JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

REAL-TIME FACIAL RECOGNIZATION BASED ATTENDANCE SYSTEM

[1]P. Gayatri, [2]Vasudha Yalla,

[1]Assistant Professor, [2]MCA 2nd year,

[2]Master of Computer Applications,

[2]Sanketika Vidya Parishad Engineering College, Visakhapatnam, India

ABSTRACT:

This project presents a real-time facial recognition-based attendance management system. It utilizes computer vision techniques to accurately identify and track individuals for attendance purposes. The system employs facial recognition algorithms, including face detection, feature extraction, and matching techniques. It operates in real-time and is suitable for educational institutions, corporate offices, and events. The system comprises a camera module, face detection algorithm, and facial recognition algorithm, leveraging machine learning to continually improve recognition capabilities. It automates attendance tracking, reducing administrative burdens, preventing proxy attendance, and enhancing security. Real-time notifications, reports, and integration with existing infrastructure further enhance functionality, offering an efficient solution for attendance management.

Keywords: Open CV, Computer vision, Face detection, Face recognition, K-nearest-neighbors, cv2, Detection-model.

1.1 INTRODUCTION

The Real-Time Facial Recognition Based Attendance System is an innovative solution that leverages computer vision and facial recognition technology to streamline and automate attendance management. By combining face detection, feature extraction, and matching techniques, the system accurately identifies and tracks individuals in real-time. This project aims to provide a reliable and efficient alternative to manual attendance tracking in various settings, such as educational institutions, corporate offices, and events. With its ability to prevent proxy attendance, enhance accuracy, and improve overall efficiency, the system offers a cutting-edge approach to attendance management that integrates seamlessly with existing infrastructure.

Conventional attendance management approaches, relying on manual processes or card-based systems, are often prone to errors, time-consuming, and susceptible to fraudulent activities like proxy attendance. In contrast, real-time facial recognition-based attendance systems utilize computer vision techniques and advanced algorithms to automatically identify and verify individuals in real-time, eliminating the need for manual record-keeping.

1 .2 SCOPE OF THE PROJECT

The Real-Time Facial Recognition Based Attendance System project involves developing and implementing an attendance management system using facial recognition technology. The scope includes designing an accurate facial recognition algorithm, processing live video streams, managing a database of authorized individuals, creating a user-friendly interface, integrating with existing infrastructure, utilizing machine learning for continuous improvement, and enabling notifications and reporting. Considerations for scalability, security, and performance optimization are also part of the project scope to ensure reliable and efficient attendance management in diverse environments.

2.1 SYSTEM ANALYSIS

System Architecture:

The system comprises a camera or video input device to capture live video feeds. Face detection algorithms process the video to locate faces in each frame. Detected faces are matched with known identities using face recognition algorithms.

Attendance records are stored in a database or storage system. Administrators or users can access the system through a user interface to view attendance reports and manage the system.

Database and Storage:

The system requires a database or storage system to store face templates or embeddings of enrolled individuals. Attendance records, including timestamps and identified individuals, may also be stored. Efficient indexing and retrieval mechanisms are necessary for fast matching and retrieval of face templates.

User Interface and Management:

An intuitive user interface enables administrators or users to interact with the system. The interface should support enrolment, management of enrolled individuals, and generation of attendance reports. Access controls and security measures ensure system protection from unauthorized access.

Privacy and Ethical Considerations:

Privacy concerns should be addressed through data protection measures, compliance with regulations (e.g., GDPR), and obtaining necessary consent. Ethical considerations related to the collection and usage of biometric data should be taken into account, ensuring transparency and fairness in system operation. Please note that the implementation of a real-time face detection-based attendance system can vary based on specific requirements and available technologies. The rephrased analysis provides an overview of the general components and considerations involved in such a system.

2.2 EXISTING SYSTEM

Before the implementation of the Real-Time Facial Recognition Based Attendance System, traditional attendance management systems were commonly used. These existing systems typically relied on manual methods, such as paper-based attendance sheets or barcode scanning, which had several limitations. Here is an overview of the existing system:

Manual Attendance Sheets: In this system, individuals would sign or mark their attendance on paper-based attendance sheets. The sheets would later be collected, manually processed, and entered into a digital format for record-keeping. This process was time-consuming, prone to errors, and required manual effort for data entry and maintenance.

