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Facial Recognition Attendance Monitoring System using Deep Learning Techniques

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Abstract
The implementation of a Facial Recognition System can aid in identifying or verifying a person's identity from a digital image. Accurate attendance records are vital to classroom evaluation. However, manual attendance tracking can result in errors, missed students, or duplicate entries. The adoption of the Face Recognition-based attendance system could help eliminate these shortcomings. This innovative approach involves utilizing a camera to capture input images, detecting faces using algorithms such as Haarcascade, Eigen values, support vector machines, or the Fisher face algorithm, verifying the faces against a database of student profiles, and marking attendance in an Excel sheet. The use of OpenCV, an open-source computer vision library, ensures the efficient functioning of the system. The proposed model involves training the system with the authorized students' faces to create a database. The system crops and stores the images in a database with corresponding labels and extracts features using algorithms such as LBPH, Haarcascade, Eigen values, support vector machines and Fisher face algorithm. The Face Recognition-based attendance system could help automate attendance records with high accuracy and reduce the burden of manual attendance tracking.

Keywords: Open CV, LBPH, Haar Cascade

I. INTRODUCTION

Over the past few years, facial recognition technology has gained significant attention due to its potential for various applications in law enforcement and other industries. It is a technology that can identify or verify a person from a digital image and has emerged as an attractive solution for identity verification. With the increased use of image-capturing devices such as smartphones and CCTV cameras, the need for computational analysis of multidimensional facial structures has become more important. The face recognition-based attendance system is an automated solution developed to address issues related to manual attendance-taking, which is time-consuming and prone to errors. In educational institutions, attendance is a critical part of daily classroom evaluation, but teachers may miss students or record multiple entries. This leads to data inconsistencies, which can be resolved with the face recognition-based attendance system. The objective of this paper is to offer a simple and automated system for recording and tracking student attendance using biometric technology. The system compares the face of the person with the images stored in the dataset to mark attendance. This paper aims to make the attendance process faster and more accurate. The documentation includes the definition, objective, design, implementation, testing,

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and future enhancements of the paper. The manual attendance system is time-consuming and requires lecturers to collect, verify and manage student records. In contrast, the automated system offers better benefits and reduces the workload of the lecturer.

Some of the drawbacks of the Existing System:

- Cost: The cost of implementing facial recognition attendance systems can be high, especially for smaller organizations with limited budgets.
- Accuracy: Despite the accuracy of the technology, there are still chances of errors in facial recognition systems. This can result in incorrect attendance records, which can create confusion and affect overall attendance management.
- Privacy concerns: Facial recognition technology has been subject to criticism due to concerns regarding privacy, particularly regarding the collection and use of biometric data.
- Security: If facial recognition attendance systems are not properly secured, they can be vulnerable to hacking and other cyber-attacks. This can result in unauthorized access to sensitive information, such as attendance records.
- Dependence on technology: Facial recognition attendance systems can be susceptible to technical glitches, which can cause delays and disrupt the attendance management process. Additionally, if the technology fails, alternative attendance tracking methods may not be in place.
- Cultural sensitivity: Facial recognition systems may not be effective for individuals with certain facial features or those who wear religious attire that covers their face, which can lead to discrimination and exclusion.

II. RELATED WORKS

This paper examines various attendance and monitoring tools currently used in the industry, which are mostly automated but are still prone to errors. A new attendance system that combines state-of-the-art methods and advances in deep learning is proposed. The system utilizes a smaller number of face images and a proposed method of augmentation to achieve high accuracy. Automated Face Recognition has revolutionized the way attendance is taken, making it a more secure and efficient process that reduces paper usage and manual effort. The system captures and stores students' facial biometrics, using various algorithms and techniques, and recognizes the student when their data is stored, marking their attendance. The proposed system uses the OpenCV library, which offers a comprehensive set of classic and state-of-the-art computer vision and machine learning algorithms for detecting and recognizing faces, identifying objects, and more.

The 3 techniques of face recognition in OpenCV library are:

a) Eigen faces algorithm
b) Fisher faces algorithm
c) Local Binary Pattern Histogram (LBPH) algorithm

The Eigen face method seeks to obtain facial features mathematically, rather than relying on physical features of the face, using mathematical transforms for recognition. The recognition process involves two phases, with a large group of individual faces serving as the training set to determine a set of Eigenvectors using Principal Component Analysis. However, this approach is susceptible to lighting conditions and head position, and the process of finding Eigen vectors and values is time-consuming.

