AI-Based Smart Cellphone Detection System

A Project Report

Submitted by:

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Abstract:

Online learners engage in a variety of educational activities such as reading, writing, watching video lectures, taking online tests, and attending online meetings.

During this era of the COVID-19 pandemic the need for online activities, particularly online conferencing and learning for educational institutions & banking sector has increased in big folds and it is the only efficient and time saving method with less expenses for all kinds of work to continue.

Hence this project which is focused on analyzing attentiveness of online learners in a meeting on a video streaming platform using YOLO V5 algorithm by criteria of object detection, preferably mobile detection ,during online examinations ,in exam halls or conference rooms, in shopping malls or on the road for vehicle detection.

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1 Important Abbreviations

The expression 'You Only Look Once' is abbreviated as YOLO. This is an algorithm for detecting and recognising different items in a photograph (in real-time). YOLO v5 is utilised to detect objects in this case.
Object detection is a computer approach that searches digital pictures and videos for instances of semantic entities of a certain class (such as people, buildings, or vehicles). It has to do with image processing and computer vision.

2 Introduction

This projectis basedon the YOLO algorithm through which we can detect the degree to which the student/person is using mobile phone in the monitored environment in a stipulated time. With schools and colleges being shut due to the pandemic, studies across the world are still being conducted online. May it be a student attending school classes or an employer doing his office work. Nonetheless, there are a number of problems about this new teaching or examination system.

- Parents and teachers cannot monitor their all students or child at all times during the period of classes to examine children are actually watching the video lectures or if they are simply using their mobile swallowing the video to play in the background.
- Usage of mobiles in examination hall, during online exams and during confidential board meetings or phone prohibited areas can be resolved with this technique.

Our project aims to solve the above-mentioned problems. We plan to implement a model that could detect whether a student is actually paying attention to class or is distracted by such as mobile phone usage.
Now, the question arises that how do you know if one is using preferably a mobile phone?
Well, the most obvious signs are:

- The object which the person uses is mostly held in the hands.
- It is on a surface which is viewable by the persons eye and is used for a detectable amount of period.

For this, we'll use the YOLO V5 algorithm.
Object detection is finding its way into a wide range of businesses, with uses ranging from personal protection to workplace productivity.

Object detection and recognition are used in a variety of computer vision applications, including image retrieval, security, surveillance, autonomous vehicle systems, and machine inspection. Object identification continues to be a major roadblock. When it comes to future object detection use cases, the possibilities are endless.

3 Problem Statement

The latest threat to information dependent businesses is the cellular phone. The technology added to cellular phones in the last 15 years has made them a jack-of-all - trades for information storage and transmission. Features like Bluetooth, USB, micro USB, high resolution cameras, microphones, internet, and 802.11 wireless make cellular phones perfect for stealing data.That is why a method to detect cellular phones in a secure facility is needed. It should be able to analyse live video from a variety of sources, including CCTV cameras and drones, in real time. But creating such a system is fraught with difficulties, such as accurately detecting objects, dealing with changing lighting and weather, including preventing false positives. As a result, there is an urgent need for more research and development in this field to come up with a dependable and practical solution.

4 Motivation

1. **Technical Usability:** Among the most basic challenges in computer vision is object detection. Several other subsequent computer vision

tasks, including as instance segmentation, visual captioning, object tracking, and also more, are built on top of it. Walker detection, individuals counting, face detection, text detection, position detection, and numeric identification are examples of specific asset detection applications.

The fast development and widespread usage of object detection systems has heightened interest in object detector accuracy and speed. The present state-of-the-art object detection works, on the other hand, are either accuracy-oriented with a huge model but high latency, or speed-oriented with a lightweight model but low accuracy. We propose a real-time object identification on mobile devices utilising the YOLO V5 framework via compression-compilation co-design in this paper.

The far more recent addition to the YOLO family of devices is the YOLOv5. YOLO was the very first object recognition model to combine object categorization and bounding box prediction into an one end-to-end differentiable network. The Darknet framework was used to develop and manage it. YOLOv5 is the first YOLO model built with the PyTorch framework, making it more simpler and easier to use. Yet, because YOLOv5 did not make major architectural enhancements to the network in YOLOv4, it does not outperform YOLOv4 on a typical standard, the COCO dataset.

2. **Increasing efficiency:** Preventing excessive or untimely mobile phone use in families, educational institutions, and companies can assist improve productivity.

3. **Avoiding distraction-related accidents:** People who use their phones while performing critical tasks like as driving or administering medical care can be tracked and informed to avert accidents. Similarly, assisted living arrangements for elderly individuals may be monitored.

