19th sept,2024

PROJECT WRITEUP

(MACHINE LEARNING)

Submitted to: Dr. Anjula Mehto

Title: 'CHEATING DETECTION SYSTEM FOR ONLINE INTERVIEWS'

PROJECT OVERVIEW:

Online interviews have become increasingly popular due to their convenience in eliminating the need for physical interviews and allowing students to take interviews from remote locations. However, one of the drawbacks of online interviews is that they make cheating easier, and it can be difficult for online proctoring to detect subtle movements by the applicants. This could lead to doubts about applicant's interview results' value and overall credibility. To address this pressing issue, we present a cheating detection method using a CCTV camera to monitor applicants' faces, eyes, and devices to determine whether they cheat during interviews. If suspicious behavior indicative of cheating is detected, a warning is raised to alert the person. The proposed method offers a promising solution to the growing concern about cheating in online interviews. This approach can significantly enhance the integrity and reliability of online assessment processes, fostering trust among educational institutions and stakeholders.

PROBLEM STATEMENT:

With the rise of remote job interviews, the risk of candidates cheating by using external help, consulting unauthorized resources, or receiving prompts from others has increased. This compromises the fairness of the hiring process.

Traditional face-to-face interviews provide controlled environments where interviewers can directly observe the behavior of candidates and detect any unethical actions. In contrast, online interviews often lack such oversight, leaving room for candidates to exploit the format and cheat. So, we are trying to make a system that can help in solving this.

MOTIVATION:

The detection of cheating is vital for ensuring the integrity and fairness of the interview process, and to avoid hiring unqualified candidates based on deceptive practices. There is a critical need for a robust, automated system that can detect a wide variety of cheating behaviors in online interviews.

OBJECTIVE:

The objective of this project is to develop a machine learning system capable of detecting cheating behavior in real-time during online interviews, using data collected from video, audio, and user interactions. The system will collect data from various inputs to create a comprehensive view of candidate behavior during an interview. By leveraging computer vision models, the system should track the candidate's gaze in real-time to determine whether they are consistently engaging with the interview screen or looking elsewhere, potentially at external sources of information. Prolonged gaze shifts or frequent, brief distractions could indicate cheating.

1. Multimodal Data Collection for Cheating Detection
2. Detection of Gaze Aversion and External Device Usage
3. Voice Activity Detection for Real-Time Cheating Analysis
4. Behavioral and Interaction Anomalies
5. Real-Time Detection and Alerts
6. Automated Reporting and Evidence Collection
7. Scalability and Ease of Integration
8. Data Privacy and Security Compliance

The overarching goal of this cheating detection system is to combine machine learning, computer vision, and audio analysis to provide a comprehensive solution that can effectively detect various cheating behaviors during online interviews. The system will operate in real-time, offering actionable insights to interviewers while safeguarding the integrity of the remote interview process.

DATASET DESCRIPTION:

In this study, four scenarios have been identified as cheating behavior: ***holding a smartphone, head movement, eye movement, and blocking the eyes with the hand.***

Data collection continued until 50 videos were obtained, which were then used for training. Each video was named according to the following format: 's_numPerson_scenario.mp4'. For instance, the third scenario involving the second person would be denoted as 's_2_3.mp4'. In total, we collected a dataset comprising 200 samples.

PRE-PROCESSING:

1) Segmentation: This format provides essential details about the identified objects or regions of interest within each frame of the videos.
2) Data Augmentation: Training and validating deep neural networks typically require substantial data, ideally in the thousands. However, with only 30 data points per category, the available data is clearly insufficient for effective training. To address this challenge, the "Albumentations" library was employed as a solution. Albumentations offers a powerful and user-friendly interface for image augmentation in various computer vision applications, including deep learning studies, object classification, segmentation, and detection.

METHODOLOGY:

A web camera is utilized to monitor student behavior during an online exam. The system captures approximately 50 video frames at a time for subsequent analysis. The face, body gestures then process these frames and eye tracking model to determine the face and eyes' position and identify suspicious objects, such as a mobile phone.

Once the positions are detected, the results are forwarded to the cheating detection module. This module examines the student's movements to identify potential cheating behavior. If the system detects a student using a mobile phone to cheat or observing answers by turning their head, an alert message is promptly sent to the student. However, if no cheating is detected, the system continues to monitor the student's behavior until the conclusion of the exam.