In contrast, Fisher face is a similar approach to Eigen face, but with the added benefit of better classification of different classes of images, including facial expressions. However, the Fisher

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face approach is more intricate than Eigen face in finding the projection of the face space, and calculating ratios takes a considerable amount of processing time. This approach also results in larger face storage and more time-consuming recognition.

The proposed system employs the Fisher face method for face recognition, which is superior and faster than other algorithms, and is also resilient to lighting conditions. Additionally, the Local Binary Pattern Histogram (LBPH) algorithm is a simple solution for face recognition that can detect both front and side faces.

III. METHODOLOGY

The Software Requirement Specification (SRS) is aimed at defining the necessary functionalities and Uniform Resource Locator (URL) for the Intelligent Network Backup Tool. It intends to establish a clear understanding of the final product's features and specifications as envisioned by both the development team and the client. The requirement statements are prioritized and detailed in this document. It targets project developers, managers, users, testers, and documentation writers, providing them with information on design and implementation constraints, external interface requirements, system features, non-functional requirements, and dependencies. Identifying needs is crucial for businesses and organizations to evaluate their market performance and maintain a competitive edge.

a) Architecture of the proposed system

The proposed system seeks to automate the existing manual attendance system by utilizing face recognition technology. Its main objective is to capture and store each student's face for attendance purposes. Accurate detection of all facial features during the image capture process is vital. With facial recognition steps applied to the captured image, teachers no longer have to take attendance manually during class. This paper tackles the challenges commonly associated with manual attendance systems. To detect faces, Haar Cascade classifiers are utilized, while the Local Binary Pattern Histogram (LBPH) algorithm is used to recognize student faces.

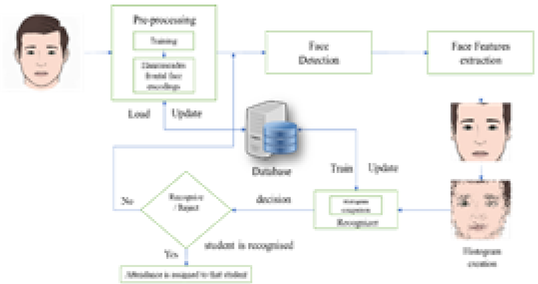

Fig 3.1: System Architecture

The proposed system for Face Recognition based Classroom attendance system. The system requires a camera installed in the classroom at a position where it could capture all the students in the classroom and thus capture their images effectively. This image is processed to get the desired results.

b) Algorithms and Flow Diagrams

Face detection uses classifiers, which are algorithms that detect what is either a face (1) or not a face (0) in an image. It is a machine learning based approach where a cascade function is trained from a lot of positive (images of faces) and negative images (images without faces).

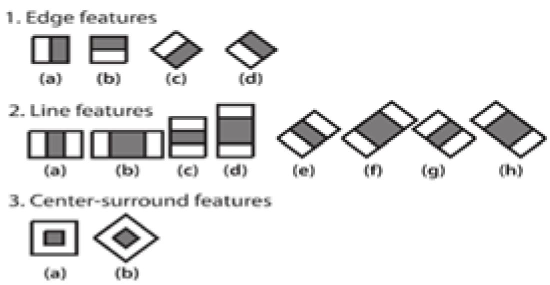

Fig 3.2: Feature Extraction

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In feature extraction, the algorithm uses training data to best identity features that it can consider a face.

c) Local Binary Pattern Histogram (LBPH) Algorithm

The Local Binary Pattern (LBP) was initially introduced in 1994 and has proven to be an influential character in texture classification. Studies have shown that the combination of LBP with histograms of oriented gradients (HOG) descriptor significantly enhances detection accuracy for certain datasets. By utilizing LBP in combination with histograms, we can create a straightforward data vector to represent facial images.

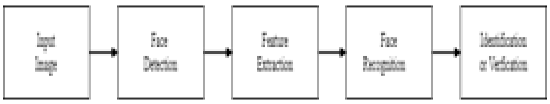

Fig 3.3: General Face Recognition Structure

The provided flow diagram depicts the image captured by the camera as the input, which is then subjected to the face detection algorithm to convert the original image into a grayscale image for feature extraction. Next, the input image undergoes a comparison process with the current image, utilizing verification and identification techniques to ensure a dependable recognition outcome.

d) Applying the LBPH Operations

The first step in LBPH computation is to produce an intermediate image that enhances the original image by highlighting the facial features. The algorithm utilizes a sliding window method, which relies on the radius and neighbor parameters, to achieve this objective.