Barcode Scanning: Some systems utilized barcode scanning technology, where individuals would have a unique barcode assigned to them. They would scan their barcodes using dedicated devices to record their attendance. However, this approach still required physical contact with the scanning device and could be prone to barcode-related issues like damage or loss.

Proximity Card Systems: Another common approach was proximity card systems, where individuals would carry a card or badge embedded with a unique identifier. They would tap or swipe their cards on designated card readers to record their attendance. However, this method still required individuals to carry their cards and physically interact with the readers.

DISADVANTAGES OF EXISTING SYSTEM:

1. Manual Effort and Errors
2. Proxy Attendance and Limited Real-Time Tracking
3. Integration Challenges and Security Vulnerabilities
4. Dependency on Physical Tokens and Lack of Flexibility

2.3 PROPOSED SYSTEM

The proposed Real-Time Facial Recognition Based Attendance System revolutionizes the traditional attendance management process. By leveraging advanced computer vision and facial recognition technology, the system offers an accurate, efficient, and secure solution. The key components include a robust facial recognition algorithm, live video stream processing, secure database management, user-friendly interface, machine learning integration, real-time notifications, and seamless integration with existing infrastructure. With this system, attendance tracking becomes automated, eliminating proxy attendance and improving overall accuracy and efficiency. Administrators can easily monitor attendance, generate comprehensive reports, and benefit from the continuous improvement of recognition capabilities over time. The proposed system transforms attendance management, streamlining processes, enhancing security, and providing a reliable solution for diverse environments.

ADVANTAGES OF PROPOSED SYSTEM:

1. Accurate Attendance Tracking
2. Real-Time Processing
3. Automated and Efficient
4. Enhanced Security
5. Seamless Integration

2.4 FEASIBLITY STUDY

The feasibility study assesses the viability and practicality of implementing the Real-Time Facial Recognition Based Attendance System. It evaluates various aspects to determine if the project is feasible and can be successfully implemented. Here are the key areas covered in the feasibility study:

1. Technical Feasibility:

- Assessing the availability of technology and infrastructure required for implementing facial recognition algorithms, live video processing, and database management.

- Evaluating the compatibility of the proposed system with existing hardware and software infrastructure.

- Analysing the scalability and performance capabilities of the system to handle the expected number of users and data volume.

2. Economic Feasibility:

- Estimating the costs associated with developing, implementing, and maintaining the system, including hardware, software, licensing, personnel, and ongoing support.

- Conducting a cost-benefit analysis to determine if the benefits derived from the system outweigh the associated costs.

- Assessing the potential return on investment (ROI) and payback period for the project.

3. Operational Feasibility:

- Evaluating the practicality and effectiveness of integrating the proposed system into the existing operational processes and workflows.

- Assessing the impact of the system on the daily operations of educational institutions, corporate offices, or event management.

- Identifying any potential challenges or resistance to change from stakeholders and developing strategies to mitigate them.

4. Legal and Ethical Feasibility:

- Identifying legal and regulatory requirements related to facial recognition technology, data privacy, consent, and security.

- Assessing the ethical implications associated with capturing and storing facial data, ensuring compliance with ethical standards and norms.

- Evaluating the potential social impact of implementing facial recognition technology for attendance tracking purposes.

