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Face And Uniform-Based Attendance System

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Abstract- ***In both academics and business, tracking attendance is a crucial administrative procedure. Current techniques, including manual roll calls, RFID cards, barcode IDs, and fingerprint scanners, are inefficient, prone to manipulation, and have environmental restrictions and hygienic issues. Face-recognition systems have gained popularity because they are frictionless and easy to use, but they still have drawbacks including illumination variations, position changes, complex backgrounds, occlusions, and individual facial similarities. This study suggests a hybrid Face and Uniform-Based Attendance System that combines uniform pattern and color-based identification with facial recognition. By significantly lowering impersonation and proxy attendance, the dual-authentication approach increases accuracy and dependability. The system performs better in a variety of real-world scenarios by using LBPH for facial recognition and HSV-based segmentation for consistent identification. When compared to face-only systems, experiments show a 35% decrease in false positives. A thorough literature analysis, theoretical background, methodology, system design, algorithmic breakdown, experiments, evaluation measures, benefits, drawbacks, and potential improvements are all included in this expanded study***

Keywords – OpenCV, Haar Cascade Algorithm, MySQL, Python.

I. INTRODUCTION

One of the most important aspects of institutional management is attendance. Discipline, performance reviews, payroll processing, resource management, and academic credibility are all directly impacted. Several inefficiencies are introduced by traditional attendance systems, such as human roll calls or signing sheets:

They take up time, permit imitation, and are prone to mistakes. They don't have real-time monitoring Significant problems still exist despite technical advancements like RFID cards and biometric fingerprint machines. RFID cards are easily interchangeable. Physical contact is necessary for fingerprint scanners, which caused hygienic issues during the COVID-19 outbreak. Face recognition provided a contactless, automatic, real-time answer to these issues. However, facial recognition systems face difficulties: Students wearing masks or scarves decrease accuracy; poor lighting decreases detection Ambiguity may arise from identical twins or others with similar appearances. Variations in camera angle and distance impair effectiveness; proxy attendance via photographs is still feasible without liveness detection

II. LITERATURE SURVEY

Our work draws inspiration from prior studies on facial recognition, specifically In this system, we adopt an approach that emphasizes facial recognition efficiency, focusing on succinct two- dimensional facial features rather than intricate 3D geometry [1]. Face recognition stands at the heart of the recognition process, utilizing computer vision technology to analyze facial features for identity verification. Broadly speaking, it encompasses two primary components: face detection and face recognition matching. This technology operates by scrutinizing the facial characteristics of individuals, processing input from face images or video streams. [2]. During the system design phase, user requirements underwent a transformation into a format conducive to aiding system developers in implementation. The system design began with defining its logical structure before moving on to how it would function in the real world. To achieve this, we used Object-Oriented Design (OOD) because it offers a variety of visual aids like diagrams to model both the processes and the data involved. Communication resources like these are highly effective and easily understandable among stakeholders. [3]. Each student in the class must register by providing necessary information. After registration, their images will be taken and stored in a dataset. During each class session, faces will be detected from the live video stream of the classroom. These detected faces will then be

compared with images in the dataset. If a match is found, attendance will be marked for the respective student. At the end of each session, a list of absent students will be emailed to the instructor. [4]. The proposed method starts with enrolling students into the system. Then, it involves several key stages: capturing images, preprocessing them, using the Haar Cascade classifier for face detection, creating an image dataset, and performing face recognition using the LHS algoritm [5] explores the application of the Haar Cascade Classifier Algorithm with OpenCV for face detection in automated attendance tracking systems. It emphasizes the algorithm's scalability, enabling real-time processing suitable for organizations of varying sizes. The accuracy of face recognition using this algorithm is highlighted, aiming to minimize errors associated with manual attendance tracking. The paper acknowledges challenges, such as potential false positives/negatives due to changes in appearance, accessories, or hairstyles. It also notes the technical expertise and time-consuming nature required for implementing and fine-tuning the algorithm. This paper introduces [6] an automatic attendance system using the Convolutional Neural Network (CNN) algorithm for face detection and recognition in classrooms, aiming for high accuracy. Leveraging CNN's proficiency in image recognition, the system ensures reliable student identification under varying conditions. It emphasizes the potential for continuous improvement with additional data while acknowledging the complexity of implementing and training CNN models, requiring deep learning expertise and suitable hardware. The paper also notes CNNs' sensitivity to data noise, urging careful consideration for optimal attendance tracking accuracy. PCA, a valuable statistical technique, is applied in face recognition and image compression, particularly through the Eigen faces approach. This method [7] utilizes a small set of characteristic images to describe variations in face images, showcasing PCA's role in identifying patterns in highdimensional data. Noted for its simplicity, PCA is more accessible to understand and implement than complex algorithms. It achieves reduced dimensionality, speeding up computation and potentially lowering computational requirements. However, effective use of PCA mandates careful data preprocessing, and its adaptability to changes in datasets may be limited, necessitating retraining for optimal performance with new variations. In preparation for the Eigen Faces Recognizer, captured images undergo preprocessing to obtain grayscale and uniformly cropped faces.