4. **Producing proof of a legal violation:** A mobile phone may be used for data theft and espionage. Mobile phones may also be restricted in exam rooms, corporate meeting rooms, theatres, govern-

ment offices, embassies, courts of law, and military bases.
A mobile phone may be used for data theft and espionage. Mobile phones may also be restricted in exam rooms, business conference rooms, theatres, government offices, embassies, the courts of law, military posts, fuel outlets, hospitals, and religious locations, among other places.
Similarly, mobile phones may allow inmates to commit new crimes while incarcerated. Furthermore, with the rise of mobile payments, many financial transactions are now conducted via mobile phones, and therefore, losing a mobile phone may have a significant impact on an individual.
As a result, our method can assist in the detection of mobile phone abuse or theft.
In many situations, cellphone detectors are inconvenient or ineffectual.

5. **Quality Education Monitoring:** Analyzing attentiveness of online learners in a meeting on a video streaming platform using YOLO V5 algorithm by criteria of object detection, preferably mobile detection ,during online examinations ,in exam halls or conference rooms, in shopping malls or on the road for vehicle detection.

5 Business Need Assessment

Governments and private organisations all around the world are very concerned about stealing data in various sensitive places, including usage of mobiles in examination hall, during online exams and during confidential board meetings or phone prohibited areas. Therefore, there is a urgent need to design an automated AI-Based Smart Cellphone Detection System that can examine live footage from diverse sources.
The objective of a AI-Based Smart Cellphone Detection System is to deliver a strong, affordable, and trustworthy solution that can analyse real-time video in order to precisely identify any potential threats. The technology can be used in a variety of locations to stop incidents before they happen. Security staff should receive an alert from the system, which will

allow them to act immediately to stop any harm.

6 Target Specification and Characterization

6.1 Target Specification

The target specifications for the AI-based smart cellphone detection system from live footage should be as follows:

- **Accuracy:** The system should be highly accurate at spotting firearms from live video in real time.
- **Speed:** The system should be able to quickly analyse video and send security staff notifications in real time.
- **Reliability:** In order to prevent pointless alarms and delays, the system should be dependable and minimise false positives.
- **Scalability:** The system must be scalable and capable of processing massive volumes of video from many sources.
- **Compatibility:** Compatible with different cameras and technology, the system should also interface with current security systems.
- **Usability:** Security professionals should only need a little amount of training to use the system.
- **Cost-Effective:** The system should be economical for the businesses who utilise it and offer good value.

6.2 Target Characterization

The AI-Based Smart Cellphone Detection System must have the following qualities in order to meet the target specifications:

- **Object Detection:** To accurately detect smart cellphone, the system should employ cutting-edge object identification algorithms like YOLO (You Only Look Once).

- **Deep Learning:** To increase accuracy and reduce false positives, the system should employ deep learning strategies.
- **Real-Time Processing:** Using powerful technology, such as GPUs, the system should be able to process live video in real-time.
- **Cloud-based:** The solution should be cloud-based so that businesses may store and analyse massive amounts of data from many places.
- **Automated Alerting:** The system should provide real-time automated notifications through email, SMS, or other messaging services to security staff.
- **User-Friendly Interface:** The system should have a user-friendly interface that enables security staff to swiftly evaluate and react to alarms.
- **Maintenance and Support:** To guarantee the system's optimum performance and dependability, it should offer routine maintenance and support.

7 Business Model

Here's a possible business model for such a system:

1. **Target Market:** The government, and private industries may be used the AI-Based Smart Cellphone Detection System's target markets.
2. **Product attributes:**The following characteristics should be included in the AI based smart cellphone detection system:
    - High dependability and accuracy in spotting firearms in real-time video.
    - Real-time notifications may be delivered to security personnel thanks to real-time processing capabilities.
    - Capacity to scale to handle massive amounts of video from many sources.

- Integration with currently installed cameras and security systems.
- User-friendly interface for simple usage and little need for training.
- To maintain peak performance, routine maintenance and support services are provided

3. **Pricing Strategy:** The pricing strategy for the AI-Based Smart Cellphone Detection System could be based on the following factors:
   - How many sources—such as cameras—the system will cover.
   - The degree of modification necessary for the system to satisfy the demands of the client.
   - The customer's need for continuing maintenance and support services
4. **Revenue Streams:** The revenue streams for the AI-Based Smart Cellphone Detection System could be as follows:
   - One-time fees for installation and customization of the system.
   - Recurring fees for ongoing maintenance and support services.
   - Subscription fees for accessing the system and its features.
5. **Marketing Strategy:** The marketing strategy for the AI-Based Smart Cellphone Detection System could involve:
   - Sales made directly to governmental bodies, police and private Institutes.
   - Taking part in trade shows and conferences to demonstrate the capabilities of the technology.
   - Developing instructional materials to explain the system's advantages to potential clients.

