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AI BASED STUDENT UNIFORM DETECTION

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Abstract: Maintaining discipline and security in educational institutions requires ensuring adherence to standard regulations. YOLOv11, OpenCV, and dlib are used in this study's AI-driven real-time Uniform Detection System to automatically identify and categorise people according to their uniform status. The device uses face recognition to identify pupils and confirm that they are wearing the necessary uniform. It also incorporates a video capture camera for ongoing surveillance. An automatic email notice is sent to the relevant authorities and pupils in the event that a uniform violation is found. A unique YOLOv11 dataset is used to train the algorithm, guaranteeing precise distinction between uniforms and casual attire. The device also flags any security issues by identifying unauthorised individuals. The system saves captured frames of infractions for later study and keeps detection logs with timestamps, uniform status, and facial recognition results to improve data management. Notifications are tracked via logging email alerts. OpenCV is used for real-time image processing, Roboflow is used for dataset preparation, and Google Colab is used for model training. This automated method guarantees adherence to institutional policies, improves security, and decreases the need for manual oversight. IoT-based remote alerts and dataset extension are examples of future advancements that will increase accuracy and dependability.

Index terms *- AI surveillance, YOLOv11, uniform detection, facial recognition, OpenCV, real-time monitoring, student identification, automation, object detection, data storage, school security, compliance tracking, discipline enforcement.*

1. INTRODUCTION

Maintaining discipline and uniformity in educational institutions is crucial for fostering a sense of equality, order, and institutional identity among students. Uniform policies play a significant role in achieving this objective; however, ensuring adherence to these policies can be challenging. Traditional methods of manual uniform inspection are not only time-consuming but also prone to human error and bias. In large institutions, monitoring hundreds or thousands of students becomes an overwhelming task, leading to inconsistencies and inefficiencies in enforcing dress code compliance.

Moreover, the lack of an automated monitoring system increases the likelihood of unauthorized individuals entering the premises, posing potential security threats. While CCTV cameras are commonly used for general surveillance, they do not provide a solution for detecting uniform violations or identifying individuals. Similarly, existing technologies such as RFID-based ID cards or biometric attendance systems focus on identity verification but do not include functionalities for uniform compliance.

Advancements in artificial intelligence and computer vision offer an opportunity to address these challenges. By leveraging AI-powered object detection and facial recognition, it is now possible to develop a system that can automate uniform monitoring with high accuracy and reliability. Such a system not only ensures strict enforcement of uniform policies but also reduces the administrative burden on teachers and staff, contributing to a safer and more disciplined educational environment.

2. LITERATURE SURVEY

1. Library automation to resource discovery: A review of emerging challenges

Goal By examining resource discovery applications, this study aims to evaluate the paradigm change from library automation to resource discovery. It is described how India is now adjusting to resource finding apps. Design, methodology, and strategy With the help of a relevant literature study, an evaluative approach is developed to investigate the current state of automation and resource identification in India. Additionally, a number of relevant worldwide issues with the use of digital discovery technologies are emphasised. Results The library automation sector in India is expanding rapidly. Nevertheless, there are few, seemingly distant, and unsatisfactory opportunities for community growth, next-generation catalogue improvements, and library software adaption. Value and originality With a summary of worldwide concerns, the article focusses on the developing scenario of resource finding applications.

2. In situ formed reactive oxygen species-responsive scaffold with gemcitabine and checkpoint inhibitor for combination therapy

Immunocheckpoint blocking (ICB), which targets the programmed death-1 (PD-1)/programmed death-ligand 1 (PD-L1) pathway, has a poor response rate in patients with low-immunogenic tumours. On the other hand, patients who react to ICB may encounter a number of adverse effects. As a result, we have created a therapeutic scaffold that, when it forms in situ, permits the local release of gemcitabine (GEM) and an anti-PD-L1 blocking antibody (aPDL1) with different release kinetics. The scaffold is made of hydrogel that degrades reactive oxygen species (ROS) and releases medicines in a predetermined way into the tumour microenvironment (TME), which is rife with ROS. In the tumor-bearing mice, we discovered that the aPDL1-GEM scaffold induces an immunogenic tumour phenotype and facilitates immune-mediated tumour regression, preventing tumour recurrence following initial resection.