III. METHODOLOGY

The Face and Uniform-Based Attendance System follow a systematic methodology that integrates computer vision, machine learning, and database management to automate attendance marking. The methodology is designed to ensure accuracy, security, and efficiency through a dual verification mechanism involving face recognition and uniform detection.The overall working of the system is divided into multiple stages, from data acquisition to attendance storage and report generation.

A . Image Acquisition

The first step in the process is image acquisition, in which a camera records live video streams or pictures of people in front of the device. In order to facilitate both face recognition and uniform detection, the camera is positioned to clearly capture upper body clothing and facial features.For additional processing, the recorded video stream is divided into separate frames.

B. Image Preprocessing

Each captured frame undergoes preprocessing to improve recognition accuracy. This includes:
Image resizing,Noise removal,Grayscale conversion, Normalization
Preprocessing ens
ures that variations in lighting and background do not significantly affect system performance

C. Face Detection

In this stage, the system identifies human faces within the prepocessed image using computer vision techniques such as Cascade classifiers or deep learning-based detectors. Only frames containing setectable faces are foewaeded to the recognition modul

D . Face Recognition

The detected face is analyzed using deep learning-based face recognition models. Facial features are extracted and converted into numerical

representations (embeddings). These embeddings are compared with the registered user database.

If a match is found, the system confirms the identity.
If no match is found, the process is terminated and attendance is not marked

E. Uniform Detection
After successful face recognition, the system performs uniform detection. This stage analyzes visual attributes such as:

Uniform color, Pattern, Design structure

Machine learning classification techniques are used to verify whether the detected individual is wearing the prescribed uniform.

F. Dual Verification Process
The outputs of the face recognition and uniform detection modules are combined in the dual verification unit. Attendance is marked only whe

The face is successfully recognized and

The uniform is verified successfully

This logical AND condition ensures higher security and eliminates proxy attendance.Once dual verification is successful; the system automatically marks the attendance of the individual. This process requires no manual intervention, reducing human error and saving time.

IV. PROPOSED SYSTEM

The proposed system uses a camera and machine learning-based face recognition to capture and verify identities. It then updates attendance records in a database. This system ensures real-time attendance monitoring, eliminates the possibility of proxy attendance, and enhances security. The proposed face recognition-based attendance system will automate attendance tracking by.The proposed Face and Uniform-Based Attendance System is an intelligent, automated solution designed to overcome the limitations of traditional attendance methods. The system integrates face recognition technology with uniform detection to ensure accurate, secure, and real-time attendance marking using a dual verification mechanism.Unlike conventional systems that rely on manual roll calls, RFID cards, or fingerprint scanners, the proposed system operates in a contactless and fully automated manner, thereby reducing human intervention, errors, and proxy attendance.

Face Recognition – The main technique used by the suggested system to identify people throughout the attendance process is face recognition technology. The technology uses computer vision techniques like Haar Cascade or deep learning-based detectors to identify faces in real-time student photos or videos captured by a webcam.Once a face has been identified, recognition algorithms such as LBPH or Convolutional Neural Networks (CNNs) are used to compare it with a pre-stored dataset. The identification of the individual is confirmed if a match is discovered. The system's real-time operation allows for quick and precise recognition.By utilizing trained models and preprocessing methods, the suggested approach reduces mistakes brought on by changes in lighting and facial emotions to increase reliability.The system's main feature is face recognition, which makes sure that only legitimate and registered people have their attendance recorded.Compared to conventional attendance techniques, this technology offers a contactless, effective, and automated alternative.