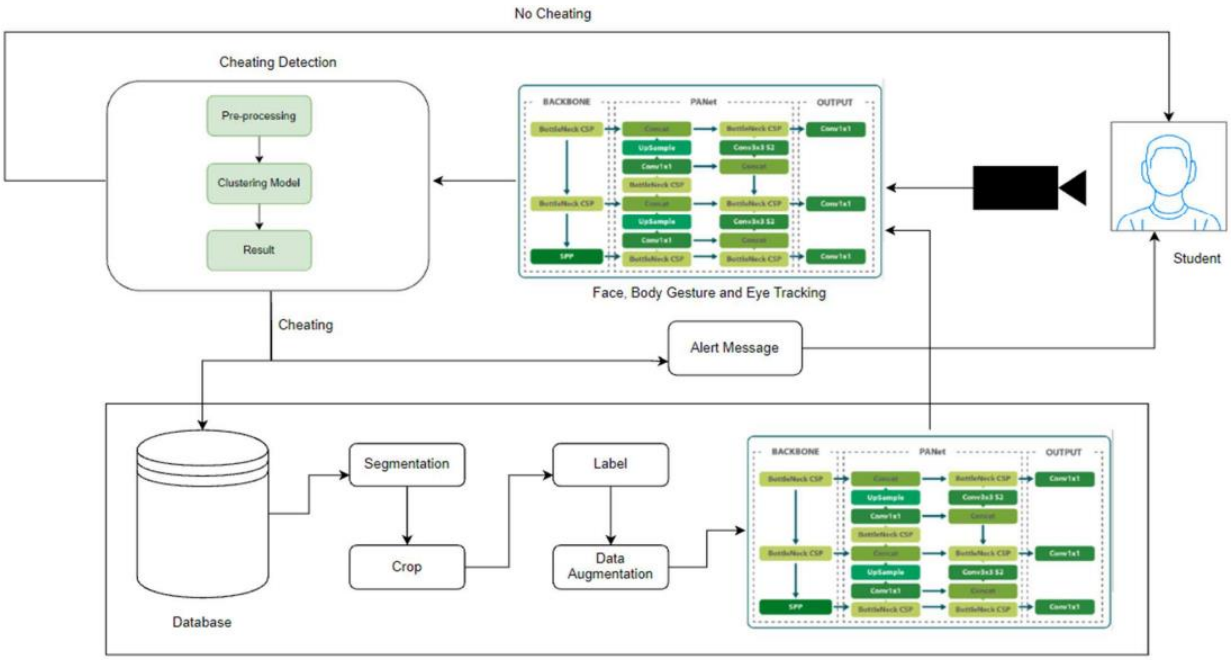


Fig. 1 Cluster Table of Time Series K-Means

MODEL DESIGN:

-YOLOv5, a well-known deep neural network, is utilized to locate landmark features. YOLOv5 belongs to the class of single-stage object detection models and offers several variants, including YOLOv5nm, YOLOv5s, YOLOv5m, YOLOv5l, and YOLOv5x. In this study, YOLOv5s is chosen due to its optimal balance between accuracy and speed.

- The system integrates multiple models: a Convolutional Neural Network (CNN) for face and gaze analysis, a Recurrent Neural Network (RNN) for detecting abnormal patterns in voice activity, and an anomaly detection algorithm for monitoring user interactions with their keyboard/mouse.

TRAINING PROCESS:

The classification of cheating behavior is performed through a clustering mechanism. Clustering is chosen as the classification algorithm because it does not require manually defining labels for each cheating behavior. Three popular time series clustering algorithms have been investigated: Self-Organizing Maps (SOM), Fuzzy C-Means, and Time Series K-Means.

- After creating the dataset, data clean-up is performed. During the data cleaning process, the system checks for noisy values in the '*block eyes', 'face down', 'face left', 'face right', 'face up', 'eyes down', 'eyes left', 'eyes right', 'eyes up', 'phone center', 'phone left', and 'phone right'*

columns. If any noisy values are found, they are replaced by the maximum values. Additionally, activities other than 'phone center', 'phone left', and 'phone right' are replaced with 0 for all other activities.

EVALUATION METRICS:

In this study, all the images are resized to 450 x 450 pixels. Two different batch sizes have been experimented with 16 and 32.

After analyzing the results, it was found that using 15 epochs provided the best performance.

