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Automated Attendance System Using Facial Recognition

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ABSTRACT

In contemporary educational and organizational settings, efficiently tracking attendance remains a significant challenge. Manual methods are prone to errors and time-consuming. To address these challenges, this study proposes an Automated Attendance System (AAS) utilizing Facial Recognition technology. The system leverages state-of-the-art techniques in image processing and machine learning to accurately identify individuals and record their attendance seamlessly. The AAS operates through a multi-step process. Initially, a comprehensive dataset is compiled comprising facial images of registered individuals. This dataset serves as the reference for subsequent recognition tasks. Upon input of an image, the system employs advanced algorithms for facial detection and matching, such as Histogram of Oriented Gradients (HOG), to identify individuals in real-time.Key to the system's functionality is its integration with Raspberry Pi, a versatile microcontroller, which serves as the hardware backbone. Raspberry Pi facilitates efficient processing of image data and enables real-time analysis, ensuring rapid attendance tracking. Additionally, the system incorporates an LCD display to provide immediate feedback, enhancing user experience and facilitating interaction. Furthermore, upon successful identification, attendance records are automatically updated in a centralized Excel spreadsheet, ensuring easy access and management of attendance data. This integration streamlines administrative tasks and enhances the overall efficiency of attendance tracking. Moreover, the system is equipped with a mailing feature, enabling administrators to receive notifications and reports regarding attendance status periodically. This feature ensures seamless communication and enhances the system's adaptability to diverse organizational environments.

Keywords :- Automated Attendance System, Facial Recognition, Capture, Histogram of Oriented Gradients, Mailing

I. INTRODUCTION

In today's fast-paced world, where efficiency and accuracy are paramount, traditional methods of attendance tracking have become outdated and cumbersome. Manual attendance systems often lead to inaccuracies, time wastage, and administrative overhead. To address these challenges, the integration of cutting-edge technology has become imperative. One such innovative solution is the Automated Attendance System (AAS) using Facial Recognition technology.

This paper explores the design, implementation, and benefits of an Automated Attendance System utilizing Facial Recognition technology. The system aims to revolutionize attendance tracking by seamlessly integrating various components such as identification, capture, dataset management, input image recognition, detection, and matching.At the core of the system lies the utilization of Facial Recognition technology, which enables the identification of individuals based on their facial features. This technology has gained significant traction due to its accuracy, speed, and non-intrusiveness. By leveraging this technology, the AAS eliminates the need for manual attendance marking, providing a streamlined and efficient solution.The system begins with the creation of a comprehensive dataset comprising facial images of registered individuals. This dataset serves as the reference for subsequent recognition tasks, ensuring accurate identification. Upon input of an image, advanced algorithms for input image recognition, such as Histogram of Oriented Gradients (HOG), are employed to detect and extract facial features.The integration of Raspberry Pi, a versatile microcontroller, serves as the hardware backbone of the system. Raspberry Pi facilitates real-time processing of image data, enabling rapid identification and attendance tracking. Additionally, the system incorporates an LCD display to provide immediate feedback to users, enhancing user experience and interaction.Furthermore, the AAS offers seamless integration with Excel, automatically updating attendance records in a centralized spreadsheet. This feature simplifies administrative tasks, enhances data management, and provides easy access to attendance records for analysis and reporting purposes.Moreover, the system incorporates a mailing feature, enabling administrators to receive notifications and reports regarding attendance status. This feature ensures timely communication and facilitates proactive management of attendance-related issues.

By combining advanced facial recognition algorithms, hardware integration, and user-friendly features such as LCD display and mailing functionality, the system offers a comprehensive solution for organizations seeking to enhance their attendance tracking processes.

The organizational framework of this study divides the research work in the different sections. The Literature survey is presented in section 2. In section 3 and 4 discussed about Existing and proposed system methodologies. Further, in section 5 shown Simulation Results is discussed and Conclusion and future work are presented by last sections 6.

II. LITERATURE SURVEY

In [1] 2017 Samuel John presented a Face Recognition Attendance System with GSM Notification. This system uses theViolaJones algorithm. This algorithm used for detect faces. Also, Fisher faces algorithm was used to create patterns of the faces which were caught. That created templates stored in the database. This system used library which is OpenCV and used Software Development Kit (SDK) to create the graphical user interface.