3 SPECIFICATIONS

3.1 HARDWARE REQUIREMENTS (Minimum Requirement)

1. RAM:4+RAM
2. PROCESSOR: i5 10th Gen 2.2 Ghz
3. STORAGE: 20GB

3.2 SOFTWARE REQUIREMENTS

1. Domain: Python
2. Version: Python IDLE (3.8.0) or above
3. Code Editors: Visual Studio Code or Notepad ++
4. Frameworks and Dependencies: pandas, scikit-learn, NumPy, joblib, flask
5. Operating System: Windows 10 or above

Pandas:
Pandas provide us with many Series and DataFrames. It allows you to easily organize, explore, represent, and manipulate data. Smart alignment and indexing featured in Pandas offer you a perfect organization and data labelling. Pandas has some special features that allow you to handle missing data or value with a proper measure. This package offers you such a clean code that even people with no or basic knowledge of programming can easily work with it. It provides a collection of built-in tools that allows you to both read and write data in different web services, data-structure, and databases as well. Pandas can support JSON, Excel, CSV, HDF5, and many other formats. In fact, you can merge different databases at a time with Pandas.

NumPy:
Arrays of NumPy offer modern mathematical implementations on huge amount of data. NumPy makes the execution of these projects much easier and hassle-free. NumPy provides masked arrays along with general array objects. It also comes with functionalities such as manipulation of logical shapes, discrete Fourier transform, general linear algebra, and many more. While you change the shape of any N-dimensional arrays, NumPy will create new arrays for that and delete the old ones. This python package provides useful tools for integration. You can easily integrate NumPy with programming languages such as C, C++, and Fortran code.

Joblib:
Joblib is a Python library for efficient parallel computing and data serialization. It simplifies the process of parallelizing code and provides caching mechanisms to optimize repetitive computations, making it valuable for data-intensive tasks.

Scikit-Learn:
Scikit Learn comes with a clean and neat API. It also provides very useful documentation for beginners. It comes with different algorithms – classification, clustering, and regression. It also supports random forests, k-means, gradient boosting, DBSCAN and others. This package offers easy adaptability. Once you get well with the general functionalities of Scikit Learn, switching to other platforms will be no problem at all. Scikit Learn offers easy methods for data representation. Whether you want to present data as a table or matrix, it is all possible with Scikit Learn. It allows you to explore through digits that are written in hands. You can not only load but also visualize digits-data as well.

Flask:
Flask is a lightweight and flexible web framework for Python, known for its simplicity and ease of use. It provides the basic features needed for web development, such as routing, request handling, and template rendering, while allowing developers to extend its capabilities with various extensions. Flask's micro framework approach allows for quick development and customization, making it a popular choice among developers. With its built-in development server and extensive documentation, Flask offers a smooth development experience and has a thriving community that provides support and resources. Whether you're building a simple web application or a complex API, Flask provides a solid foundation for your Python web development needs.

4 CODE EDITORS

4.1 Notepad++
Notepad++ is a source code editor and a replacement for Microsoft Windows' default Notepad, available for free under the GNU General Public License. It supports multiple languages and is built using C++ with Scintilla, ensuring a faster execution speed and a smaller program size through optimized routines while maintaining user-friendliness. The developer of Notepad++, Don Ho, originally used JEXT but decided to build a C++ text editor with Scintilla after being dissatisfied with JEXT's poor performance. He developed it in his spare time since his company rejected the idea. Notepad++ was released in 2003 and was initially available only for Windows. Although the author considered porting it to Mac OS X and Unix platforms using wx Widgets, this idea was ultimately rejected. In 2010, the US government obliged US-based open-source project hosts to deny access to users in certain countries, which the developer felt was a violation of the free and open-source software (FOSS) philosophy. As a response, Notepad++ moved out of US territorial jurisdiction by releasing a version on Tux Family in France. Notepad++ was criticized by Lifehacker for its user interface but was still voted as the most popular text editor by its readers in 2014. In 2015, it was voted the most used text editor worldwide by Stack Overflow respondents. Notepad++ left Source Forge completely in 2015 and moved its forums to Node BB and its bug tracker to GitHub.

4.2 VISUAL STUDIO CODE EDITOR

Visual Studio Code (VS Code) is a popular and versatile source code editor that provides a rich set of features for project documentation. It offers a user-friendly interface with a wide range of extensions and plugins, making it highly customizable and adaptable to various programming languages and project requirements. With its integrated terminal, version control system, and intelligent code completion, VS Code allows developers to efficiently write and manage project documentation. It supports Markdown, a lightweight markup language, enabling easy creation and formatting of text documents. Additionally, its live preview feature enables real-time visualization of Markdown files, facilitating a seamless editing experience. Overall, VS Code provides a powerful and efficient environment for creating comprehensive and well-structured project documentation.