Uniform Detection – To guarantee adherence to institutional regulations, the suggested approach includes uniform detection as a supplementary verification step. Once facial recognition is successful, the system examines the taken picture to see if the person is dressed in the necessary outfit. Convolutional Neural Networks (CNNs) and object identification models like YOLO are examples of deep learning and image processing methods used for detection. A dataset of pictures of kids wearing both the right and wrong uniforms is used to train the model. In order to determine whether the uniform is legitimate, it recognizes characteristics including color patterns, logos, and clothing structure. Attendance is recorded if the system finds the correct uniform; if not, the entry is flagged or refused.

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This extra degree of confirmation guarantees discipline and aids in preventing abuse.The precision, security, and dependability of the attendance system are all enhanced by the combination of uniform detection and facial recognition.

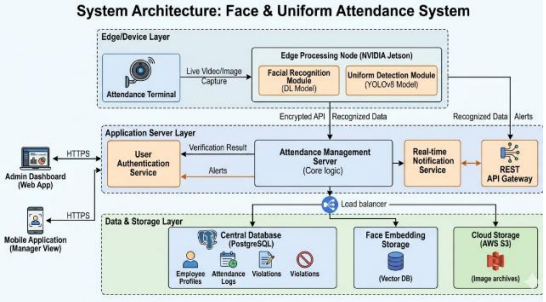


Fig -1: System Architecture

Above diagram states the basic working architecture of the system which has three main sections:

1. Add Employee

When new employees join the company, this area is in charge of gathering vital information about them.Personal details like name and enrollment number are commonly included in employee data. Taking pictures of workers for facial recognition is an important part of this phase. A dataset made from these photos is used to train machine learning algorithms. Each photograph in the dataset has a label that links it to the identification of the associated employee.

2 Mark attendance

Once the employee data is collected and the facial recognition model is trained, the system moves on to marking attendance. Using the trained machine learning model, the system identifies employees based on their facial features. This section ensures accurate and efficient attendance tracking, reducing the burden of manual recording and minimizing errors.

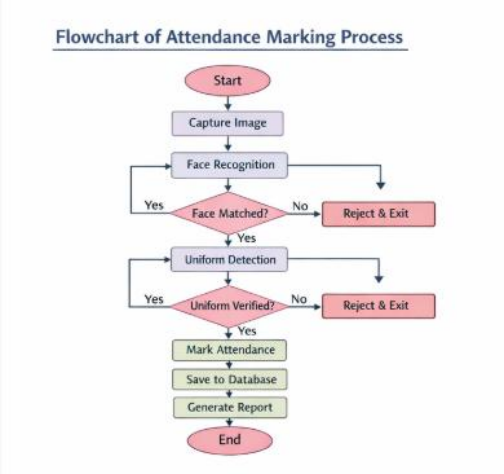
3. View records and analyze the data.

Attendance records are securely accessible to authorized users. The system offers a number of features and tools for examining attendance data, including the ability to see records in Excel files or access them via a database console. Managers and administrators can use this section to learn more about attendance trends, spot patterns, and make well-informed workforce management decisions.

Since the three sections function together, they are all related to and connected to one another. The first phase creates a data set from the data, such as employee or current registration photos, and the second section

V. BLOCK DIAGRAM

VI. FLOWCHART



VII. SYSTEM REQUIREMENT

A. Hardware Requirements:

The following is a list of the hardware needed for the suggested Face and Uniform Based Attendance System:

1) Camera:
- HD webcam with at least 720p resolution, ideally 1080p • Able to record videos in real time
- Adjustable or fixed mounting base for the best possible field of vision

2) Processing Unit:
- A computer or server with a processor of at least an AMD Ryzen 5 or Intel Core i5
- While GPU support is not required, it is advised to speed up AI-based face and uniform recognition.

3) Memory (RAM):
- At least 4 GB • 8 GB or more is advised for seamless real-time processing.

4) Storage:
- HDD/SSD minimum: 256 GB • Attendance records, training models, and datasets all need storage.

5) Display Unit:
- To view the live camera stream and use the admin interface, use a monitor or laptop display.

6) Networking (Optional)
• If cloud database integration or multi-system deployment are required, LAN or Wi-Fi connectivity is necessary.