In [2] other paper, **Jenif D Souza** introduces a Automated Attendance Marking and Management System by Facial Recognition. This system marked students attendanceautomatically by the camera

which captures the photo of studentin the class. This system uses the algorithm called Histogram. Histogram algorithm used for face identification purpose. In this algorithm, The face image is converted to matrix form. Histogram are used for recognize of the exact faces. This system overcome the problem of time consuming.

In [3] 2019 **Nandhini R.** introduced Attendance System based on face recognition. This system capture the video of the students, convert it into frames and store it in the database. Also, Convolution Neural Network(CNN) algorithm is used to detect faces. This System helps in improving the accuracy and speed.

In [4] 2019, **Shreyak Sawhney**, karan kicker, Samyakjain introduced Real Time Smart Attendance Management System Using Face Recognition Techniques. In this system they use face detection and recognition method using convolution Neural Network and Principal Component Analysis (PCA) but using two camera some camera is used for the face detection and recognition at the door of classroom and the camera is used at inside the classroom for checking proxy attendance.

In [5] 2016, **E Vardharajan**, R Dharani, S Jeevitha,SHemalata introduced Automatic Attendance Management System Using Face Recognition. In this system the use Eigen Faces, Eigen Weight method for face detection this system the camera detention the image and then system crop the faces ofstudent and tie the faces with student database.

In[6] 2017, **Poornima S**, Sripriya N introduced Attendance Management System using Facial Recognition with Audio Output and Gender Classification. In this system they use Viola Jones algorithm and Principal Component Analysis(PCA) for the face recognition and they also use the gender classification and Voice conversion module. After the face detection and recognition the system use the Microsoft Speech API for announce the absent student names this can serve as a cross check.

In [7] 2018, **Omkar abdul rhmansa** lim introduced Class Attendance Management System Using Face Recognition. The system is based on RaspberryPi. By facing the camera. Itwill capture the image. The Raspberry Pi is a programmed to handle the face recognition by implement in the Binary Patterns algorithm LBP.

In[8]2018,**KritikaShrivastava**,ShwetaManda,Prof.P. S. Chavan introduced Automated Attendance System based on Face Recognition and Gender Classification using HaarCascade, LBPH Algorithm along with LDA Model.

In [9] 2017, **Prof. Arun Katara1** , Mr. SudeshV. Kolhe2 introduced Attendance System Using Face Recognition and Class Monitoring.This paper introduced the raspberrypi.They used OpenCv library installed for both. The web camera connected with raspberry pi and also database which is connected to pi.

III. EXISTING METHOD

In existing method through a high-resolution digital camera that detects and recognizes students' faces, facial recognition technology can be utilized to register presence compares the student's face to the one recognized .The database contains images of people's faces. As soon as the face of the student corresponds to the photograph stored in the database. The attendance database records your presence for the purpose of subsequent calculation If the image you took isn't quite right, does not correspond to the students' faces in the this image is saved as a new image in the database the repository of information There is a potential in this system that the image will not be captured by the camera appropriately, or you might miss the opportunity to catch a few students. The block diagram of existing method is shown in figure 1.

Input Image: An input image is the initial visual data fed into a system for processing. It could be any image containing faces or individuals whose identities need to be recognized or analyzed.

Image Capture: Image capture involves the process of obtaining digital images using a camera or any other imaging device. In the context of face recognition, images are captured to gather data for training the face recognition model or for recognizing faces in real-time.

Creating and Training Dataset: To create a dataset for face recognition, you need to gather a collection of images containing faces of individuals whose identities you want the system to recognize. These images should cover various poses, lighting conditions, and facial expressions to improve the robustness of the model. Once you have the dataset, you need to label each image with the corresponding identity. Then, you can use this labeled dataset to train a machine learning model, such as a deep learning model, using techniques like convolutional neural networks (CNNs).

Face Detection and Recognition: Face detection is the process of locating and identifying human faces within an image or video frame. This involves finding the presence and location of faces in the image. Face recognition, on the other hand, involves identifying or verifying the identity of a person from an image or video frame. It compares the detected face with a database of known faces to determine if there is a match.

Attendance Database: An attendance database is a structured collection of data that stores information related to attendance records. In the context of face recognition, an attendance database would store the identities of individuals along with timestamps indicating when they were detected or recognized by the face recognition system.

Using LBP (Local Binary Patterns): LBP is a feature extraction technique used in image processing and computer vision for texture analysis. In the context of face recognition, LBP can be used to extract features from facial images. These features can then be used to train a classifier or directly compare with other facial features for recognition purposes. LBP is particularly useful because it is robust to changes in illumination and facial expression.