5 MODULE DESCRIPTION

The implementation of Real-Time Facial Recognition Based Attendance System involves below modules.

Camera Module:

The system utilizes the OpenCV library and a webcam to capture live video streams for facial recognition. The OpenCV library provides functionalities to access and process video frames from the webcam in real-time. The webcam should have sufficient resolution and image quality to ensure accurate facial capture.

Face Detection:

The system incorporates the Haar cascade classifier provided by OpenCV for face detection. This classifier is trained to detect faces within the video frames based on specific patterns and features. It efficiently locates and extracts facial regions from the video stream, which serves as input for further processing.

Feature Extraction:

After the face is detected, the system applies feature extraction techniques to extract relevant facial features. It uses the extracted faces to create resized face images of a standard size (50x50 pixels) for consistency. These resized face images are flattened into a 1D array, which serves as the input for the facial recognition algorithm.

Facial Recognition:

The system utilizes the K-Nearest Neighbors (KNN) classifier from the scikit-learn library for facial recognition. The KNN classifier is trained on the available face images of registered users. During recognition, the system predicts the identity of a detected face by comparing its extracted features with the trained model. The predicted identity is then used to mark the attendance of the corresponding individual.

Attendance Tracking and Recordkeeping:

The system maintains a CSV file named "Attendance-{datetoday}.csv" to track and record attendance. Each row in the CSV file represents a registered user and includes columns for Name, Roll (unique identifier), and Time (timestamp of attendance). When a face is recognized, the system adds a new row or updates the existing row in the CSV file with the attendance details.

5.1 ARCHITECTURE

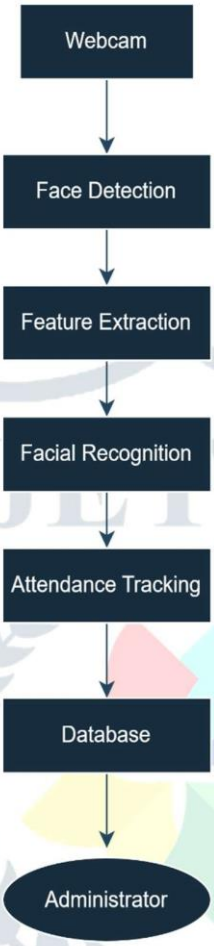

Figure 5.1: System Architecture

5.2 DATAFLOW DIAGRAM

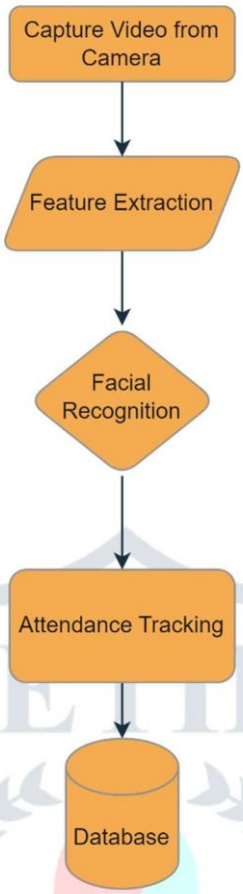

Figure 5.2: DATAFLOW DIAGRAM

Things in UML

Things are the abstractions that are first-class citizens in a model; relationships tie these things together; diagrams group interesting collections of things.
There are four kinds of things in the UML:
•Structural things
•Behavioural things[10]
•Grouping things
•An notational things
Structural things are the nouns of UML models. The structural things used in the project design are:
First, a class is a description of a set of objects that share the same attributes, operations, relationships and semantics.

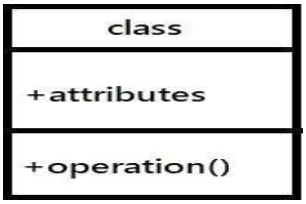

Figure 5.2:1 Classes

Second, a use case is a description of set of sequence of actions that a system performs that yields an observable result of value to particular actor.