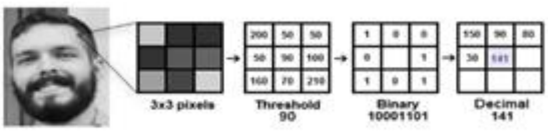

Fig 3.4: LBPH operation

Based on the image above, let's break it into several small steps so we can understand it easily:

• From a grayscale facial image, we can extract a 3x3 pixel window.

• The window can be represented as a 3x3 matrix that includes the intensity values of each pixel, ranging from 0 to 255.

• The central value of the matrix acts as the threshold, used to define new values from its eight neighbors.

• For each neighbour of the central value, we assign a new binary value based on whether its intensity is equal to or greater than the threshold. If it is, we set the binary value to 1; otherwise, we set it to 0.

• The matrix now contains only binary values (excluding the central value), which we concatenate line by line into a new binary value (e.g., 10001101). Note that the approach for concatenating binary values may vary among different authors (e.g., clockwise direction), but the outcome will remain the same.

• Next, we convert the binary value to a decimal value and set it as the central value of the matrix, which corresponds to a pixel from the original image.

• Following this LBP (local binary pattern) procedure, we obtain a new image that better highlights the facial characteristics of the original image.

e) Extracting the Histograms

To further process the image, it is divided into multiple rectangular regions using Grid X and Grid Y parameters. Each region is analyzed to generate a histogram based on the frequency of LBP codes found within that particular region. This process is repeated for each grid in the image to obtain a set of histograms that represent the distribution of LBP features for each region. As the image is in

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grayscale, each histogram will contain 256 positions (0~255) that represent the frequency of pixel intensity occurrences in the respective region.

After generating histograms for each region of the image, the next step is to concatenate them to create a larger, overall histogram. If we have an 8x8 grid, for example, the final histogram will contain 8x8x256=16,384 positions. This final histogram encapsulates the essential characteristics of the original image.

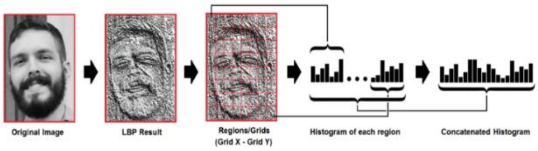

Fig 3.5: Extracting the Histogram

f) Performing the Face Recognition

In this stage, the algorithm has completed its training process. Each histogram generated during training represents an image in the training dataset. To recognize a new input image, we repeat the same steps as before, creating a histogram that represents its features. We can then compare this histogram to the histograms in the training dataset to find the closest match. Several approaches can be used to compare histograms and calculate the distance between them, such as Euclidean distance, chi-square, absolute value, and others. In this case, we can use the Euclidean distance formula, which is a commonly used method.

$$D = \sqrt{\sum_{i=1}^{n} (hist1_i - hist2_i)^2}$$

Equation 1: Euclidean Distance

The output of the algorithm is the ID of the image that has the closest histogram to the input image. Additionally, the algorithm should provide the calculated distance between the histograms, which serves as a measure of 'confidence'. It is important to note that a lower 'confidence' score is better because it indicates that the distance between the histograms is closer, and thus, the images are more likely to be a match.

IV. IMPLEMENTATION

The application allows faculty to take attendance of students by operating the system through the webcam. The system marks the attendance by matching the student's details previously uploaded by the faculty in the database.

a) Methods of Implementation

The OpenCV library includes the LBPH algorithm, which we have utilized. Additionally, OpenCV provides a Haar cascade classifier that is employed for detecting faces. The Haar cascade classifier utilizes the LBPH algorithm.

Let's see the implementation of face recognition in step by step.

