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An Automated Attendance Management System Based on Facial Recognition

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Abstract:
The development of a face recognition-based attendance monitoring system for educational institutions is the main objective of this automated attendance management system based on facial recognition. This will update and improve the current attendance system to make it more effective and efficient than it was before. The current, out-of-date system is highly unclear, which leads to inaccurate and inefficient attendance tracking.When the authority cannot enforce the regulations that are in place under the current system, many issues arise. To make it possible to recognize each student's face specifically, this project was created. The face recognition system will be the technology at work. One of the natural characteristics that can be used to distinguish an individual is their face. Because it is unlikely for a face to differ or be replicated, it is utilized to trace identification. In this project, data will be fed into the recognizer algorithm through the creation of image folders. Next, during the session for recording attendance, the folder containing the sought-after identify will be compared to the faces. The attendance will be automatically recorded when a person is recognized, entering the necessary information into an excel sheet. At the end of the day, the appropriate faculty members receive an email including the excel sheet containing each person's attendance information. By introducing a faculty module next to the student module, we are modernizing it to make it more functional, and the attendance records will be displayed immediately on the main page.

Keywords: Face Recognition, Attendance Management System, LBPH Algorithm, Open CV, Cascading file, Tkinter interface.

Introduction

The personnel staff should have a suitable system in place for regularly approving and keeping the attendance record in order to validate the student attendance record. The two main types of student attendance framework are the Automatic Attendance System (AAS) and the Manual Attendance System (MAS). Realistically speaking, in MAS, the staff may have trouble constantly reviewing and maintaining every student's record in a classroom.Employees at AAS may have less of a managerial role. The facial photographs of the students are often included as they enter the classroom or when everyone is seated in the room to record their attendance for an attendance system that uses Human Facial Recognition (HFR). The feature-based approach and the brightness-based approach are the two methods that have typically been utilized to address HFR.The landmarks of the face, such as the eyes, nose, mouth, edges, or other distinctive characteristics, are used in the feature-based methodology. In this manner, only a portion of the previously extracted picture is covered during the calculating procedure. Yet, the brightness-based approach combines and calculates every aspect of the provided image.It is also known as an image-based or holistic methodology. Because the entire picture must be taken into account, the brightness-based solution requires more handling time and is also more difficult. First, pictures of the kids' faces will be needed to record attendance. This picture can be taken with the camera that will be

placed in the room so that it can see the whole classroom.The system will take this image into account as an input. The image should be improved using image processing techniques like grayscale conversion and histogram equalization in order to identify faces accurately. After improving the image's quality, face detection will be used. Face identification is followed by facial recognition. The Eigen face, LBPH, PCA, and LDA hybrid algorithms are only a few examples of the numerous facial recognition techniques that are accessible. Faces are eliminated from images when they are identified by the Eigen face. The element extractor aids in retrieving different facial highlights.

Related Work

In[1] The Fisher faces algorithm was used to create patterns of the faces that were caught, and the ViolaJones algorithm was used to detect faces. This system used the Open CV library and the Software Development Kit (SDK) to create the graphical user interface. Samuel John presented the Face Recognition Attendance System with GSM Notification in[1] 2017.

In[2] Jenif D. Souza describes an Automated Attendance Marking and Management System by Facial Recognition in another article. By taking a picture of each student in the class with the camera, this method automatically recorded each student's attendance. The Histogram algorithm is used by this device. The histogram method is used to identify faces. The facial image is transformed into a matrix in this algorithm. Histograms are used to identify specific features. The issue of time consumption is solved by this method.

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 accuracyand speed.

In[4] 2019 saw the introduction of the Real Time Smart Attendance Management System Using Face Recognition Techniques by ShreyakSawhney, Karan Kicker, and Samyakjain. Using two cameras, one for face detection and recognition at the classroom door and the other for checking proxy attendance inside the classroom, this system uses a convolution neural network and principal component analysis (PCA) method for face detection and recognition.

In[5] 2016 saw the introduction of the Automated Attendance Management System Using Facial Recognition by E Vardharajan, R Dharani, S Jeevitha, and SHemalata. This system uses the Eigen Faces and Eigen Weight face identification algorithms. The camera captures the image, and the system subsequently crops the students' faces and ties them to the student database.

In[6] 2017 saw the introduction of the Attendance Management System with Gender Classification and Facial Recognition with Audio Output by Poornima S. and Sripriya N. In this system, the gender classification and Voice conversion module are used along with the Viola Jones algorithm and Principal Component Analysis (PCA) for face recognition. 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] Automatic Attendance System based on Face Recognition and Gender Classification utilising HaarCascade, LBPH Algorithm, and LDA Model was introduced in 2018 by Kritika Shrivastava, Prof. P.S. Chavan, and others.

In[8] 2017 saw the introduction of the Attendance System Utilizing Face Recognition and Class Monitoring by Prof. Arun Katara1 and Mr. SudeshV. Kolhe2. The raspberrypi was introduced in this paper. Both made use of the installed OpenCv library. Both the webcam and the

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database that are connected to the Raspberry Pi.