Figure 5.2.2: Use Cases

Third, a node is a physical element [20] that exists at runtime and represents a computational resource, generally having at least some memory and often processing capability

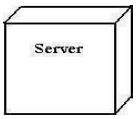

Figure 5.2.3: Nodes

Behavioural things are the dynamic parts of UML models. The behavioural thing used is:

Interaction: An interaction is a behaviour that comprises a set of messages exchanged among a set of objects within a particular context to accomplish a specific purpose. An interaction involves a number of other elements, including messages, action sequences (the behaviour invoked by a message, and links (the connection between objects)

5.3 Relationships in UML

There are four kinds of relationships in the UML:
•Dependency
•Association
•Generalization
•Realization
A dependency is a semantic relationship between two things in which a change to one thing may affect the semantics of the other thing (the dependent thing)

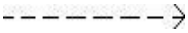

Figure 5.3: Dependencies

An association is a structural relationship that describes a set links, a link being a connection among objects. Aggregation is a special kind of association, representing astructural relationship [14] between a whole and its parts.

Figure 5.3.1: Association

A generalization is a specialization/ generalization relationship in which objects of the specialized element (the child) are substitutable for objects of the generalized element (the parent).

Figure 5.3.2: Generalization

A realization is a semantic relationship between classifiers, where in one classifier specifies a contract that another classifier guarantees to carry out.

Figure 5.3.3: Realization

6 RELATED WORKS

6.1 Shreyak Sawhney; Karan Kacker; Samyak Jain; Shailendra Narayan Singh; Rakesh Garg(2019), Real-Time Smart Attendance System using Face Recognition Techniques

The management of the attendance can be a great burden on the teachers if it is done by hand. To resolve this problem, smart and auto attendance management system is being utilized. But authentication is an important issue in this system. The smart attendance system is generally executed with the help of biometrics. Face recognition is one of the biometric methods to improve this system. Being a prime feature of biometric verification, facial recognition is being used enormously in several such applications, like video monitoring and CCTV footage system, an interaction between computer & humans and access systems presents indoors and network security. By utilizing this framework, the problem of proxies and students being marked present even though they are not physically present can easily be solved. The main implementation steps used in this type of system are face detection and recognizing the detected face. This paper proposes a model for implementing an automated attendance management system for students of a class by making use of face recognition technique, by using Eigenface values, Principle Component Analysis (PCA) and Convolutional Neural Network (CNN). After these, the connection of recognized faces ought to be conceivable by comparing with the database containing student's faces. This model will be a successful technique to manage the attendance and records of students.

6.2 Hao Yang; Xiaofeng Han, Face Recognition Attendance System Based on Real-Time Video Processing

With the advent of the era of big data in the world and the commercial value of face recognition technology, the prospects for face recognition technology are very bright and have great market demand. This article aims to design a face recognition attendance system based on real-time video processing. This article mainly sets four directions to consider the problems: the accuracy rate of the face recognition system in the actual check-in, the stability of the face recognition attendance system with real-time video processing, the truancy rate of the face recognition attendance system with real-time video processing and the interface settings of the face recognition attendance system using real-time video processing. By analysing the situation of these problems, the concept of attendance system based on face recognition technology is proposed, and the research on face recognition attendance system based on real-time video processing is carried out. Experimental data shows that the accuracy rate of the video face recognition system is up to 82%. Compared with the traditional check-in method, the face recognition attendance system can be reduced by about 60%. The rate of skipping classes has greatly reduced the phenomenon of students leaving early and skipping classes. The face recognition time and attendance system with real-time video processing through the above experimental certification can quickly complete the tasks of students in the time and attendance check-in system, get rid of the complex naming phenomenon, greatly improve the efficiency of class, and play an important role in guiding the development of the time and attendance system.