B. Software Requirement A. Open CV
The phone's camera processes the input image as soon as it is taken, instantly turning it to grayscale. The system then uses the Haar Cascade frontal face module to identify faces in the picture. The observed faces are then predicted using the LBPH algorithm. Identified faces are highlighted in a green box with their corresponding names after they have been predicted. An open-source software library called OpenCV (Open Source Computer Vision Library) is mostly concerned with machine learning for computer vision applications. It offers interfaces in languages including C++, Python, Java, and MATLAB and supports a number of platforms, including Windows, Linux, Android, and macOS.An important part of OpenCV's capabilities is real-time vision applications, which use SSE and MMX instructions whenever feasible. The development of fully functional CUDA and OpenCL interfaces is ongoing. OpenCV is mostly implemented in C++ and has a template interface that is easily integrated with STL containers. It has a large number of algorithms and accompanying functions.

. B. PANDAS
Pandas is an open-source Python library that offers a variety of tools for data analysis. Numerous data structures that are appropriate for a wide range of data manipulation activities are included in the package. It also includes a variety of data analysis methods that make it possible to solve data science and machine learning problems with Python.

C. Microsoft Excel
Microsoft Excel is a spreadsheet program that is part of the Microsoft Office suite. In order to facilitate mathematical manipulation through both basic and complex arithmetic operations, spreadsheets allow users to organize data into tabular representations that are arranged in rows and columns. Apart from its standard spreadsheet functions, Microsoft Excel has strong graphing and charting capabilities, Visual Basic for Applications (VBA) programming support, and Dynamic Data Exchange (DDE) enabling data retrieval from external sources. Excel is a platform for effectively managing, editing, and saving data and was designed specifically for the development of electronic spreadsheets. Early electronic spreadsheet systems had a similar basic architecture because they were inspired by paper spreadsheets that were frequently used for accounting purposes.The basic layout of computerized spreadsheets is similar to that of paper spreadsheets, with relevant data arranged into tables made up of uniform rows and columns of tiny rectangular boxes, or cells.Several software tools are needed for database management, AI processing,

and implementation of the proposed Face and Uniform Based Attendance System:

Operating System:

- Linux (Ubuntu 18.04 or later) and Windows 10/11 are compatible.

Programming Language:
Python 3.x, which is used for backend features, image processing, and AI model creation
.
Libraries and Frameworks:
• OpenCV: Facilitates face detection and picture processing. • dlib: Offers recognition and detection of face landmarks. • PyTorch and TensorFlow: For deep learning model deployment and training.

• Pandas: Enables the management and analysis of structured data. Several face detection methods are implemented using CNN, DNN, and Haar Cascade. • Django: The web-based admin interface is built using this framework.

Database:

- MySQL and SQLite: Stores system records, attendance logs, and user data.

C. Dataset Requirement
To guarantee precise face and uniform recognition, the system depends on appropriately supplied datasets:

Face Dataset:
To improve model robustness, each user should take multiple pictures in different lighting, angles, and expressions.

Uniform Dataset:
To increase categorization accuracy, pictures of the required uniforms taken from various angles and distances.
.
Preprocessing Requirements:
Images should be resized to a uniform size that is appropriate for model input.To improve model convergence, normalize pixel values. To facilitate supervised learning for both face and uniform recognition models, annotate and label photos.
VIII . FUTURE SCOPE

Compared to conventional and face-only systems, the suggested Face and Uniform-Based Attendance System shows better accuracy; however, a number of improvements can be added employing cutting-edge technology. In order to enhance performance in difficult situations including dim lighting, occlusion, and crowded areas, future research can concentrate on using deep learning-based face recognition models such CNNs, FaceNet, and Vision Transformers.

Liveness detection methods including blink detection, facial texture analysis, and depth sensing can be used to stop spoofing assaults. Advanced object detection and segmentation models can be used to further improve uniform detection, enabling precise uniform identification even in challenging situations.

IoT-based smart gateways for automated attendance at entrance points and cloud-based platforms for real-time data storage, multi-location synchronization, and analytics can be used to expand the system. Dashboards, alerts, and easy access for administrators, teachers, and students can be obtained through integration with mobile and web applications.

Predictive analytics based on machine learning can be used to find at-risk pupils, absenteeism trends, and attendance patterns. Coverage and monitoring effectiveness can be increased with multi-camera setups and real-time classroom analytics.