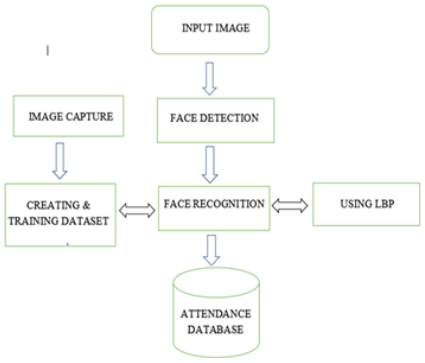


Figure 1. Block diagram of existing method

IV. PROPOSED METHOD

The block diagram of proposed method is shown in figure 2.

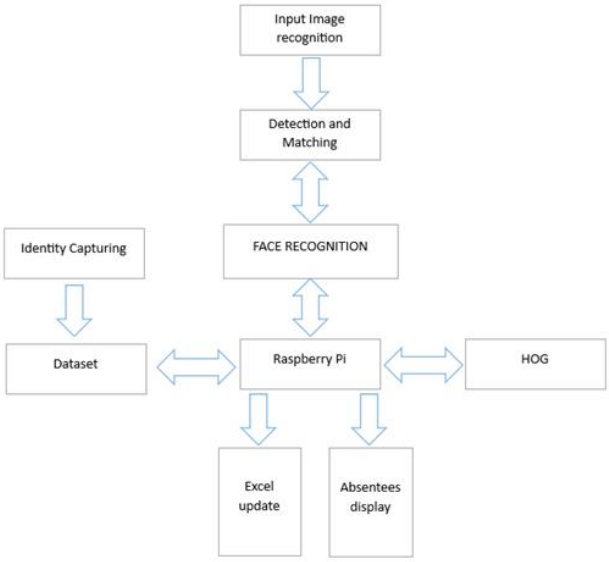


Figure 2. Block diagram of proposed method

An Automated Attendance System (AAS) using Facial Recognition technology is a sophisticated solution designed to streamline the process of attendance tracking in various settings such as educational institutions, corporate offices, or events. This system employs advanced techniques and integrates multiple components to efficiently identify

individuals and record their attendance. Let's break down the key elements involved:

Identify and Capture: The system is capable of identifying individuals by analyzing their facial features captured through a camera. It uses Facial Recognition algorithms to distinguish between different faces and match them with existing records in the system.

Dataset: A comprehensive dataset is compiled containing facial images of registered individuals. This dataset serves as the reference for the Facial Recognition system to accurately identify and match faces during attendance tracking.

Input Image Recognition: When an individual's image is captured by the system, it undergoes input image recognition, where facial features are extracted and compared against the dataset to determine the person's identity.

Detection and Matching: The system employs sophisticated algorithms, such as Histogram of Oriented Gradients (HOG), for facial detection and matching. These algorithms analyze the captured images to detect faces and compare them with the dataset for accurate identification.

Raspberry Pi: Raspberry Pi serves as the hardware platform for the system, providing the necessary computing power for image processing and facial recognition tasks. Its compact size and versatility make it an ideal choice for deploying AAS in various environments.

Excel Update: Attendance records are automatically updated in a centralized Excel spreadsheet, eliminating the need for manual data entry. This ensures accurate and organized tracking of attendance data, which can be easily accessed and managed by administrators.

HOG (Histogram of Oriented Gradients): HOG is a feature descriptor used for object detection in images. In the context of AAS, it helps in extracting relevant features from facial images for accurate detection and matching.

LCD Display: The system incorporates an LCD display to provide immediate feedback to users. It can display attendance status, notifications, or prompts for interaction, enhancing user experience and facilitating communication.

Mailing: A mailing feature is integrated into the system, allowing administrators to receive notifications and reports regarding attendance status via email. This enables proactive management of attendance-related issues and ensures timely communication.

In summary, an Automated Attendance System using Facial Recognition technology integrates various components and advanced techniques to accurately track attendance, streamline administrative tasks, and enhance user experience in diverse organizational settings. It represents a significant advancement over traditional attendance tracking methods, offering efficiency, accuracy, and scalability.

ALGORITHM

The Histogram of Oriented Gradients (HOG) algorithm is a popular technique used for object detection in images. It works by quantifying the distribution of gradient orientations in localized regions of an image. Here are the steps involved in the HOG algorithm:

Image Preprocessing:

Convert the input image to grayscale.

Optionally, perform image normalization to improve robustness against variations in illumination and contrast.