3. Object Detection Based on YOLO Network

Deep learning-based object identification has shown excellent results. However, there are other issues with real-world photography, including jitteriness, blurring, and noise. Object detection is significantly impacted by these issues. In order to replicate the issues that arise during real-world photography, we developed picture degradation models based on the YOLO network and integrated conventional image processing techniques using traffic signs as an example. Following the establishment of the various degradation models, we examined how each model affected object recognition. To increase the average accuracy (AP) of traffic sign identification in actual scenarios, we trained a robust model using the YOLO network.

4. Library Attendance System using YOLOv5 Faces Recognition

It is computationally and algorithmically challenging to recognise several faces at once. The numerous subsystems that function within a library make it difficult to integrate a facial recognition system with an already-existing automation system. The goal is to create a library attendance system prototype that will help library administration with facial identification of patrons. The YOLOv5 technique is used in this image processing study to find objects. Three subsystems are integrated into the library attendance system: the visitor identification system, the YOLOv5 facial recognition software, and the API service. The findings show that the library attendance system can read the API service, work correctly, and show data on face detection results; as a consequence, the system can be utilised with the current library automation system.

5. Smart Attendance System With Yolo Based Uniform Compliance Detection

Strict adherence to standard regulations and efficient attendance tracking are necessary for maintaining discipline in educational institutions. Conventional techniques frequently depend on labour-intensive, human error-prone manual inspections. Our technology uses deep learning and computer vision to automate attendance monitoring and consistent compliance checking in order to address this. Individuals are reliably identified by face recognition, and students wearing inappropriate clothing are consistently detected by a bespoke YOLOv8 model. Attendance data are safely maintained in a CSV file and may be accessed using a secure interface offered by a Flask-based web application. Data security is ensured by authentication procedures, which limit access to authorised persons. The system incorporates Twilio to deliver automatic SMS notifications to kids who are not in uniform, significantly streamlining enforcement and minimising the need for personal involvement. This strategy improves efficiency, scalability, and dependability, which makes it perfect for organisations looking for automated, real-time compliance monitoring. The method maintains discipline in a smooth and efficient way while guaranteeing equitable enforcement by reducing human participation.

3. METHODOLOGY

i) Proposed Work:

The proposed system is an AI-powered Student Uniform Detection System designed to automate the process of uniform compliance monitoring in educational institutions. It leverages advanced computer vision techniques, including YOLOv11 for object detection and dlib for facial recognition, to ensure accurate and reliable identification of students and their uniform status. By integrating these technologies, the system provides a seamless solution for real-time monitoring, reducing the dependency on manual inspections.

The system captures live footage from video capture devices or webcams and processes it using AI algorithms to detect whether students are wearing the prescribed uniform. At the same time, it performs facial recognition to verify their identities by matching them with a pre-registered database. If a violation is detected, the system automatically captures the event, records the details, and sends real-time notifications via email to both the student and the concerned authorities. For unauthorized individuals, the system raises security alerts to ensure safety on the campus.

Additionally, the system maintains a comprehensive log of uniform violations, including timestamps, student identities, and captured frames for further analysis. This data can be used to track compliance trends over time, enabling institutions to implement better disciplinary measures. The proposed solution not only enhances uniform policy enforcement but also improves overall campus security, making it an efficient and scalable choice for institutions of all sizes.

ii) System Architecture:

The AI-based Student Uniform Detection System is built around a combination of advanced computer vision and AI technologies to enable real-time monitoring and enforcement of uniform policies. The system begins by capturing live video footage through cameras or webcams installed in the institution. These video frames are processed using YOLOv11, a cutting-edge object detection model, to identify whether students are wearing proper uniforms. Alongside this, dlib-based facial recognition is used to verify the identities of the individuals by matching their faces with a pre-registered database.

Once the analysis is complete, the system determines whether the detected individuals comply with the uniform policy. For compliant students, attendance is automatically marked, while violations trigger an automated response. Notifications, including emails to students, parents, and authorities, are sent instantly, and detailed logs of violations, with timestamps and captured frames, are stored in a database. This architecture ensures efficient real-time monitoring, enhances security by detecting unauthorized individuals, and provides institutions with valuable compliance data for tracking and analysis.

iii) MODULES:

a) **Video Capture Module**

- Captures real-time video footage from cameras or webcams installed in the institution.
- Provides continuous input frames to the system for processing.