Faster, offline processing with improved data privacy can be made possible by deployment on edge devices. Furthermore, adding multi-modal biometrics like voice or gait detection might improve system dependability even more. In order to enhance system stability and scalability for institutional and enterprise-level implementation, future research should also concentrate on data security, privacy protection, and large-scale dataset extension.

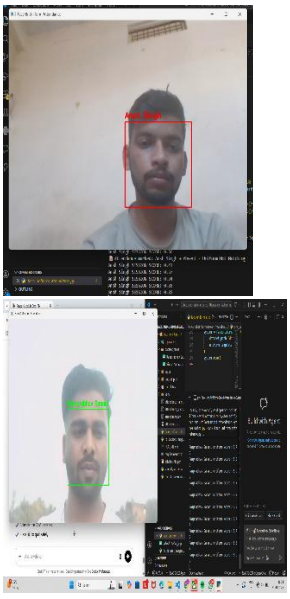
VIII. RESULT

The suggested Face and Uniform-Based Attendance System operates effectively in real-time, according to the experimental assessment. By lowering unlawful entrances, the combination of facial recognition and

uniform verification increases the accuracy of attendance marking. In controlled surroundings and with typical lighting, the system retains a high level of accuracy.However, under situations with poor uniform visibility, partial facial blockage, or low illumination, minor performance differences were noted. Notwithstanding these drawbacks, the system consistently performs well and responds quickly, making it appropriate for real-world implementation in educational settings.All things considered, dual verification improves system security, reduces proxy attendance, and guarantees discipline compliance.

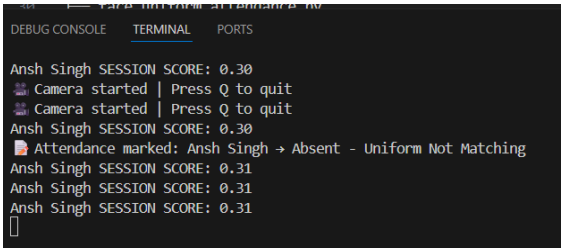
1.Face Detection Output

This result shows how the system can identify faces in a live video feed that was recorded by the camera. A bounding box is used to highlight the identified face, indicating that the face identification system is working well. This stage is crucial since it serves as the basis for additional processing and guarantees that the recognition module receives only pertinent face areas.



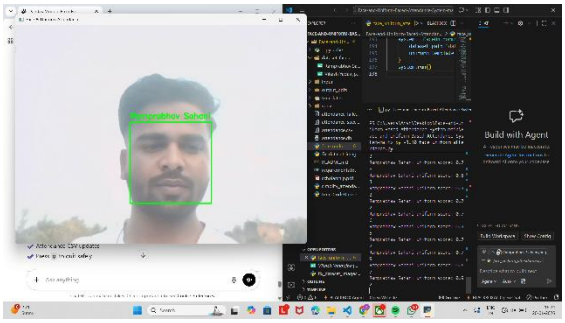
2. Face Recognition Result

The recognized face is now compared to the system's pre-trained dataset. The system shows the matching student name or unique ID on the screen after a match is discovered. This result confirms that the person's identity has been successfully identified. It guarantees that attendance is only recorded for registered users and is essential in preventing unwanted access.



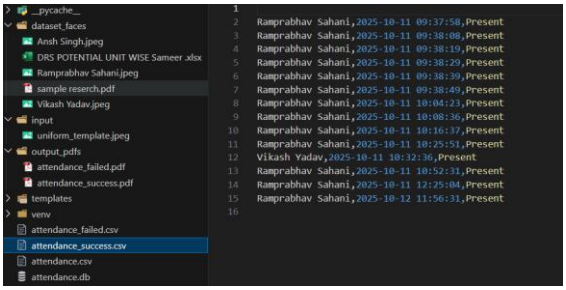
3. Uniform Detection Output

This output shows if the specified person is dressed in the required uniform. The technology uses machine learning techniques to assess clothing characteristics including color, pattern, and structure. It shows a result like "Uniform Detected" or "Uniform Not Detected" based on the analysis. This extra verification process guarantees adherence to institutional regulations and aids in maintaining discipline.



4. Attendance Marked Screen

The technology automatically marks the attendance once the requirements for both uniform detection and face recognition are met. The successful recording of attendance is indicated by a confirmation message that appears on the screen. By ensuring that the process is finished without human involvement, this output increases productivity and lowers errors.



