# FACE-GUARD:
*A Comprehensive Approach to Identity Authentication and Access Management using Face Recognition Technology*

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ABSTRACT

The Haar-Cascade Classifier is a popular technique for object detection that uses a machine-learning approach to identify objects in images and videos. In the context of face detection, the algorithm uses a series of classifiers that are trained on thousands of positive and negative images to identify regions of the image that may contain a face. The algorithm is a multi-stage process that involves collecting training data, extracting features, training the classifiers, building the cascade classifier, detecting faces in the test image, and post-processing the results to remove false positives and false negatives.It can be very useful in making a widely used attendance system for various Domains such as in colleges, schools, corporate etc.And To deal with the Problem of Proxy or Fake Attendance, YOLOv8 is there, YOLOv8 is a real-time object detection algorithm in the YOLO family(previous versions), known for quickly and accurately spotting objects in images or video. It's an improved version, offering better performance. YOLO algorithms split images into cells, predicting object bounding boxes and class probabilities efficiently in one pass. It's used in autonomous vehicles, surveillance, image analysis, and more due to its speed and accuracy.Be aware that as research continues, the details of YOLOv8 may change.

## Problem Statement:

- Project seeks to address the challenges of designing and implementing a robust face recognition-based Attendance system that effectively captures and verifies individuals' identities.
- Also Records the Time of their Detection in a CSV file and Compare the Captured image with a Live Video Captured by the Webcam to check Image Spoofing.

## Introduction

- In computer vision, face detection is related to the detection of human faces in images. OpenCV'sHaar cascades continue to serve a useful purpose as they are light and secondly they are Superfast and even runwith low-resource devices. The model size is limited to around 930 KB. Apart from this, Haar cascades have anumber of flaws, including the fact that they are more prone to false-positive detections and are less reliable than their HOG + Linear SVM, SSD, YOLO, and other equivalents for serving the purpose of anti spoofing feature encountering the problem of Proxy attendance In the Starting Phase of the Project I had Used K-Nearest Neighbour and Haar feature-based cascade classifier For Detecting the Face of a Person or the subject. Haar feature-based cascade classifiers are used for face detection by analyzing patterns of pixel intensity in an image. They involve a two-step process: first, they identify candidate regions, and then, they use a series of trained

classifiers to confirm if those regions(Co-ordinates of the Image Captured) contain a face, making them efficient for real-time face detection..

- These classifiers use a sequence of phases, each of which contains a strong classifier. The cascade structure efficiently filters out non-facial regions, concentrating computing effort on prospective face regions. As a result, it can recognise faces in photos and video streams in real time. **The final classifier is a weighted average of these poor classifiers. It is named weak because it cannot categorise a picture on its own, but when combined with others, it becomes a strong classifier.And for addressing the Problem of Anti-Spoofing i have used YOLOv8 algorithm as explained above YOLOv8, it can help address anti-spoofing by detecting fake objects like printed photos or masks, which are commonly used in spoofing attempts. It can be used in applications like face spoofing detection, access control, and document authentication to enhance security. However, anti-spoofing often requires specialized techniques beyond object detection for more robust protection.**

## 1 FACE DETECTION: FIRST LEVEL

In the Initial Stage while experimenting I have taken HAAR-Cascade Classifier Technique in account to Identify the Face of the Person,For the Dataset I have Created my own Custom Dataset The Dataset consists of 6-7 individuals with 100 images of each that have been taken for this project. In the context of face detection, the algorithm uses a series of classifiers that are trained on thousands of positive and negative images to identify regions of the image that may contain a face. The algorithm is a multistage process that involves collecting training data, extracting features, training the classifiers,building the cascade classifier, detecting faces in the test image.The Architecture of HAAR-CASCADE CLASSIFIER is explained through this image below along with Face Recognition library in python serves the purpose of initial stage of the Project of Detecting a Face, and collecting the attendance in a Excel sheet(Database).