7 OUTPUT SCREENS

7.1 Landing Page

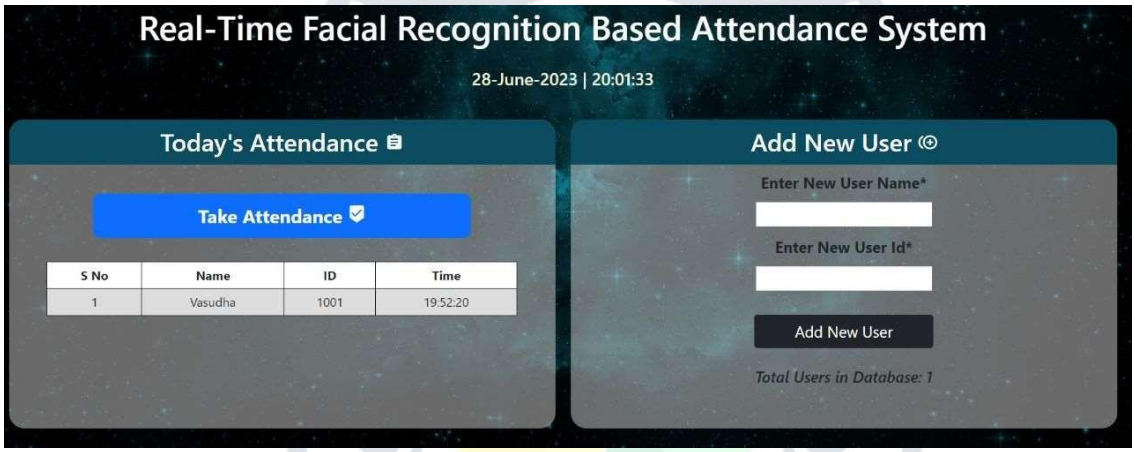

Figure 7.1 Landing Page

7.2 Face Recognition

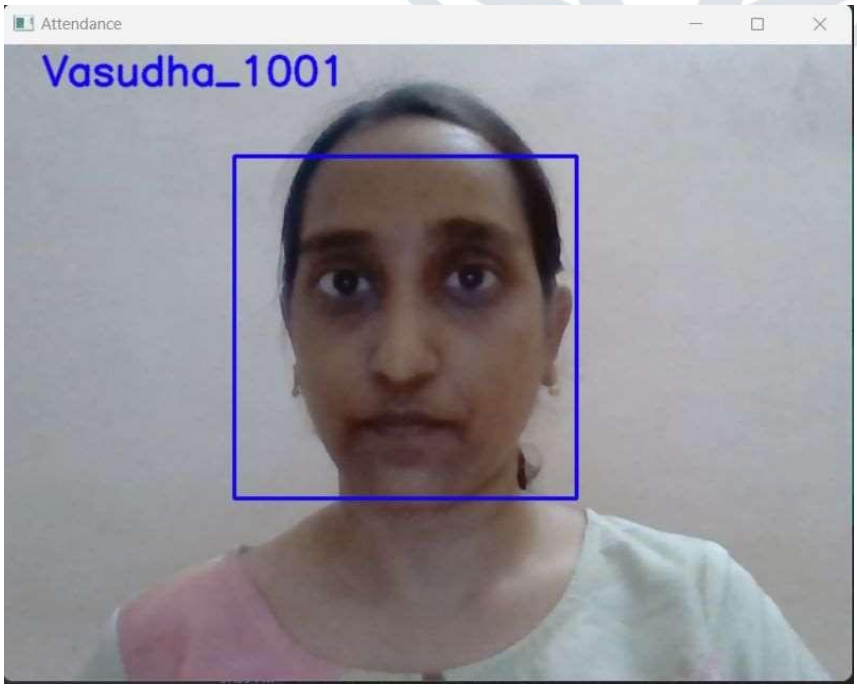

Figure 7.2 Face Recognition

7.3 Attendance Tracking Database

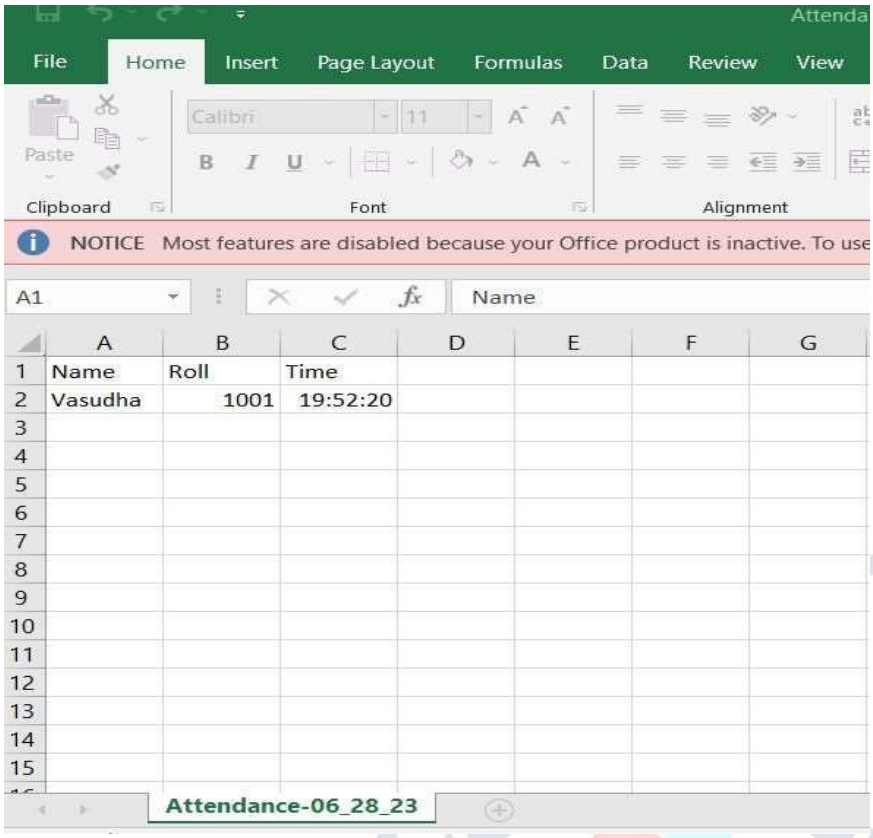

Figure 7.3 Attendance Tracking Database

8 PURPOSE

The purpose of this project is to develop a real-time facial recognition-based attendance system using Flask, OpenCV, and machine learning techniques. The system aims to automate the process of taking attendance by accurately identifying individuals through facial recognition and recording their attendance in a centralized database. By leveraging facial recognition technology, the project eliminates the need for manual attendance taking, reduces administrative workload, and provides a more efficient and reliable attendance management solution. The system can be used in various environments such as educational institutions, workplaces, or events where attendance tracking is required.

9 CONCLUSIONS

In conclusion, the real-time facial recognition-based attendance system developed in this project offers a modern and efficient solution for attendance management. By utilizing computer vision techniques and machine learning algorithms, the system accurately identifies individuals in real-time, eliminating the need for manual attendance tracking. The system provides benefits such as enhanced accuracy, prevention of proxy attendance, improved security, and streamlined administrative processes. Real-time notifications and reporting features enable easy monitoring of attendance and generation of attendance reports. The integration of Flask and OpenCV allows for a user-friendly interface and seamless interaction with the camera module. Overall, this project presents a reliable and effective solution for automating attendance management using facial recognition technology.

9.1 SCOPE FOR FUTURE DEVELOPMENT

The facial recognition-based attendance system developed in this project lays the foundation for potential future development and enhancements. Some possible areas of scope for future development include:

1. Multi-factor authentication: Integration of additional authentication factors, such as voice recognition or fingerprint scanning, can enhance the security and reliability of the attendance system.

2. Mobile application: Developing a mobile application for the attendance system would enable users to access attendance records, receive notifications, and perform administrative tasks on their smartphones, providing more flexibility and convenience.

3. Cloud-based storage: Implementing cloud-based storage for attendance records can enhance data accessibility, scalability, and backup. It would allow seamless access to attendance data from multiple locations and provide a secure and centralized storage solution.