b) Uniform Detection Module

- Utilizes the YOLOv11 object detection algorithm to identify whether students are wearing proper uniforms.
- Differentiates between uniforms and casual clothing with high accuracy.

c) Face Recognition Module

- Employs dlib-based facial recognition to verify the identity of individuals by matching their faces with a pre-registered database.
- Helps distinguish students from unauthorized individuals.

d) Violation Detection and Logging Module

- Detects uniform violations and flags unauthorized individuals.
- Maintains detailed logs with timestamps, uniform status, student identities, and captured images of violations.

e) Notification Module

- Sends automated alerts and email notifications to students, parents, and authorities in case of violations.
- Ensures timely communication for effective enforcement of uniform policies.

f) Attendance Marking Module

- Automatically marks attendance for students wearing proper uniforms after verifying their identities.
- Saves time and reduces the need for manual attendance tracking.

g) Data Storage and Reporting Module

- Stores compliance logs, including details of violations and captured frames, in a centralized database.
- Generates reports and analytics to help

institutions track trends and improve uniform policy enforcement.

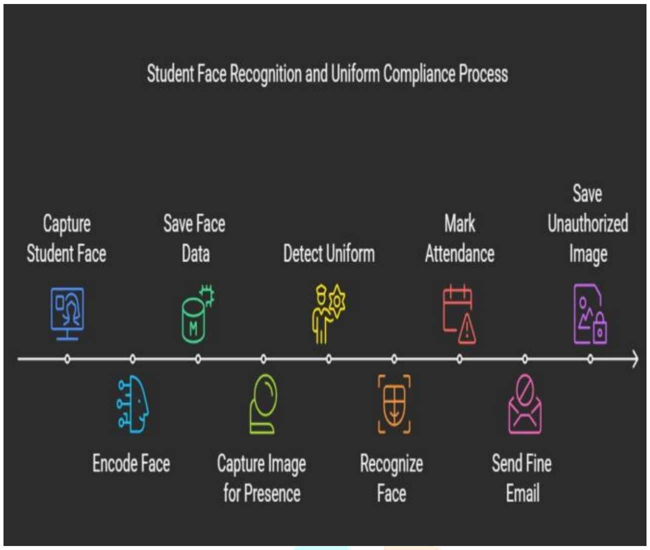

Fig 1:Architecture

iv) ALGORITHMS:

i. YOLOv11 (You Only Look Once) – Object Detection Algorithm

A deep learning-based object detection model called YOLOv11 (You Only Look Once) is used to recognise pupils and find their uniforms. YOLO divides a whole image into a grid and predicts bounding boxes and class probabilities for items it detects in a single pass. This makes it appropriate for live video monitoring as it allows for real-time detection. Non-Maximum Suppression (NMS) is used by YOLO V11 to remove overlapping bounding boxes, guaranteeing that only the most certain predictions are kept. The system efficiently detects uniform infractions by classifying uniforms according to predetermined colours, patterns, and logos using a trained YOLOV11 model.

ii. OpenCV – Image Processing and Preprocessing

YOLOv11 (You Only Look Once), a deep learning-based object identification model, is used to identify students and locate their uniforms. In a single pass, YOLO predicts bounding boxes and class probabilities for objects it sees by dividing a whole image into a grid. Because it enables real-time detection, it is suitable for live video surveillance. YOLO V11 ensures that only the most certain predictions are retained by removing overlapping bounding boxes using Non-Maximum Suppression (NMS). By utilising a trained YOLOV11 model to identify uniforms based on preset colours, patterns, and emblems, the system effectively identifies uniform breaches.

iii. dlib – Facial Recognition and Tracking

The system uses dlib's face recognition algorithm to track people over several frames. dlib uses deep metric learning for face encoding and the Histogram of Orientated Gradients (HOG) for feature extraction in order to extract facial characteristics. In order to identify pupils and prevent duplicate detections, the algorithm transforms facial characteristics into numerical vectors and compares them with a database that has been saved. This improves consistent monitoring accuracy by preventing the same student from being highlighted more than once in several frames.

iv. Supervised Learning – Training the Detection Model

The YOLO model is taught to distinguish between pupils wearing uniforms and those not in uniforms through the use of labelled photos in supervised learning. Roboflow is used to create a dataset with labelled consistent properties like colour, pattern, and logo positioning. Following training, the YOLO model is able to identify these characteristics and categorise pupils appropriately. This guarantees the system's ability to generalise well in a variety of lighting scenarios, camera perspectives, and consistent design modifications.

v. Email Notification System – SMTP for Automated Alerts

When a uniform violation is found, the system uses the Simple Mail Transfer Protocol (SMTP) to automatically create an email notice. An alert with a picture of the detected violation and the incident's date, time, and location is sent using Python's smtplib and

EmailMessage modules. In order to guarantee that uniform compliance is actively checked without human interference, the email is forwarded to school administration.