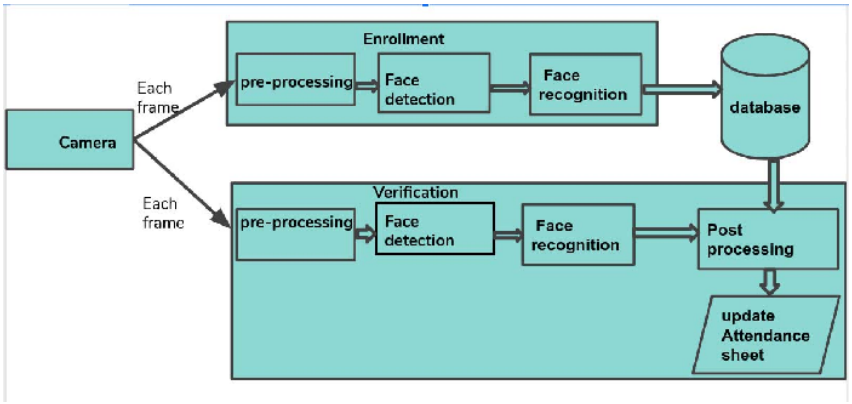



Figure 1: Architecture of HAAR-CASCADE Classifier

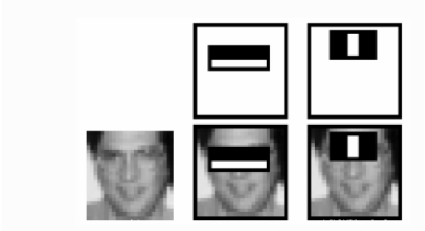


Figure 2: Relevant HAAR features

## 2 ANTI-SPOOFING: SECOND LEVEL

To Tackle the Problem of Proxy we must upgrade our first level system to second level so that we can get a Fully functional Attendance System For that I have used yolo v8 algorithm to the model as This Algorithm in the level 1 is not suitable for Serving the purpose of Anti-Spoofing which is a Crucial Factor in a Face Recognition Based Attendance System YOLO (You Only Look Once) is a real-time object detection algorithm that swiftly identifies and locates objects in images or video frames. It stands out for its speed, single-pass processing, and precise object localization. YOLO can detect multiple objects in various classes and is used in applications like autonomous vehicles and surveillance. It unifies object detection and classification, offering both efficient and accurate results. The implementation of YOLO and why is it Neccessary for this Problem statement is explained Below.

- **Single Forward Pass: YOLO provides object detection in a single forward pass through the neural network, making it more efficient than alternative methods that require many passes.**
- **Object Localization: In addition to detecting objects, YOLO offers precise bounding box coordinates (x, y, width, and height) for each identified object.**
- **Multi-Object Detection: YOLO is capable of detecting several items in a single image or frame, even if they are from different classes.**
- **CLass-Probability: YOLO assigns class probabilities to observed objects, indicating the amount of confidence in each categorization.**
- **Unified Framework: YOLO combines object detection and classification into a single neural network that is trained from start to finish.**

The YOLOv8 based Model that i have used is trained on a dataset that includes examples of both genuine and spoofed biometric data. This allows the model to learn the specific patterns and characteristics associated with spoofing attacks, improving its ability to detect such attempts the Proxy-Fake-attendance Class in the Dataset Contains 1584 spoofed images where as Real-Attendance Class 1833 Images in Total , I have Trained the YOLO Model on my Dataset instead of COCO Dataset which Comprises of 80 Classes and on the Other hand i have used ony Two Classes since for tarining the Model we need a Powerful GPU i have restricted the number of epochs to 10 which Subsequently gave Quite satisfying Result on the Dataset.

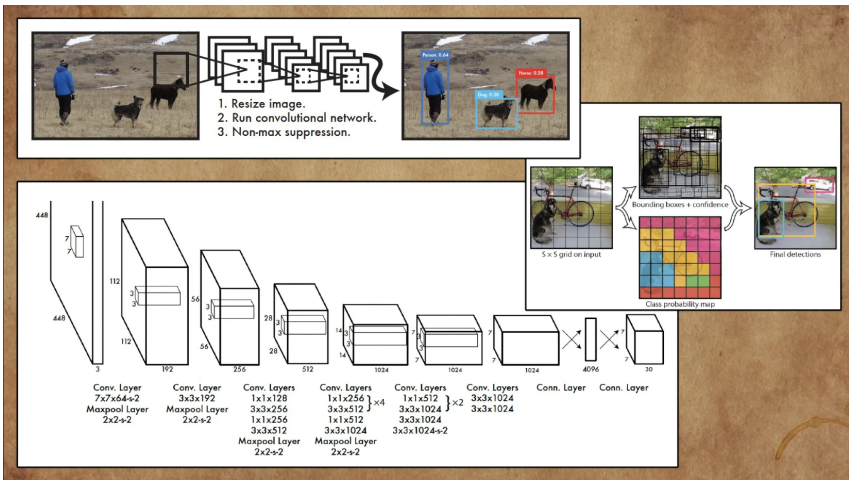



Figure 3: Architecture of YOLO

## 3 RESULTS AND CONCLUSIONS:

In the Model evaluation we can see that the cls-loss is decreased from 6.892 in the starting to 0.9442 in the end of 10 epochs this shows that the Proposed model is performing good on computing the