4. Real-time analytics and insights: Incorporating data analytics capabilities into the system can provide valuable insights and trends related to attendance patterns, student or employee behaviour, and performance. This information can support decision-making processes and help optimize resource allocation.

5. Integration with other systems: Integrating the attendance system with other existing systems, such as access control systems or learning management systems, can create a unified ecosystem for managing various aspects of attendance, security, and student or employee data.

By exploring these areas of future development, the facial recognition-based attendance system can evolve into a comprehensive and intelligent solution that meets the evolving needs of educational institutions, businesses, and event organizers.

10 REFERENCES

[1] An artical Reference on "Attendance System Based on Face Recognition System Using CNN-PCA Method and Real-time Camera" by Edy Winarno; Imam Husni Al Amin; Herny Februariyanti; Prajanto Wahyu Adi; Wiwien Hadikurniawati; Muchamad Taufiq Anwar
https://ieeexplore.ieee.org/abstract/document/9034596/
[2] An artical Reference on "A Real-time Attendance System Using Deep-learning Face Recognition" by Weidong Kuang, Abhijit Baul
https://scholarworks.utrgv.edu/ece_fac/11/
[3] An artical Reference on "Smart Attendance Monitoring System (SAMS): A Face Recognition Based Attendance System for Classroom Environment" by Shubhobrata Bhattacharya, Gowtham Sandeep Nainala, Prosenjit Das, Aurobinda Routray
https://ieeexplore.ieee.org/abstract/document/8433537/
[4] An artical Reference on "FACE RECOGNITION BASED
ATTENDANCE MARKING SYSTEM" by K.Senthamil Selvi, P.Chitrakala, A.Antony Jenitha3
https://www.academia.edu/download/33035039/V3I2201468.pdf
[5] An artical Reference on "Vision-Face Recognition Attendance Monitoring System for Surveillance using Deep Learning Technology and Computer Vision" by J. Harikrishnan; Arya Sudarsan; Aravind Sadashiv; Remya A.S. Ajai
https://ieeexplore.ieee.org/abstract/document/8899418/
[6] An artical Reference on "Real Time Automatic Attendance System for Face Recognition Using Face API and OpenCV" by Sikandar Khan, Adeel Akram & Nighat Usman
https://link.springer.com/article/10.1007/s11277-020-07224-2
[7] An artical Reference on "Real-Time Smart Attendance System using Face Recognition Techniques" by Shreyak Sawhney; Karan Kacker; Samyak Jain; Shailendra Narayan Singh; Rakesh Garg
https://ieeexplore.ieee.org/abstract/document/8776934/
[8] An artical Reference on "Face Recognition-Based Mobile Automatic Classroom Attendance Management System" by
Refik Samet; Muhammed Tanriverdi
https://ieeexplore.ieee.org/abstract/document/8120338/
[9] An artical Reference on "Real Time Attendance System Using Face Recognition Technique" by Mayank Srivastava; Amit Kumar; Aditya Dixit; Aman Kumar
https://ieeexplore.ieee.org/abstract/document/9087197/
[10] An artical Reference on "Face Recognition Attendance System Based on Real-Time Video Processing" by Hao Yang; Xiaofeng Han
https://ieeexplore.ieee.org/abstract/document/9138372/

BIBILIOGRAPHY

Potnuri Gayatri, Assistant professor, she received her M Tech in Computer Science & engineering from JNTU Kakinada in January 2015. She received her B Tech Degree from VITAM College of Engineering, JNTU Hyderabad in 2004. she currently working as Assistant Professor, CSE Dept in SVPEC, Andhra Pradesh, India. Her Research Interests include Sensor Networks.

Vasudha Yalla is studying her 2nd year, Master of Computer Applications in Sanketika Vidya Parishad Engineering College, affiliated to Andhra University, accredited by NAAC. With her interest in python, machine learning and as a part of academic project, she chooses Real-Time Facial Recognition Based Attendance System with the aid of machine learning. As a result of our analysis, the project is an excellent example of how technology can be used to address real-world challenges. A completely developed project along with code has been submitted for Andhra University as an Academic Project. In completion of her MCA.