Gradient Calculation:

Compute the horizontal and vertical gradients of the image using techniques like Sobel, Prewitt, or Scharr operators.Calculate the gradient magnitude and orientation at each pixel.

Histogram Calculation:

Divide the image into small, overlapping cells. Typically, cells are square regions of a fixed size.

For each cell: Construct a histogram of gradient orientations within the cell.Bin the gradient orientations into a predefined number of orientation bins (e.g., 9 bins covering 0 to 180 degrees).

Accumulate gradient magnitudes weighted by their orientations into the corresponding bins of the histogram.

Block Normalization:

Combine histograms from neighboring cells into blocks. Blocks are typically larger regions composed of multiple cells.Normalize the histograms within each block to improve invariance to changes in lighting and contrast.Different normalization methods can be used, such as L1-norm, L2-norm, or block normalization.

Descriptor Formation:

Concatenate the normalized histograms from all blocks within a sliding window to form the final feature descriptor.The sliding window moves across the entire image, and the process is repeated for each window position.The resulting descriptor captures the spatial distribution of gradient orientations and magnitudes in the image.

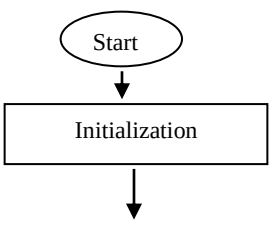
Detection :

Use the HOG feature descriptors as input to a machine learning classifier, such as Support Vector Machine (SVM) or AdaBoost, for object detection. Train the classifier on labeled training data to learn to distinguish between positive (object) and negative (non-object) examples.Apply the trained classifier to new images to detect objects based on their HOG features.

Post-processing:

Optionally, perform non-maximum suppression or other post-processing techniques to refine the detected object locations and remove duplicate detections.

FLOW DIAGRAM



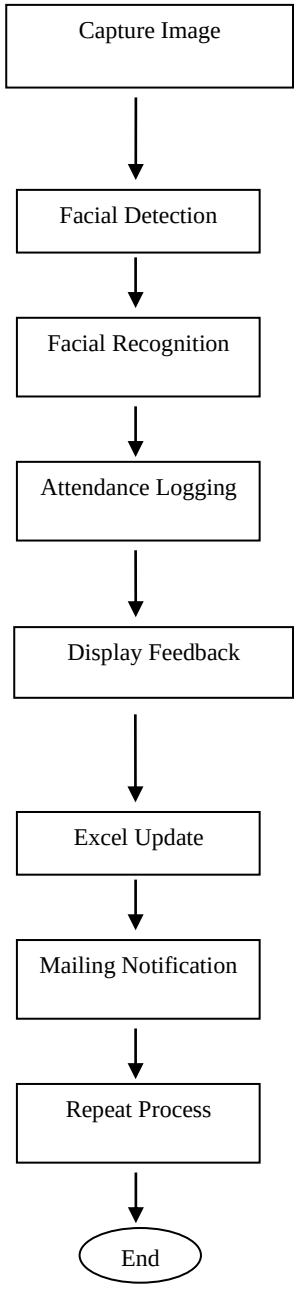


Figure 3. Flow Diagram

IMPLEMENTATION STEPS

1. Initialization: System initializes all necessary components including the camera, Raspberry Pi, LCD display, and database.

2. Capture Image: The camera captures an image of individuals present in the environment.

3. Facial Detection: The captured image undergoes facial detection using algorithms like HOG to locate faces within the image.

4. Facial Recognition: Identified faces are matched against the existing dataset to recognize registered individuals.

5. Attendance Logging: If a match is found, the system logs the attendance of the recognized individual.

6. Display Feedback: The LCD display provides immediate feedback to the user, indicating whether the recognition was successful or unsuccessful.

7. Excel Update: If attendance is logged successfully, the system updates the attendance records in the Excel spreadsheet.

8. Mailing Notification: The system sends notifications via email to administrators regarding attendance updates or any system errors.

9. Repeat Process: The system continuously repeats the process, capturing images, detecting faces, recognizing individuals, and updating attendance records as long as it's operational.

10. Shutdown: When the system is no longer needed, it shuts down all components and enters a standby state until the next operation.

V. RESULTS AND DISCUSSIONS

Attendance Management system using face acknowledgments is very simple to use and works proficiently with less time condition. The system is recording attendance more accurately and operating with more efficiency.

