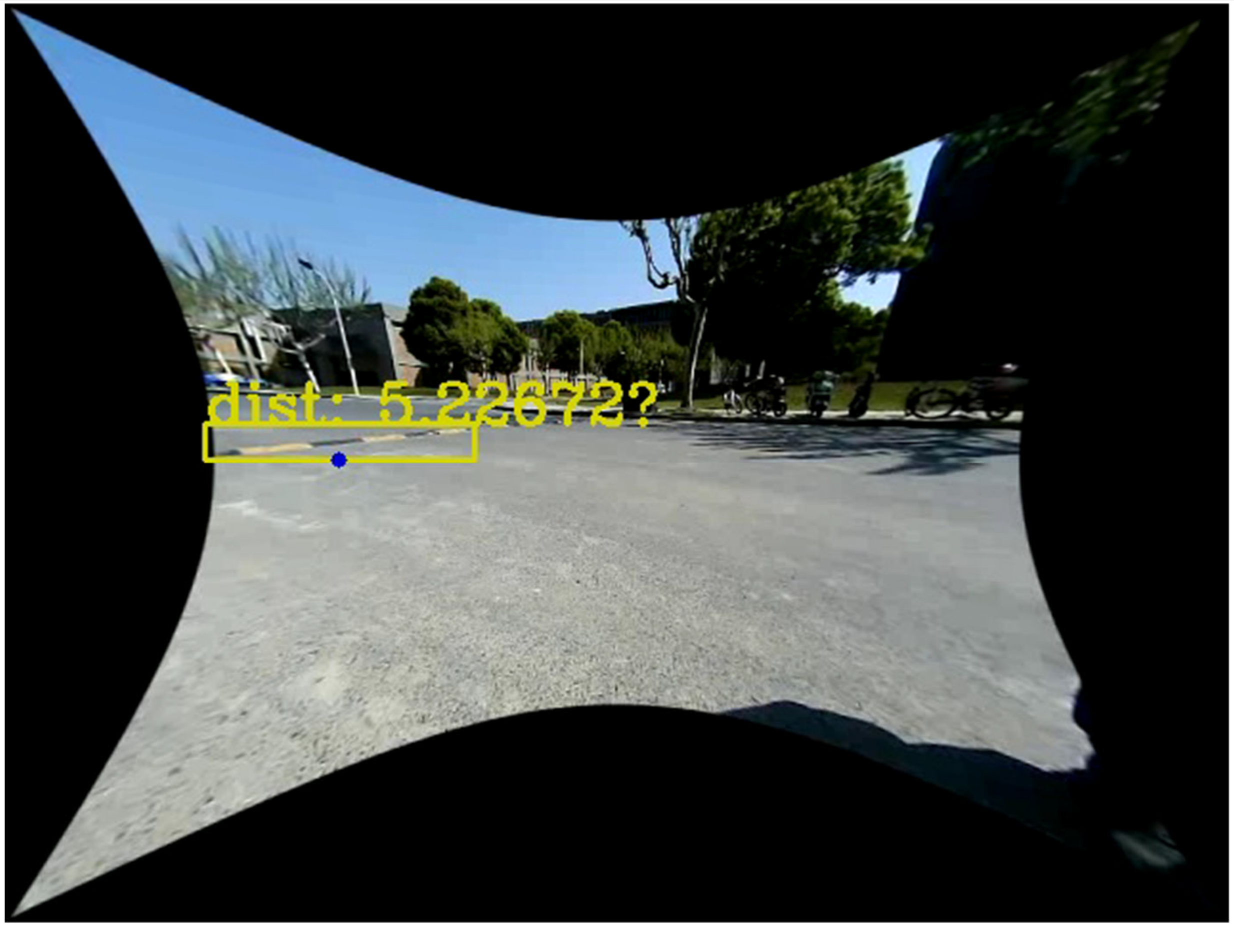
person: 0.70
bicycle: 0.97
bicycle: 0.99

Multiple objects detection

Problem definition of object detection


dist: 5.22672?

Perform object detection on each video frame

Problem definition of object detection

- Object detection is a fundamental task in computer vision that involves identifying and locating objects within an image or video. This capability is crucial for a wide range of applications, from autonomous driving and surveillance to medical imaging and retail analytics
- Challenges in object detection
  - Variability in object appearance: Objects can appear in various shapes, sizes, colors, and orientations
  - Occlusion: objects may be partially hidden by other objects, making them difficult to detect
  - Complex backgrounds: Cluttered or dynamic backgrounds can interfere with object detection
  - Real-time processing: Many applications require object detection to be performed in real-time, necessitating efficient algorithms