LBP HISTOGRAM

A detectable descriptor style called Local Binary Patterns (LBP) is used to categories computer vision. The proposed Texture Spectrum model from 1990 is applied specifically to LBP. LBP first had a representative in 1994. Since then, it has been discovered to be a reliable component for categorizing texture. In more detail, once LBP and the descriptor histogram of directed gradients are joined (HOG). For the purpose of encoding characteristics, the image is divided into cells (4 × 4 pixels in size). By employing a clockwise or anticlockwise bearing of the surrounding pixel values, it is contrasted. Each neighbor's intensity value is compared to the value of the main pixel. Depending on whether the difference is larger or lower than 0, or both, the location is given either a 1 or a 0. A single cell receives an 8-bit value as a result.

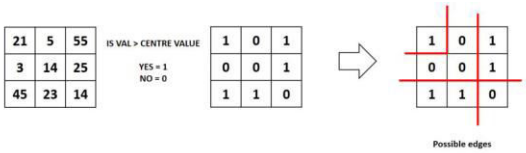

Figure 1: LBPH creating an 8-bit number

The final outcome is equivalent to the first result, regardless of how the image is illuminated. In larger cells, histograms are employed along with the frequency of values to create a robust system. By examining the findings in the cell, edges can be found as the quality varies. By calculating the values of all cells and linking the histograms, feature vectors may be obtained. Images can be categorized using ID-related handling techniques. The same process is used to classify input images, and the data set is contrasted and separated as a result. Whether it is a well-known or obscure face, it can be very accurately identified by setting a limit value. The values of the matrix in Fig. 2 when the light intensity is wavering.

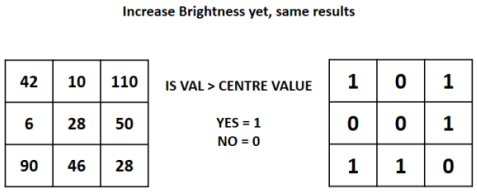

Figure 2: If the brightness changes, the results will be the same.

Methodology

The proposed face recognition method is composed of four primary modules: image acquisition, feature extraction, classifier database training, and classification. The image acquisition module first collects the face datasets. The feature extraction module is then used to extract a number of conspicuous features. These facial characteristics are utilized to examine facial landmarks that serve as indicators of human identity. The classifier is trained to recognize faces in the following step. The system recognizes a face image in the final module and retrieves personal data from a Training image folder database. Figure 3 displays the flowchart for the system.

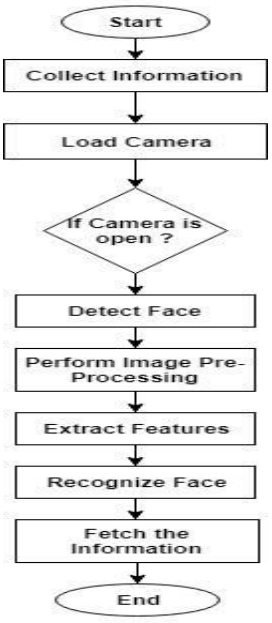

Figure 3: Face recognition system workflow

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Detection of Face

OpenCV, which introduces a Haar cascade classifier [15], is employed for face detection. The AdaBoost method is used by the Haar cascade's classifier to find various facial features in images. In the beginning, it transforms a colour image captured with the camera into a grayscale image. The Haar cascade classifier is then loaded to determine whether or not there are any faces in the image. Any time a face is recognized, additional facial characteristics are examined, and a square frame is drawn on the face. If not, it begins reading additional images. The flowchart for the detection process is shown in Figure 4.

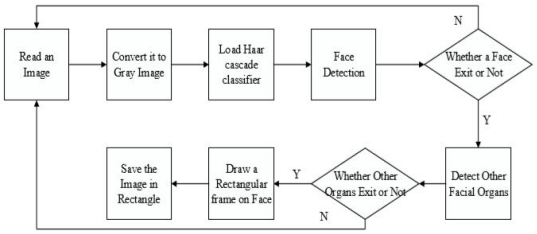

Figure 4: Face detection flow chart.

Extraction

The LBP procedure, which compares the intensity values of each component with the values of the eight pixels that are closest to it, is used to extract facial features from images. It will assign a value of 1 to its neighboring pixel if it is higher than the value of the centered pixel, otherwise it will assign a value of 0. This activity outputs an 8-bit string for each pixel. The LBP value is represented as an 8-bit pixel string's decimal value.

$$s(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases} \quad (1)$$

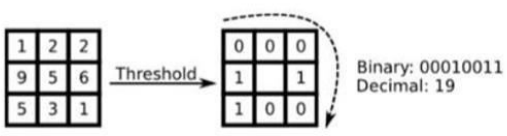

Figure 5 depicts this procedure.

After applying the LBP operation, the input image is separated into several little sub-images, and the histograms of the LBP values of each sub-image are recovered. Then, all histograms are connected to create a feature vector that represents an image and is used to train a classifier for facial recognition.