8 Product Details

Here are the product details for a AI-Based Weapon Detection System, including a schematic diagram:

1. **Camera System:** The camera system captures live footage of the target area. It should be designed to provide high-quality video footage even in low-light conditions. The camera system can be installed at various locations.

2. **Data Processing Unit:** The data processing unit is responsible for analysing the live footage captured by the camera system. It should be designed to handle large volumes of video data in real-time and support machine learning algorithms. The data processing unit can be a standalone server or a cloud-based solution.

3. **Machine Learning Algorithms:** The machine learning algorithms are used to analyse the live footage and detect potential weapons. They are trained on a large dataset of images and videos that contain various types of weapons and non-weapons. The machine learning algorithms should be regularly updated to ensure the highest level of accuracy and precision. Here we have used YOLOv5. "You Only Look Once" (YOLO) is a state-of-the-art, real-time object detection system.

4. **Alert System:** The alert system is triggered when the machine learning algorithms detect a smart cellphone. It can be designed to send an alert to security personnel or trigger an alarm to warn nearby individuals of the phone. The alert system can also be configured to provide detailed information about the location of the phone and the type of phone detected.

5. **User Interface:** The user interface is designed to provide security personnel with a real-time view of the footage captured by the camera system. It can also display alerts generated by the machine learning algorithms and provide access to historical data for analysis and reporting.

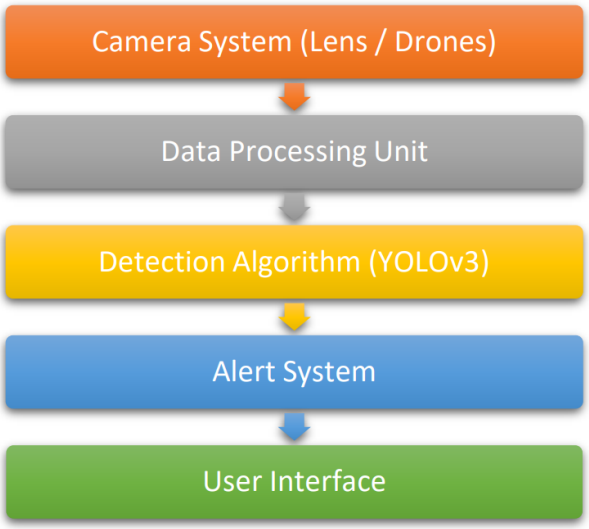


Figure 2: Schematic diagram of the model

9 Implementation

Here I have tried to develop a prototype that is, to detect cellphone using some predefined data set.
Used modules: NumPy, OpenCV.

Code

```
import cv2
import numpy as np

# Load YOLOv3 weights and configuration

net = cv2.dnn.readNet("yolov3.cfg", "yolov3.weights")

# Load class names

classes = []
with open("coco.names", "r") as f:
    classes = [line.strip() for line in f.readlines()]

# Define output layers

layer_names = net.getLayerNames()
output_layers = [layer_names[i - 1] for i in
net.getUnconnectedOutLayers()]

# Initialize video capture

cap = cv2.VideoCapture("testgif.gif")

while True:
    # Read frame from video
    ret, frame = cap.read()
    if not ret:
        break

    # Detect objects in the frame

    height, width, channels = frame.shape
    blob = cv2.dnn.blobFromImage(frame, 0.00392, (416, 416), (0, 0, 0),True, crop=False)
    net.setInput(blob)
    outs = net.forward(output_layers)
```

```
    # Get detection results

    class_ids = []
    confidences = []
    boxes = []
    for out in outs:
        for detection in out:
            scores = detection[5:]
            class_id = np.argmax(scores)
            confidence = scores[class_id]
            if confidence > 0.2 and classes[class_id] == "cellphone":

                # Cellphone detected & save detection results
                center_x = int(detection[0] * width)
                center_y = int(detection[1] * height)
                w = int(detection[2] * width)
                h = int(detection[3] * height)
                x = int(center_x - w / 2)
                y = int(center_y - h / 2)
                class_ids.append(class_id)
                confidences.append(float(confidence))
                boxes.append([x, y, w, h])


    indexes = cv2.dnn.NMSBoxes(boxes, confidences, 0.5, 0.4)
    font = cv2.FONT_HERSHEY_PLAIN
    colors = np.random.uniform(0, 255, size=(len(boxes), 3))
    for i in range(len(boxes)):
        if i in indexes:
            x, y, w, h = boxes[i]
            label = f"{classes[class_ids[i]]}: {confidences[i]:.2f}"
            color = colors[i]
            cv2.rectangle(frame, (x, y), (x + w, y + h), color, 2)
            cv2.putText(frame, label, (x, y - 5), font, 1, color, 1)
```