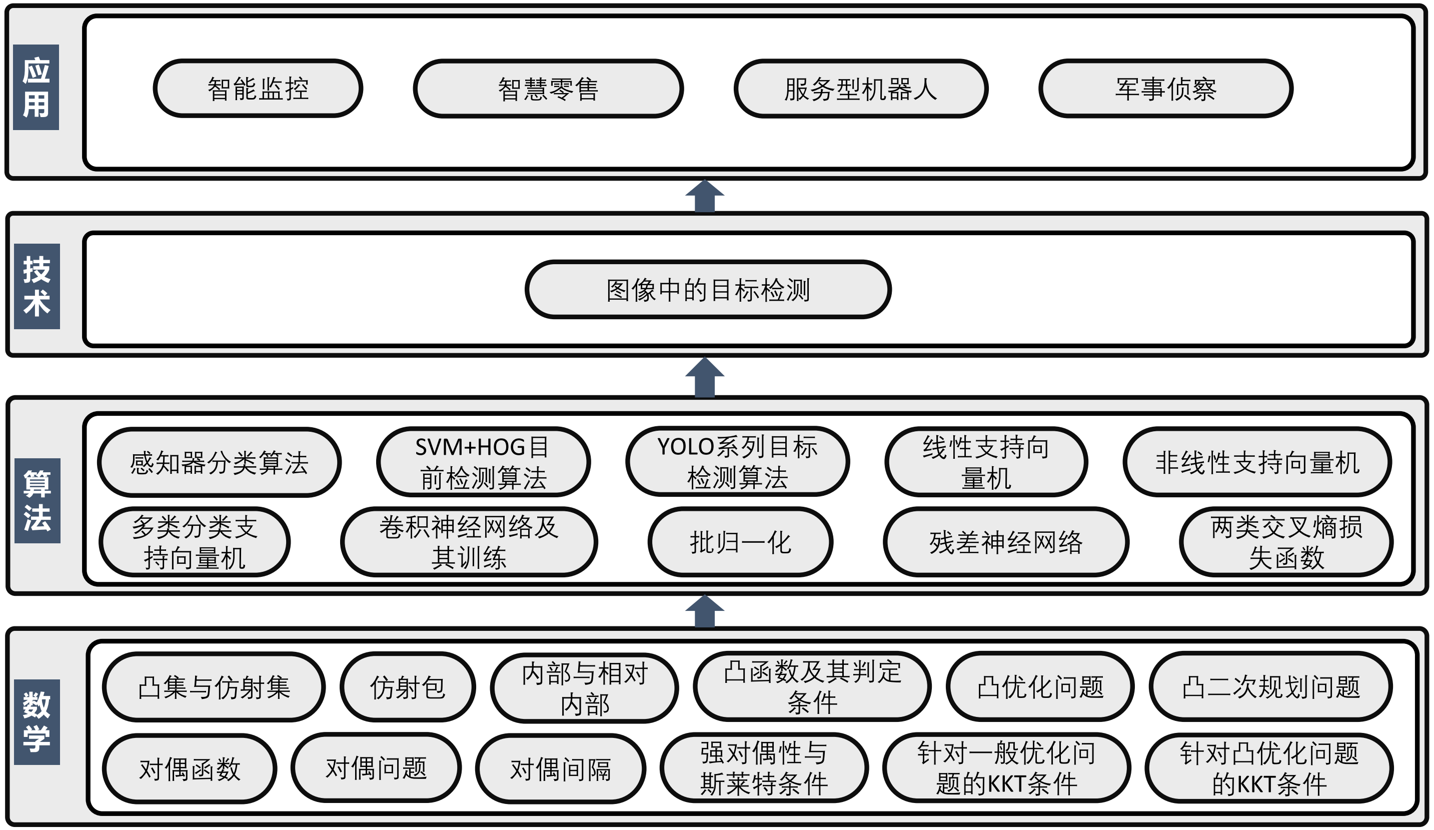
Popular object detection algorithms

- Traditional Methods
  - Haar Cascades: Used for face detection, relying on handcrafted features
  - HOG (Histogram of Oriented Gradients) + SVM (Support Vector Machine): Effective for pedestrian detection
- Deep Learning-Based Methods
  - R-CNN (Region-based Convolutional Neural Networks): Proposes regions and classifies them using CNNs
  - Fast R-CNN: Improves R-CNN by sharing computation across region proposals
  - Faster R-CNN: Introduces Region Proposal Networks (RPN) for faster processing
  - YOLO (You Only Look Once): A single-shot detector that predicts bounding boxes and class probabilities directly from full images in one forward pass
  - SSD (Single Shot Multibox Detector): Balances speed and accuracy by predicting bounding boxes at multiple scales
  - DETR (DEtection TRansformer): an object detector using a transformer architecture

Contents of this theme

- ✓ SVM is classical classification approach; to learn it, some knowledge about convex optimization is necessary, which will be covered in Chapter 13
- ✓ SVM+HoG based object detector will be introduced in Chapter 14
- ✓ Fundamental knowledge about CNNs and YOLO will be detailed in Chapter 15

Contents of this theme



应用

- 智能监控
- 智慧零售
- 服务型机器人
- 军事侦察

技术

- 图像中的目标检测

算法

- 感知器分类算法
- SVM+HOG目前检测算法
- YOLO系列目标检测算法
- 线性支持向量机
- 非线性支持向量机
- 多类分类支持向量机
- 卷积神经网络及其训练
- 批归一化
- 残差神经网络
- 两类交叉熵损失函数

数学

- 凸集与仿射集
- 仿射包
- 内部与相对内部
- 凸函数及其判定条件
- 凸优化问题
- 凸二次规划问题
- 对偶函数
- 对偶问题
- 对偶间隔
- 强对偶性与斯莱特条件
- 针对一般优化问题的KKT条件
- 针对凸优化问题的KKT条件

Q+A