

Real-Time Object Detection System Using YOLO for Intelligent Surveillance and Monitoring

Team members:-

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1.Problem Statement

Manual monitoring of video feeds is inefficient and prone to human error. Traditional object detection methods are either too slow or inaccurate for real-time use. There is a need for a fast, reliable, and lightweight solution that can detect and classify objects from live video in real time.

2.Key Features

- Real-time detection of multiple objects from live video feeds
- High-speed performance using YOLO's single-shot detection architecture
- Accurate object classification with confidence scores and bounding boxes
- Support for 80+ object classes (COCO dataset)
- Visual overlay of detections on video frames
- Lightweight and scalable for low-end or embedded devices
- Easy integration with webcams, IP cameras, or video files
- Event logging and frame saving for later review
- Customizable for specific applications like crowd monitoring or traffic analysis

3.Rationale

Manual oversight is a widespread practice employed by traditional surveillance systems although it is tedious and prone to make mistakes. Surveillance automation is becoming increasingly common, which detects and responds to objects or events in real time. With deep learning methods, YOLO (You Only Look Once) provides a fast and efficient option for object detection, making it useful for real-time surveillance. Incorporating YOLO into surveillance systems improves security, lowers workload, and increases responsiveness during emergencies.

4.Expected Outcomes

- Accurate detection and classification of multiple objects in real-time
- Smooth video processing with high frame rates (20–30 FPS)
- Clear display of bounding boxes, labels, and confidence scores on live video
- Reduced need for manual surveillance through automated monitoring
- Compatibility with various camera types (USB, IP, RTSP)
- Efficient system performance even on mid-range hardware
- Optional logging of detected objects with timestamps
- Scalable design for integration into larger surveillance systems
- Foundation for future features like tracking and behavior analysis
- Enhanced situational awareness and faster response to security events

5.Technology and Frameworks

- Python – Primary programming language for development
- YOLO (You Only Look Once) – Deep learning model for fast and accurate object detection
- PyTorch – Framework for implementing and running YOLO models (YOLOv5, YOLOv8)
- OpenCV – For video capture, image processing, and visual output
- NumPy – For numerical operations and array handling

- CUDA & cuDNN – GPU acceleration for faster model inference
- Ultralytics YOLO – Ready-to-use YOLO implementation with CLI and API support
- Jupyter Notebook / VS Code – Development and testing environment
- Labellmg / Roboflow – Tools for dataset annotation (for custom data)
- Anaconda – For managing Python environments and dependencies

6. Students' Challenges

While working on a Real-Time Object Detection System based on YOLO, students often struggle with deep learning concepts as well as selection between different versions of YOLO, and how to configure them for real-time execution. Restricted access to hardware, particularly a GPU, can obstruct seamless detection. Resolving issues with software dependencies, stream integration, data preparation (annotation and formatting), and many others can be quite challenging too. Moreover, optimizing models for speed and precision involves numerous iterations of model output interpretation and tuning. Solving these problems, however intricate, allows learners to acquire valuable experience in AI and computer vision.