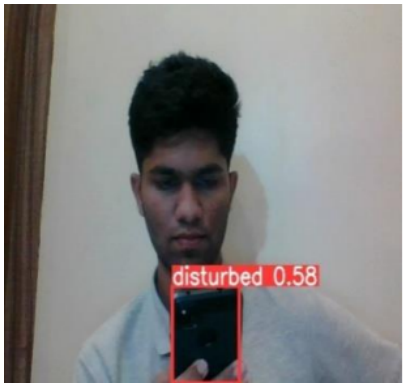
```
    # Show the output video
    cv2.imshow("Cellphone Detection", frame)

    # Exit when 'q' key is pressed
    if cv2.waitKey(1) == ord("q"):
        break

    # Release video capture and destroy all windows
    cap.release()
    cv2.destroyAllWindows()
```

Input :

Output :



10 Team Requirement

Developing an AI-based cellphone detection system using YOLOv5 requires a multidisciplinary team with expertise in various domains. Here are some key roles that would be essential for the team:

- **Data Scientists:** Data scientists are responsible for collecting, cleaning, and pre-processing the dataset required for training the YOLOv5 model. They have expertise in machine learning and computer vision algorithms, and they work on optimizing and fine-tuning the model to achieve accurate cellphone detection.
- **Computer Vision Experts:** Computer vision experts specialize in developing algorithms and techniques for image and video processing. They play a crucial role in designing and implementing the object detection framework using YOLOv5. Their expertise is essential in fine-tuning the model architecture and optimizing it for real-time performance.
- **Software Engineers:** Software engineers are responsible for developing the software infrastructure that integrates the YOLOv5 model into the overall cellphone detection system. They build the backend systems, APIs, and interfaces required to receive and process video feeds from surveillance cameras, perform real-time detection, and trigger appropriate responses.
- **Hardware Specialists:** Hardware specialists are involved in selecting and configuring the hardware components necessary for deploying

the cellphone detection system. They optimize the system for efficient processing and ensure compatibility with the chosen AI model. Their expertise helps in achieving the required speed and accuracy for real-time detection.

- **Domain Experts and Law Enforcement Professionals:** Collaboration with domain experts and law enforcement professionals is crucial to understand the specific requirements, challenges, and regulations related to security and public safety. Their input helps in designing the system to meet the real-world needs and align with legal and ethical standards.

- **Project Managers:** Project managers oversee the entire development process, coordinate the efforts of the team members, and ensure timely delivery of the cellphone detection system. They communicate with stakeholders, set project goals, manage resources, and ensure effective collaboration among team members.

Effective teamwork and collaboration among these experts are essential for developing an AI-based smart cellphone detection system using YOLO5 . Each team member brings unique skills and perspectives, contributing to the success of the project.

11 Conclusion

The first version of YOLOv5 is highly fast, responsive, and easy to use. While YOLOv5 does not provide a new model topology to the YOLO family, it does add an additional PyTorch training and deployment framework that upgrades the advancements for object detectors. Nevertheless, YOLOv5 is extremely adaptive and it is usually "out of the box" ready to use on bespoke objects.
Basically we are using roboflow to crop the images into matrices and further into grids and then creating our own customised dataset using YOLO v5 for mobile detection and training it using the Yolov5 algorithm.This gives a very high accuracy for moble detection.
The YOLOv5 model is implemented in Pytorch, as compared to previous

improvements that used the DarkNet technology. This streamlines the model's interpretation, training, and deployment.
YOLO v5 offers a tremendous advantage of run speed. The smaller YOLO v5 model is 2.5 times better than the bigger YOLO v5 model, and it identifies tiny things better. Ultralytics has done a brilliant job with its open - sourced YOLO v5 model, which is easy to train and deploy for inference. Hence using our own customised dataset and YOLO v5 algorithm, we are able to detect mobiles with a very high accuracy.

12 References

1. Joseph Redmon, Santosh Divvala, Ross Girshick, "You Only Look Once: Unified, Real-Time Object Detection",The IEEE Conference on Computer Vision.

2. S. Ren, K. He, R. B. Girshick, and J. Sun, "Faster R-CNN: towards real-time object detection with region proposal networks," CoRR, vol. abs/1506.01497, 2015. [Online]. Available: http://arxiv.org/abs/1506.01497 2

3. J. Redmon and A. Farhadi, "Yolo9000: Better, faster, stronger," arXiv preprint, 2017. 3, 4