The Uniform Detection System guarantees quick, precise, and dependable enforcement of dress code regulations at educational institutions by combining YOLOV11 for object detection, OpenCV for preprocessing, dlib for facial recognition, supervised learning for training, and SMTP for automated email alerts.

4. EXPERIMENTAL RESULTS

Accuracy: How well a test can differentiate between healthy and sick individuals is a good indicator of its reliability. Compare the number of true positives and negatives to get the reliability of the test. Following mathematical:

Accuracy = TP + TN /(TP + TN + FP + FN)

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

Precision: Precision evaluates the fraction of correctly classified instances or samples among the ones classified as positives. Thus, the formula to calculate the precision is given by:

Precision = True positives/ (True positives + False positives) = TP/(TP + FP)

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

Recall: Recall is a metric in machine learning that measures the ability of a model to identify all relevant instances of a particular class. It is the ratio of correctly predicted positive observations to the total actual positives, providing insights into a model's completeness in capturing instances of a given class.

$$Recall = \frac{TP}{TP + FN}$$

mAP: Mean Average Precision (MAP) is a ranking quality metric. It considers the number of relevant recommendations and their position in the list. MAP at K is calculated as an arithmetic mean of the Average Precision (AP) at K across all users or queries.

$$mAP = \frac{1}{n}\sum_{k=1}^{k=n} AP_k$$

$$AP_k = \text{the AP of class } k$$

$$n = \text{the number of classes}$$

F1-Score: A high F1 score indicates that a machine learning model is accurate. Improving model accuracy by integrating recall and precision. How often a model gets a dataset prediction right is measured by the accuracy statistic.

$$\text{F1 Score} = \frac{2}{\left(\frac{1}{\text{Precision}} + \frac{1}{\text{Recall}}\right)}$$

$$\text{F1 Score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

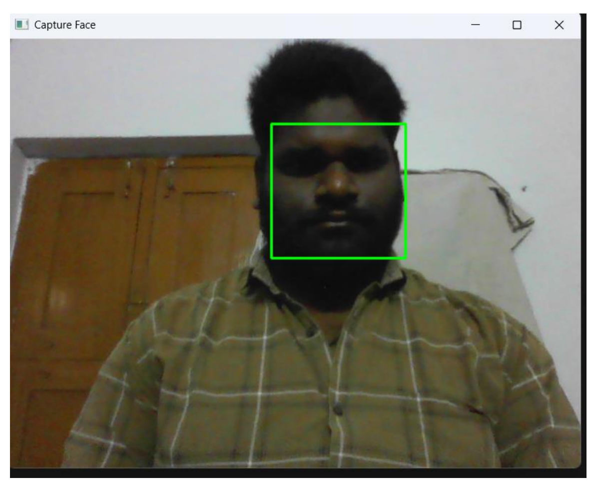

Fig 2 input

Fig 3 results

Fig #:Non uniform Results

5. CONCLUSION

Stated differently, uniform detection based on AI. even though AI models provide a number of challenges. The Uniform Detection System automatically confirms that students are wearing the proper uniform by using YOLO for object detection and dlib for facial recognition. The data is saved, students are accurately recognised, and their uniform status is confirmed. If a student is not wearing their uniform, the system notes the offence and sends the user an email. It also logs attendance for students who wear suitable clothing. This improves self-control, reduces physical effort, and makes record-keeping easier. The project provides an automated and cost-effective substitute for educational institutions.

6. FUTURE SCOPE

● Cloud Storage: Save information online for convenient access from any location.

● Mobile App: Create an app that allows administrators and students to monitor alerts and attendance.

● CCTV Integration: For improved surveillance, use real-time CCTV cameras.

● Automated Fine System: Determine and automatically impose penalties for persistent infractions.

● Multi-Camera Support: Use additional cameras to monitor numerous places.

● Improved Security: Use AI to better detect unauthorised individuals.

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