# Online Exam Proctoring System

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## Problem Statement

The objective of this project is to develop a simplified Online Exam Proctoring System focusing on head pose angles and eye gaze estimation using webcam video. The system aims to monitor and identify behaviors such as looking away from the screen, which may indicate potential cheating during online exams.

## Background or Theory behind the Problem Statement:

#### i. Webcam-based Monitoring:

The utilization of webcam-based monitoring has become imperative in the realm of online exams, providing real-time insights into students' behaviors and potential cheating activities.

#### ii. Data Collection and Consent:

A dataset was curated by instructing students to participate in a science, math, and general knowledge quiz while being recorded via webcam and an overhead camera. The overhead camera was utilized for labeling data after feature extraction. To ensure ethical considerations, students signed a [consent form](https://forms.gle/uNTNNeA6xLx56n7z8), permitting the use of both webcam and overhead camera videos.

#### iii. Importance of Head Pose and Eye Gaze:

Deviation in head pose angles and eye gaze estimation can serve as vital indicators of a student's engagement and potential cheating during an online exam. These features were chosen due to their significance in capturing behavioral nuances.

## Methodology Followed:

#### i. Video Preprocessing:

To isolate the relevant segments of the webcam video, it was trimmed to the duration when the participant was actively taking the test. Subsequently, the trimmed video was converted into frames using the ffmpeg tool. (Code: ‘Other/frame.sh’)

#### ii. Feature Extraction:

Head pose angles and eye gaze estimation were extracted from the recorded videos using separate models. GitHub repositories for the code sources related to head pose angles and eye gaze estimation are provided: [Head Pose GitHub Repository](https://github.com/PINTO0309/HeadPoseEstimation-WHENet-yolov4-onnx-openvino) and [Eye Gaze GitHub Repository](https://github.com/glefundes/mobile-face-gaze).

#### iii. Data Labeling and Preprocessing:

After data extraction, students' actions were labeled as cheating or not cheating based on an overhead camera's perspective. The data was then exported to an Excel file, and subsequently, to a CSV file for further processing.

#### iv. Data Augmentation:

To address the sequential nature of the data, each row was duplicated and features were pasted in parallel with the original row for 299 cells. A final "cheating" column was generated using the OR function across the 300 parallel cells’ individual cheating data. NaN cells were dropped, resulting in a refined dataset. (Code: ‘Other/CSVfiles.py’)

#### v. Dataset Compilation:

Ten CSV files, each containing data from a different person, were created, resulting in a total of more than 100,000 rows. These individual files were combined into one comprehensive CSV, which served as the input for training various machine learning models. (Code: ‘code.py’)

#### vi. Model Comparison:

The following machine learning models were employed for comparison:

* RandomForestClassifier (99.62)
* SVC (Support Vector Classifier) (96.73)
* LogisticRegression (90.44)
* MLPClassifier (Multi-layer Perceptron Classifier) (99.61)
* DecisionTreeClassifier (96.01)
* XGBClassifier (XGBoost Classifier) (99.78)
* GradientBoostingClassifier (99.07)

## Results and Analysis:

The system demonstrated robustness in monitoring head pose angles and eye gaze estimation during online exams. The refined dataset, obtained through meticulous video preprocessing, facilitated effective model training. A comprehensive evaluation of these models was conducted, and results pertaining to accuracy were analyzed.

#### Model Comparison:

The models were assessed based on both speed/time efficiency and accuracy. Among the models, the XGBClassifier emerged as the most efficient in terms of processing speed while maintaining a satisfactory level of accuracy for head pose angles and eye gaze estimation.

#### Feasibility Considerations:

While the models exhibited promising performance, it's crucial to acknowledge the practical constraints. The current GitHub repositories for obtaining head pose angles and eye gaze estimation have limitations in terms of data acquisition speed. These repositories can capture data at a maximum rate of 3 frames per second, significantly lower than the typical 30 frames per second of webcam video. Additionally, the pipeline involves data processing and machine learning model inference, contributing to further latency.

#### Active Cheating Detection:

Considering the constraints mentioned above, the system may not be suitable for real-time active cheating detection during online exams. The inherent lag in data acquisition and processing may lead to delays in identifying and responding to cheating behaviors promptly. Future improvements may involve optimizing the data acquisition process or exploring alternative models to enhance the system's real-time capabilities.

## Conclusion:

By integrating webcam-based monitoring with machine learning models for head pose angles and eye gaze estimation, the Online Exam Proctoring System showcased a comprehensive approach to maintaining exam integrity. The meticulous data collection, video preprocessing, labeling, preprocessing steps, and model comparisons ensured the system's effectiveness. The project's transparency, ethical considerations, and emphasis on essential features contribute to its potential as a valuable tool in preventing cheating during online exams.

However, it's important to note the feasibility challenges related to real-time active cheating detection. The limitations in data acquisition speed and processing capabilities, as observed in the current GitHub repositories, highlight the need for further optimization to meet the demands of online exam proctoring in a timely manner. The GitHub repositories offer transparency and reproducibility for future enhancements and evaluations.