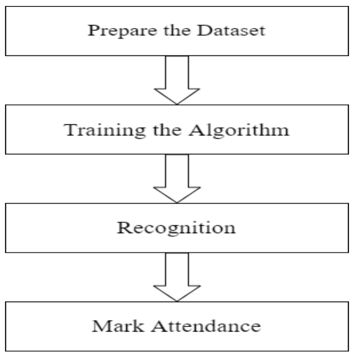

Fig 4.1: Code implementation process

b) Test cases

Application Testing is a vital process that ensures the correctness, completeness, security, and quality of a developed user application. This process involves technical investigation that is intended to reveal quality-related information about the product within its intended context. This includes executing the program or application with the aim of identifying

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errors, although testing cannot completely establish the correctness of arbitrary computer software. Instead, it provides a criticism or comparison that compares the state and behavior of the product against a specification. It is important to distinguish software testing from Software Quality Assurance (SQA), which encompasses all business process areas, not just testing. Quality is subjective and varies for each person.

Table 1: Test cases

Test case name	Test case Description	Expected value	Actual value	Result
User Operation Test	To check Whether the user operations like buttons are working properly.	The buttons must on when it is pressed.	The result we get on checking.	True/False
Video Recording Test	To check whether the video is being recording properly.	The camera should be turned on immediately and the video must be recorded.	The result we get on checking.	True/False
Training Test	Check for the training samples given for the algorithm.	The training samples given to the algorithm should be correct.	The result we get on checking.	True/False
Recognition Test	To check whether the algorithm recognizes student.	Displays the image with student id.	The result we get on checking.	True/False

V. RESULTS

a) Home Page

Fig 5.1: User Interface.

This is the admin interface of our project. Here, we have student dashboard to take the details of the student, which are used for further attendance purpose.

b) Data Collection Page

Fig 5.2: Inserting students data into database.

Student data is collected using Student dashboard and stored in student database.

c) Take Images Page

Fig 5.3: Web cam is taking the images to train the system.

Take facial images and integrate with student details and store in a dataset directory.

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d) Dataset Storage Page

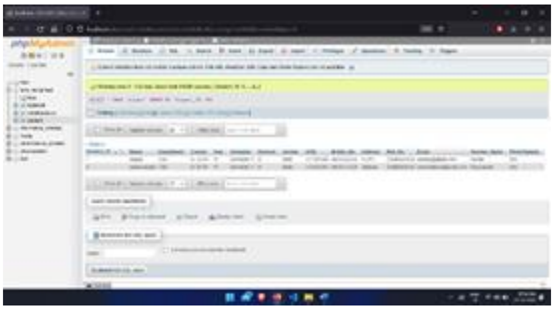

Fig 5.4: Directory is created to store the Students images.

This is how images are stored in the database as shown in the above screen. It stores 20 images of each student.

e) Student Details Page

Fig 5.5: student details stored in the database.

Data entered in the user interface are stored in the student database as show in above screen.

f) Track Images Page

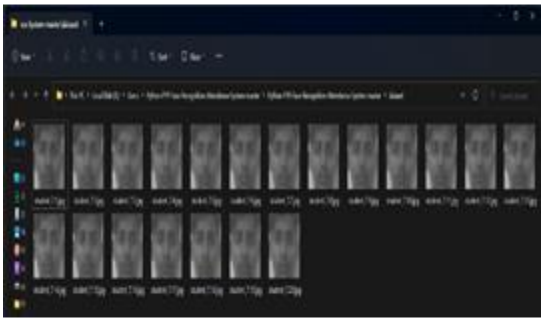

Fig 5.6: Recognition of the face of the student

On clicking the face detector button, a webcam is started for taking the attendance of the students.

g) Attendance Page

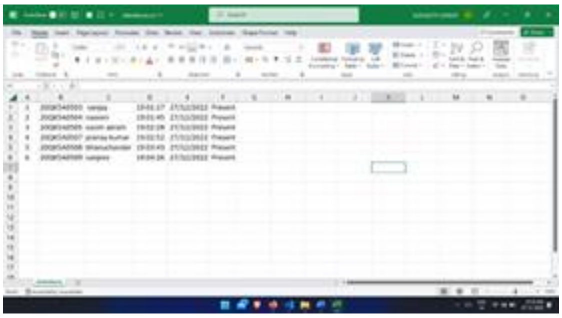

Fig 5.7: Attendance entry of the students

After recognizing the student's faces, the attendance of that student is stored in the excel sheet with their student id and name.

