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AN INTELLIGENT AUTOMATIC ATTENDANCE SYSTEM (IAAS) USING FACE RECOGNITION

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Abstract

In the present-day educational system, regular class attendance of students plays an important role in quality monitoring and performance assessment. The traditional method practiced in most organizations, taking attendance bypassing the attendance sheet, calling out names is both time-consuming and open to simple fraud. There are so many techniques for recognizing a person like biometric, IRIS, voice, etc. The main objective of this paper is to design and build a reliable, cost-effective Intelligent Automatic Attendance System (IAAS). Various face-recognizing techniques such as Eigenfaces, Fisherfaces, and Local Binary Pattern Histogram (LBPH) provided by the OpenCV 2.4.8 are studied and compared. IAAS marks attendance for the authorized person by recognizing the person's face and automatically posts the attendance without involving any individuals. The primary advantage of this IAAS is to automate the process of posting the attendance, avoid human intervention in posting the attendance and to avoid fake attendance and proxies.

Index Terms: *Intelligent Automatic Attendance System (IAAS), Face Detection, Face Recognition, OpenCV, Eigenfaces, Fisherfaces, LBPH*

I. INTRODUCTION

In recent years one of the highly effective biometric techniques for identifying individuals is the Face Recognition method. In the field of education, it is used to manage student participation. There are many universities and organizations where thousands of learners take up their education. In each college, the number of students that take up education is huge in number and it varies from university to university. Taking the attendance manually and also maintaining student's attendance and documents is a very challenging job. Therefore, this paper introduces an efficient system (i.e., IAAS) that will automatically mark student attendance by identifying their faces.

In this face recognition system, the process is split into different steps, but the significant steps are face detection and face recognition. Firstly, an HD camera is installed in the classroom at an appropriate place where it is possible to cover the entire classroom. The students' group image is snapped from the camera. This picture will function as input to the system. The picture is to be improved by using some image processing methods such as grayscale image conversion and histogram equalization for efficient face detection. The histogram equalization of the picture must be performed to correctly identify the learners seated in the last rows.

After the image quality has been improved, the picture will be carried to the face detection module. In the face detection phase, different algorithms are used such as neural networks, support vector machines, Ada-Boost algorithms, etc. The Ada-Boost algorithm is found to be most efficient. Therefore, this algorithm is used in IAAS to detect student's faces by using Haar Cascade classifiers.

Recognizing the faces is the next job to be accomplished after identifying the student's faces from the picture. There are numerous methods available for face recognition such as Eigenface, Fisher face, and LBPH, etc. This paper uses the LBPH method.

In LBPH, the face of each student is cropped and the multiple characteristics are identified, such as the distance between the nose, eyes, an outline of a face, etc., are extracted from them. Later, these features are converted as histograms. These are compared with the Facial DataBase (FDB) which is exclusively developed for this IAAS. FDB consists of a huge number of images of the learners which is used for the training and comparison purpose. The FDB also consists of different parameters related to the student such as roll number, the name of the student, gender,

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etc., If the student is identified, then their attendance is marked automatically in the database server using an automated application developed for this purpose.

II. BASIC STEPS IN FACE RECOGNITION

This paper focuses on image-based face recognition. The face recognition scheme is generally intended and performed in three steps as shown in Fig. 1.

- Detection of the face.
- Extracting the feature.
- Recognition of the face.

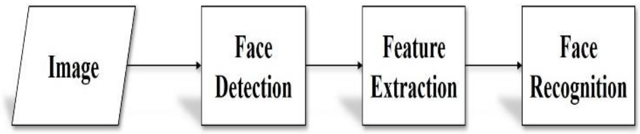

Figure 1: Basic Structure of Face Recognition

2.1 Face Detection

Face detection is a process of finding the faces and the number of faces from the input image. It checks whether the given image consists of faces or not by using Haar-like features. If the images have faces they will be detected, and the faces are cropped from the image. It is also used to detect faces in surveillance and real-time for tracking of person.

2.2 Feature Extraction

Once the face is identified, regions of the human face are removed from the pictures and sent for face recognition. There are some constraints in this feature extraction. Firstly, each region of the image consists of over 1000 pixels, which is too large to construct a powerful identification scheme. Second, facial regions can be drawn from different camera alignments, with different facial expressions, illuminations, and may be affected by occlusion and clutter. Extractions of features are performed to solve the inconveniences such as light illuminations and contrast, etc., Cleaning the noise is also performed through the extraction method.

2.2.3 Face Recognition

The last stage after formalizing each face's representation is to identify each face's entity. For immediate recognition of the faces, a face dataset is required. The dataset stores a person's face with distinct poses and stores the face's distinct characteristics as well. When the face picture is provided as input, face detection and extraction of the function takes place automatically by refereeing the face dataset. The database allows you to think if the facial input image of a person is affirmative.

2.2.4 Face Detection vs Face Recognition

Detection of the face responds to the issue, where is the face? It defines an object as a "face" and locates it in the input image. On the other side, Face Recognition responds to the issue who is this? Or who's that face? It chooses whether the identified face is an unknown or known person depending on the face database.