Moreover, the difference in performance between the two batch sizes was negligible. Therefore, the smallest batch size, which is 16, is selected for the subsequent tests. Overall, the detection results showcased in these figures demonstrate the method's ability to identify various cheating behaviors reliably.

RESULTS:

This section evaluates the performance of the proposed cheating detection approach. To calculate the accuracy of each cluster, the maximum value within the cluster is considered for each cheating behavior, and this value is divided by the total number of occurrences of that cheating behavior. The cluster with the highest maximum value is chosen as the final cluster for that specific cheat. The mean function is also utilized to calculate the average accuracy across all clusters.

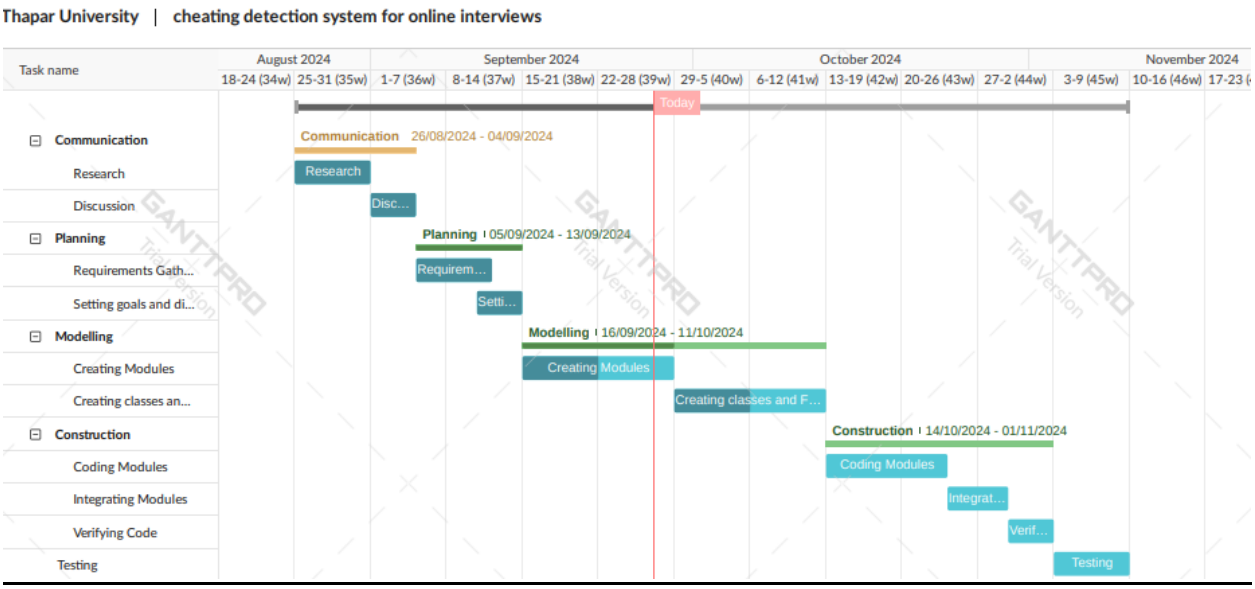
The accuracy of all clusters is above 50%, indicating that each cluster can predict the motion well. Overall, the average accuracy achieved by the clustering algorithm is ***83.60%.*** This indicates that all cheating behaviors have been correctly clustered, contributing to the effectiveness of the proposed approach in detecting and categorizing cheating instances.

CONCLUSIONS:

This study presents a robust cheating detection method for online examinations. The developed system effectively detects cheating behavior based on facial expressions, eye movements, and body posture with high accuracy. Additionally, the system saves a video recording of detected cheating behaviors in a designated folder.

However, certain limitations have been identified. The system requires the camera to be positioned in the center. If the camera is placed at a different angle, the system may misinterpret the student's gaze direction, even when they are looking directly ahead. Currently, the system classifies "eye left" and "eye peek left" into the same cluster, potentially leading to misinterpretation. To address these limitations, future improvements will be implemented. Additional data from various camera angles and scenarios involving multiple individuals will be collected. This expanded dataset will enable the system to learn and adapt to different camera placements and differentiate between multiple individuals' behaviors. Secondly, the preprocessing stage will be enhanced to improve the distinction between "eye left" and "eye peek left" behaviors. This could involve refining the clustering process and incorporating more clusters during training to achieve better separation.

GANTT CHART:



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