VI. CONCLUSION

The proposed system is designed to provide an automated attendance system for lectures, sections, and laboratories, allowing lecturers or teaching assistants to easily record student attendance. By utilizing face detection and recognition algorithms, this system saves time and effort, especially in classes with a large number of students. This automated system can improve an institution's goodwill by reducing drawbacks in the traditional manual system. Through thorough testing of the face detection and recognition algorithms, student attendance is marked by recognizing their face and storing the data in an attendance sheet. The system was developed from requirements to a complete system, including evaluation and testing, and achieved its objectives to the satisfaction of the client. Although some challenges were encountered during implementation, they were addressed and resolved. Strategies for future work and improvements to the system are discussed in this section.

FUTURE WORKS

The attendance marking system we have developed is successful in automatically recording attendance and generating an excel sheet in real-time. However, in order to create a dedicated system for educational institutions, a highly efficient algorithm that is not affected by varying lighting conditions in classrooms is necessary. Additionally, the system must utilize a camera with an optimal resolution. Another area for improvement is creating an online attendance database with automatic updates. This can be accomplished by installing a standalone module in the classroom with wireless internet access. Implementing these improvements would greatly enhance the functionality and usefulness of the paper.

REFERENCES

[1]. Marko Arsenovic, Srdjan Sladojevic, Andras Anderla, “FaceTime – Deep Learning Based Face Recognition Attendance System”. ResearchGate. Retrieved 2017-10-14.

[2]. Aparna Trivedi, Chandan Mani Tripathi, Dr. Yusuf Perwej, Ashish Kumar Srivastava, Neha Kulshrestha, “Face Recognition Based Automated Attendance Management System”. IEEE xplore. Retrieved 2022-02-12.

[3]. Lim, S. Sim, and M. Mansor, "Rfid based attendance system, " in Industrial Electronics & Applications, ISIEA, IEEE Symposium on, vol. 2. IEEE, pp. 778-782, 2009.

[4]. W. Zhao, R. Chellappa, P. J. Phillips, and A. Rosenfeld, "Face recognition: A literature survey", Acm Computing Surveys (CSUR), vol. 35, no. 4, pp. 399-458, 2003.

[5]. Yusuf Perwej, “Recurrent Neural Network Method in Arabic Words Recognition System”, International Journal of Computer Science and Telecommunications (IJCST), UK, London, volume 3, Issue 11, Pages 43-48, 2012.

[6]. Yusuf Perwej, Firoj Parwej, Asif Perwej, “Copyright Protection of Digital Images Using Robust Watermarking Based on Joint DLT and DWT”, International Journal of Scientific & Engineering Research (IJSER), France, ISSN 2229-5518, Volume 3, Issue 6, Pages 1- 9, 2012.

[7]. Robert Schalkoff, Pattern Recognition Statistical Structural and Neural Approaches, Wiley Student Edition.

[8]. Yusuf Perwej, “An Evaluation of Deep Learning Miniature Concerning in Soft Computing”, International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), Volume 4, Issue 2, Pages 10 - 16, 2015, DOI: 10.17148/IJARCCE.2015.4203.

[9]. K. Sun, Q. Zhao, J. Zou and X. Ma, "Attendance and security system based on building video surveillance", International Conference on Smart City and Intelligent Building, pp. 153- 162, 2018.

[10]. B. K. Mohamed and C. Raghu, “Fingerprint attendance system for classroom needs,” in India Conference (INDICON), 2012 Annual IEEE. IEEE, pp. 433–438, 2012.

[11]. Ali akbar punjani, chowdhary obaid, automated attendance management system using face recognition international journal of advanced computer science and technology vol 6 2017.

[12]. S. Kadry and K. Smaili, “A design and implementation of a wireless iris recognition attendance management system,” Infor. Tech. and control, vol. 36, no. 3, pp. 323–329, 2007.

[13]. T. A. P. K. K. L... Roshan- Tharanga, S. M. S. C. Samarakoon, “Smart attendance using real time face recognition,” 2013.

[14]. Yusuf Perwej, “The Bidirectional Long-Short Term Memory Neural Network based Word Retrieval for Arabic Documents”, Transactions on Machine Learning and Artificial Intelligence (TMLAI), ISSN 2054-7390, Volume 3, Issue 1, Pages 16 - 27, 2015, DOI: 10.14738/tmlai.31.863

[15]. Sarkar Simul, Md. Saiful Islam, " Convolutional Neural Network (CNN) Approach for Vision Based Student Recognition System." 2017, 20th International Conference of Computer and Information Technology (ICCIT), 22-24, 2017.