Therefore, it can be seen that the output of the face detection system (the detected face) is the input to the face recognition system and the output of face recognition is the recognized face (Known or Unknown).

In this paper, IAAS concentrates on face recognition to identify the ID of the recognized person and post the attendance automatically via the interface developed.

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2.3 OpenCV Face Recognition

OpenCV consists of three face recognizers built in it. Any of them can be used by simply changing a single line of code. Below are the names of the face recognizers that the embedded in the OpenCV.

- Eigen Faces Face Recognizers
- Fisher Faces Face Recognizers
- Local Binary Patterns Histograms (LBPH) Face Recognizers

This paper presents a short overview of all these three face recognizers so that the user/programmer can make a choice

- Which one to use?
- When to use?
- Which one is better?

2.3.1 Eigen Faces Face Recognizer

This algorithm takes into account the fact that not all sections of a face are equally essential and helpful. Looking at someone you acknowledge him/her by his/her separate characteristics such as forehead, nose, cheeks, eyes and how they differ. So, the focus is on the face fields that have peak change (mathematically speaking, this change is variable). For instance, there is a substantial shift from eyes to nose, and the same is the case from nose to mouth. When you look at various faces you compare these face's fields because these parts are the most helpful and significant elements of a face. It enables you to distinguish between one face and the other. This is precisely how Eigen Faces Face Recognizer works.

2.3.2 Fisher Faces Face Recognizer

This algorithm is an enhanced face recognizer variant of Eigenfaces. Eigenfaces face recognizer considers all the individuals training faces at once and discovers the main parts from all of them together. By taking the main parts from all of them together, there is no need to focus on the characteristics that distinguish one individual from the other but should concentrate on the characteristics that represent all the people in the training data as a whole.

This strategy has disadvantages, for instance, pictures with sharp modifications may dominate the remainder of the pictures. There is a high possibility that it may end up with characteristics that are like light from outside sources that are not at all helpful for discrimination. Ultimately, the main parts will depict changes in the light rather than the real face characteristics.

Instead of extracting helpful characteristics that represent all the faces of all the people, the Fisher Faces algorithm extracts helpful characteristics that discriminate between one individual with the other. This way one person's characteristic doesn't dominate the others and you have the characteristics that discriminate one individual from the other.

This is precisely how Fisher Faces Face Recognizer works.

2.3.3 Local Binary Pattern Histogram (LBPH) Face Recognizer

Like any other classifier, LBPH also needs to be trained using the Local Binary Patterns (LBP in short), on thousands of images [1]. LBP is a texture/visual descriptor, and fortunately, micro visual patterns also make up the faces. LBP characteristics are obtained from a non-face to define a feature vector that categorizes a face.

LBPH scans 9 pixels at a moment in each block (consider it as a window) and the pixel in the middle of the window is considered to be of specific importance. Then, the central pixel value is compared to the pixel value of each neighbor under the windows. It sets its value to 1 for each neighboring pixel higher than or equal to the center pixel, and it sets it to 0 for the others. It reads the updated pixel values in a clockwise order (which can be either 0 or 1) and forms a binary number afterward. Next, the binary number is converted into a decimal number, and that decimal number is the center pixel's new value. It can be done in a block for every pixel. It then transforms each block value into a histogram. So, there will be one histogram in a picture for each block. Finally, these block histograms are concatenated to form a vector for one picture,

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containing all the characteristics that are interested in. This is how the LBP characteristics are extracted and how LBPH works.

III. RELATED WORK

In [2] the author discussed that taking attendance for every period by the teacher is time-consuming and hectic. Even an advanced attendance management system maintained by the authorities in any institution is a very long and time-consuming process. Besides this, biometrics attendance is also available. These methods also take time, as every student has to form a queue to scan his thumb with a biometric device such as a fingerprint scanner. The biometric attendance can be a retinal scanner that has its pros and cons. Some attendance systems like face recognizer mark the attendance by capturing a picture taken from a camera and then comparing the faces with the facial database of the students and staff. Such automated systems will help to reduce the manual work and discrepancies in the maintenance of the attendance.

In [3] the author discussed that the academic performance of the day is affected by the attendance activity of the staff during the lecture hours. There are more existing manual attendance tracking systems to ensure that students participate without fail in the lectures. The developers always try to develop a system that minimizes manual efforts through automation. Therefore, the authors have implemented an Automated Assistance Management System (AAMS) that changes the student's attendance if he/she comes to a classroom after a while. A new hybrid classifier by modified Viola-Jones algorithm with PCA and LBP is developed for more precise performance in this project. Once a student has been identified and recognized, the system updates the entries in the college/school attendance software or in the data server.

In [4] the author discussed that the current industries and organizations use personal identification strategies, such as RFID, IRIS, fingerprint attendance identification. Among all these strategies for personal identification, face recognition strategy takes less time and is highly efficient. The flip side of this strategy involves the difficulty in implementation and continual observation in terms of updates. Face recognition has various applications in attendance and security systems. In this work, a system is implemented which marks attendance for students, industry employees and so on using face detection and face recognition. A time period is set for taking attendance and the database is automatically uploaded into the webserver through the internet connectivity. This process is carried out without human involvement. In the system, a Raspberry Pi installed with the OpenCV library and a Raspberry Pi Camera module is connected for facial detection and recognition. The data is stored in the memory card connected to Raspberry Pi and it can be accessed through the internet.