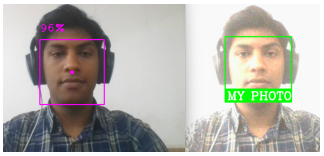
| Epoch | GPU_mem | box_loss | cls_loss | dfl_loss | Instances | Size |
|---|---|---|---|---|---|---|
| 1/10 | 13.8G | 2.771 | 6.892 | 3.668 | 12 | 736: |
| | Class | Images | Instances | Box(P | R | mAP50 |
| | all | 20 | 20 | 0.024 | 0.0556 | 0.028 |
| Epoch | GPU_mem | box_loss | cls_loss | dfl_loss | Instances | Size |
| 2/10 | 13.8G | 2.661 | 6.96 | 3.405 | 12 | 736: |
| | Class | Images | Instances | Box(P | R | mAP50 |
| | all | 20 | 20 | 0.987 | 0.5 | 0.5 |
| Epoch | GPU_mem | box_loss | cls_loss | dfl_loss | Instances | Size |
| 3/10 | 14.1G | 1.176 | 4.866 | 1.806 | 12 | 736: |
| | Class | Images | Instances | Box(P | R | mAP50 |
| | all | 20 | 20 | 0.53 | 0.722 | 0.632 |
| Epoch | GPU_mem | box_loss | cls_loss | dfl_loss | Instances | Size |
| 4/10 | 14.1G | 1.018 | 2.879 | 1.579 | 12 | 736: |
| | Class | Images | Instances | Box(P | R | mAP50 |

Figure 4: Model Evaluation and Training

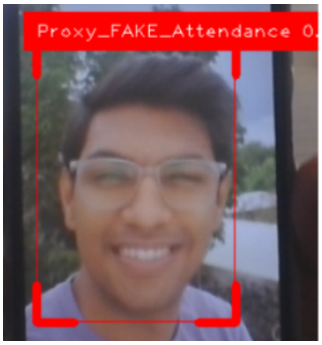
| Epoch | GPU_mem | box_loss | cls_loss | dfl_loss | Instances | Size |
|---|---|---|---|---|---|---|
| 9/10 | 14.1G | 0.6333 | 1.124 | 1.152 | 12 | 736: |
| | Class | Images | Instances | Box(P | R | mAP50 |
| | all | 20 | 20 | 0.5 | 1 | 0.516 |
| Epoch | GPU_mem | box_loss | cls_loss | dfl_loss | Instances | Size |
| 10/10 | 14.2G | 0.542 | 0.9442 | 1.114 | 12 | 736: |
| | Class | Images | Instances | Box(P | R | mAP50 |
| | all | 20 | 20 | 0.5 | 0.5 | 0.517 |

Figure 5: Model Evaluation and Training

Evaluation and In the end of the code we get a recorded attendance in our database with latest time at which it was reported in the database.And if we are proving the Proxy to the system it is not recording any attendance instead of that it is showing Proxy attendance on the system Screen.




(a) Detecting the image and comparing how much is it real




(b) Detecting the proxy image which i have provided via External Source

```
ANSHUMAN,00:03:49
SIDDHI_LIPARE,10:00:00
MY PHOTO,15:32:41
```

(c) Attendance Recorded in a CSV File

Figure 6: Outputs

## 4 DISCUSSION:

The Model has Certain Limitations Like environmental Variations can Cause model to deflect the Results such as excessive light, bluriness though i have introduced a blurthreshold in the model but excessive Blur input image can affect the output/Result Since the custom dataset that i have used comprises of few thousand images but for using this system on a vast scale can increase the time complexity and we have to consider that YOLOv8 is still an experimental version it is still under research so future changes upcoming in this model domain may affect the result a little bit though

this model performs well on a small dataset so for Considering a class strength of 20-30 students it can give satisfactory Results and if we increase number of students and classes results may change but further advancement in Computer vision Domain can rectify this issue in Future.....

## 5 REFERENCES

A hybrid tiny YOLO v4-SPP module based improved face mask detection vision system

The Detection of Face Recognition As Employee Attendance Presence Using The YOLO ALGORITHM.

Implementation of a Smart Checkout System Based on Face Recognition Using YOLO v3-tiny, IEEE