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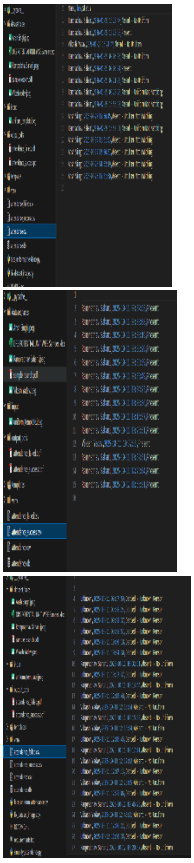
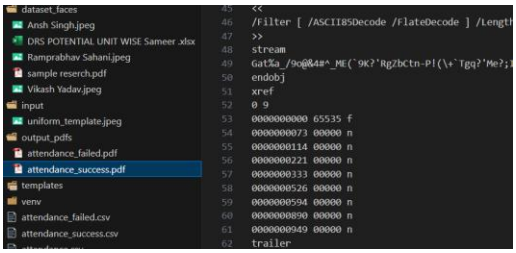
5. Database Record

This section demonstrates how the database stores attendance data. Details like the student's name, ID, entry date, and time are usually included in the record. It shows that the system keeps an orderly and structured attendance record that can be accessed for reporting and analysis at a later time.



6. Admin Dashboard

A consolidated interface for controlling and tracking attendance data is offered by the admin dashboard. It presents reports, summaries, and comprehensive records in an understandable manner. Administrators may examine individual records, see attendance trends, and effectively administer the system. This improves usability and gives you more flexibility over managing attendance.



2. View Attendance records in excel sheet

In this image, we can see the attendance recorded in an Excel sheet categorized by department.

	A	B	C	D	E	F	G	H	I
1	Enrollment		Name		Date			Status	
2	2201790		Ansh singh		26-03-2026			Absent	
3	2207186		Vikash Yadav		26-03-2026			Absent	
4	2207169		Ramprabhav Yadav		26-03-2026			Present	
5									
6									
7									

IX. CONCLUSION

A reliable and effective Face and Uniform-Based Attendance System that greatly enhances institutional security and attendance accuracy is presented in this research. The technology gets beyond the drawbacks of current attendance techniques by combining two separate verification modules, facial recognition and uniform detection. The hybrid strategy decreases proxy attempts and improves dependability under various scenarios, according to the experimental results. The approach has a lot of promise for contemporary companies and educational institutions. By fusing biometric face recognition with uniform verification methods, the Face and Uniform-Based Attendance System is a major breakthrough in automated attendance management. Manual roll calls, RFID cards, fingerprint scanners, and ID-based techniques are examples of traditional attendance systems that frequently have drawbacks, such as proxy attendance, human error, time consumption, hygienic issues, and a lack of real-time monitoring. By offering a non-contact, intelligent, and dependable solution appropriate for contemporary educational institutions and corporate settings, the suggested method effectively tackles these issues.

The technique ensures great accuracy and removes the potential of impersonation by using face recognition technology to individually identify

people based on their facial features. By confirming if the identified person is wearing the required uniform, uniform detection integration enhances the authentication process even more. Strict adherence to institutional discipline and policies is ensured by this dual-layer verification system, which also dramatically lowers fake attendance entries. As a result, the system not only automates the marking of attendance but also effectively and smoothly enforces adherence to uniform requirements.

Real-time identification and recognition from live camera feeds are made possible by the application of computer vision and machine learning algorithms. This automation saves important teaching time, lessens administrative burden, and minimizes manual intervention. Due to their digital storage, attendance records are readily available for analysis, reporting, and long-term record keeping. Accurate data generation is supported by the system and can be utilized for compliance audits, eligibility assessments, and performance evaluations.

Practically speaking, the method improves accountability and openness. Disputes pertaining to attendance manipulation or bias are removed because attendance is automatically and impartially recorded. Furthermore, the system's contactless design makes it ideal for post-pandemic settings where safety and cleanliness are crucial factors. The system's scalability makes it possible to implement it with little modification in offices, labs, classrooms, and big campuses.

To sum up, the Face and Uniform-Based Attendance System is a reliable, effective, and creative way to update attendance records. In order to provide accuracy, security, and convenience, it effectively integrates technology with institutional requirements. The system is a vital addition to the creation of smart campuses and digitally enabled businesses because of its strong potential for real-world application and future expansion

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