Training Images

61 unique photographs made up our own dataset, which we created. Face photos are cropped and made grey throughout the image acquisition process, and these images are then saved in the same folder to create face databases for extraction activities. In order to swiftly achieve the result of recognition, the standardisation technique is then used to all photos in order to minimise noise and set the proper image scaling position.

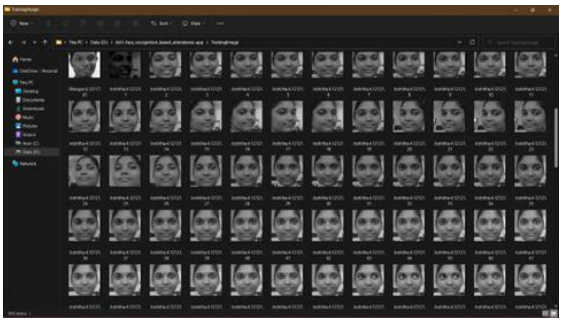

Figure 6 displays the dataset pictures.

Face Recognition

For the face recognition process, Local Binary Pattern Histogram algorithm is applied. The LBP operator uses local binary patterns to reduce the local spatial distribution of a face image [18]. The LBP operator is a collection of binary pixel value ratios in the center at regular pixel intervals and is around 8 pixels. It is shown in the below equation.

$$LBP(x_c, y_c) = \sum_{n=0}^{7} S(i_n - i_c)2^n$$

Where icrepresents the index value of the middle pixel and (xc, yc) shows 8 close surrounding pixels data.

Python is a computer language utilized to create this system. In this system, IDLE and Training image folder is employed along with the OpenCV (3.0) package. An integrated development environment (IDE), designed for the Python programming language. A Training image

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folder is integrated into the Python programming library. It is not a client-server database system, in contrast to other database management systems. It is incorporated into the final programme.
The entire project is broken down into three sections: facial detection, face image training, and face recognition. All three of these actions are carried out in IDLE, and data about a person, such as name, roll no, year, branch and section is stored in the Training image folder.

Result

First, we must get the face dataset ready for training before we can create a face recognition system. We used the Face detection approach, which recognizes faces in real time camera footage, to create a face dataset. For use in feature extraction and training procedures, the captured images are saved into a dataset folder.The device first questions the person's roll no, name, branch, year and section before opening the camera and taking 61 pictures of their face in various expressions and positions. The collected photographs are saved into a dataset folder with the same unique id as the person's information, which is saved into a training image folder. Attendance Management system using face acknowledgments is very simple to use and works proficiently with less time condition. This is the automated system so if admin created a student profile once in database then it will use automatically by the number of times in face detection and recognition process. This system is based on Haar Cascade methods. For initializing this system, admin firstly create all student profile with their name, roll number, department and other educational details.

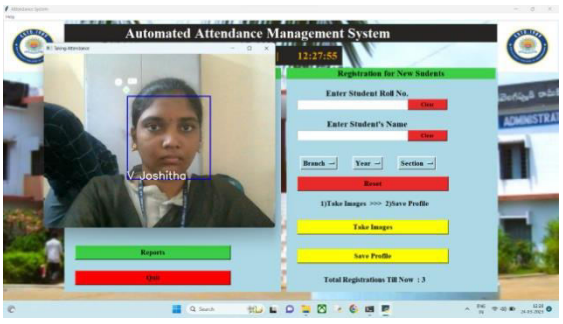

Figure 7 Face detection

The system then extracts the LBP texture features from each image in the input dataset and trains a Haar Cascade classifier on them.

Table I. Statistics of Training Images

Training Images	Time
61	10 sec

The machine then uses face recognition to complete the procedure. Before to extracting facial features from the input test face image, it first recognizes all faces in the image. The trained image dataset model and this input feature vector are then compared using the Haar Cascade Classifier. It recognizes the face and retrieves data about that image from the Training image folder. if the input test feature vector matches the training model. If a fresh face image enters the camera frame, the system can detect numerous faces in the image and identify each one based on facial attributes.

Conclusion

To provide a high level of security is the system's objective. Therefore, a highly efficient attendance system that can concurrently recognize multiple faces is required for the classroom. Furthermore, its implementation does not call for any specialized hardware. Simply incorporate a camera, a computer, and database servers to create a smart attendance system. Face detection, facial feature extraction, and image categorization are the three primary elements of the process. The face detection approach identifies a person's face in the input image. A classifier is used to compare the input image's histogram to a database's histogram during the recognition phase, and facial landmarks are extracted during feature extraction to build an LBPH histogram that produces a completely unique output. The outcome shows that the system is capable of recognizing both known and unknown individuals. The problem with the suggested method is that face recognition will be subpar if the system encounters high and persistent occlusion or if the frame's rate of change is excessively rapid. For this problem,

additional work might be considered. By using the suggested method, security organizations will be able to search anyone captured on camera and identify offenders for attendance purposes. Additionally, this system helps to lessen the possibility of proxy attendance. In the modern world, there are numerous techniques that make use of biometrics. However, facial recognition is emerging as a potential remedy due to its high accuracy and low requirement for human involvement.

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