1. For initializing this system, admin firstly create all student profile with their name, department and other educational details. We have created a dataset of our class student for purpose of system testing.
2. When the student arrives for lectures then system automatically capture the image, detect all faces then enhance all the captured images and compared with faces that is already existed in our dataset.
3. When the all process has done then generate the marked attendance sheet of student in excel sheet format.
4. Attendance management system is recognize all images with different angles and lights, If some entered data is not in our dataset then it is stored in dataset as a unknown data.

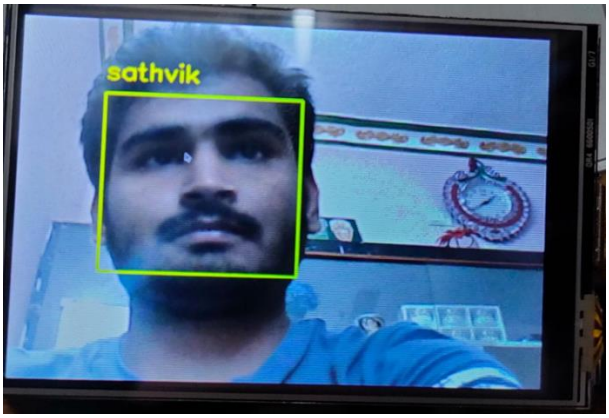


Figure 4. Face recognised by the system

The mail that the system has received is displayed in the linked figure 5.

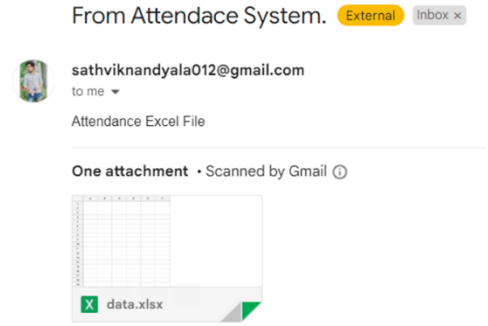


Figure 5. Mail Notification

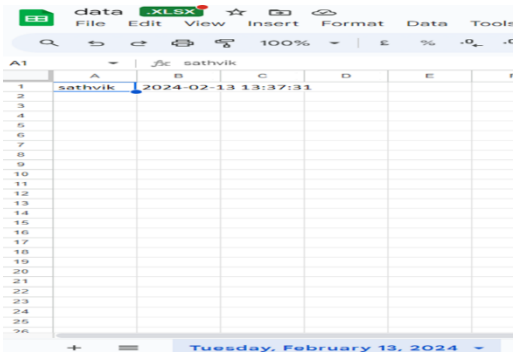


Figure 6. Face recognised person name in excel

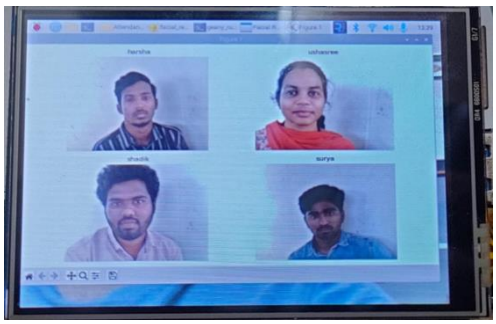


Figure 7. Absentee's images with identity

VI. CONCLUSION AND FUTURE SCOPE

In conclusion, the Automated Attendance System (AAS) utilizing Facial Recognition technology presents a transformative solution to the challenges faced by traditional attendance tracking methods. Through the integration of innovative components such as identification, capture, dataset management, input image recognition, detection, and matching, along with the utilization of Raspberry Pi, Excel update, HOG algorithms, LCD display, and mailing functionality, the system offers a comprehensive and efficient approach to attendance management. The implementation of Facial Recognition technology enables accurate and rapid identification of individuals, eliminating the need for manual attendance marking and reducing administrative overhead. The creation of a robust dataset ensures reliable recognition performance, while advanced algorithms such as HOG enhance the system's accuracy and speed.

FUTURE SCOPE

Integration with IoT and AI: AAS can benefit from integration with Internet of Things (IoT) devices and artificial intelligence (AI) systems. For example, IoT sensors could provide additional context for attendance tracking, while AI algorithms could analyze attendance data to identify patterns or anomalies.

Regulatory Compliance: As facial recognition technology becomes more widespread, there will be increasing regulatory scrutiny. Future systems will need to ensure compliance with relevant regulations and standards, such as GDPR in Europe or biometric privacy laws in various jurisdictions.

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