IV. IMPLEMENTATION

4.1 Local Binary Patterns Histograms

This paper discusses one of the common face identification algorithms: Local Binary Patterns Histograms (LBPH).

Face information can be divided into micro-texture pattern compositions called LBP. LBPH finds a descriptor of texture helpful for symbolizing faces. LBPH is performed in 3 phases they are
1. Face Detection
2. Extraction of features
3. Classifying the faces for recognition

4.1.1 Local Binary Pattern (LBP)

LBP is a straightforward yet highly effective texture operator that labels picture pixels by thresholding each pixel's neighborhood and sees the outcome as a binary number [5]. It was first described in 1994 (LBP) and a strong function for texture classification has since been discovered. It was also determined that when LBP is coupled with the descriptor histograms of focused gradients (HOG), the detection efficiency on some datasets is significantly improved.

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Using the LBP in combination with histograms is highly efficient as a simple data vector is used to represent the face images. It can also be used for face recognition activities as LBP is a visual descriptor. Fig 2 depicts an example of how to calculate the LBP value for a 3X3 pixel

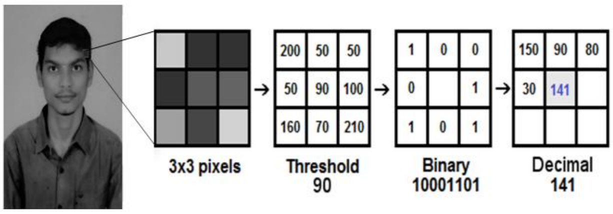

Figure 2: Example depicting the calculation of LBP Value

The step-by-step process for calculating LBP value
To understand about face recognition and the LBPH a little bit more, let's go further and see the algorithm steps:
Parameters: Four parameters are used by LBPH:

- **Radius (R):** The radius is used to build the local circular binary pattern and represents the radius around the main pixel. It is normally set to 1.
- **Neighbors (P):** The number of samples that help to construct the local binary circular pattern. Keep in mind: the more sample points you include, the greater the computational price. Usually, it's set to 8.
- **Grid X:** Number of horizontal cells. The more cells, the finer the grid, the greater the dimensionality of the resulting vector. It is usually set to 8.
- **Grid Y:** Number of cells in a vertical direction. The more cells, the finer the grid, the greater the dimensionality of the resulting vector. It is usually set to 8.

Fig 3 shows various examples of different values of P and R

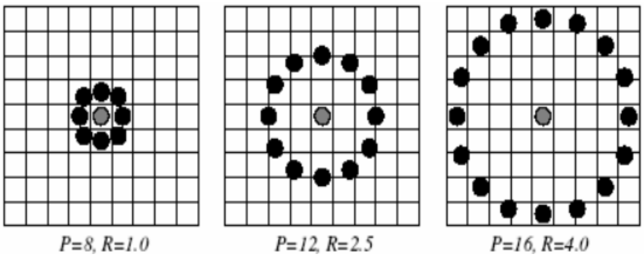

Figure 3: Figure Shows the Neighbours (P) and Radius (R)

4.1.2 Face detection

Before recognizing a face, first, it is essential to detect and extract the faces from the original image. The algorithm compares only faces acknowledging a person. Face detection is a process of finding the faces and the number of faces. It checks whether the given image consists of faces or not by using Haar-like features. If the images have faces it will be detected and a rectangular box is drawn along the boundary of the faces.

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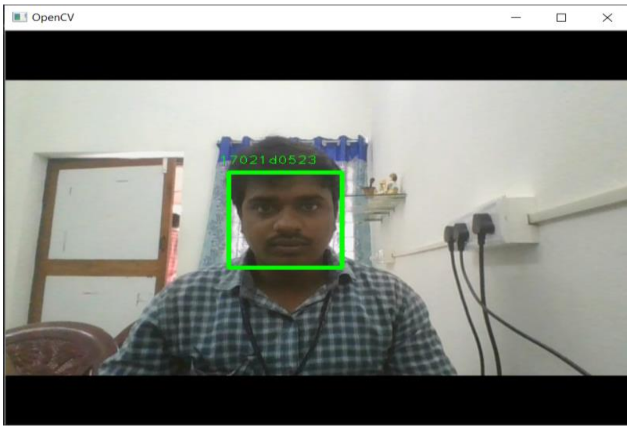

Figure 4: Face detection through webcam

4.1.3 Extraction of Features using Haar-Cascade classifier

Haar-cascade (Wilson & Fernandez, 2006) is a technique developed by Viola and Jones (Viola & Jones, 2001) that trains a learning machine to detect items in a photograph [6]. It can be used to identify faces in this context. Two significant words, Haar and Cascade, make up the name of this technique. Haar belongs to Haar-like characteristics that are a weak classifier and is used to recognize the face. A weak classifier is a slightly better classifier than random forest. A Haar-like characteristic is a rectangle divided into two, three or four rectangles as shown in Fig 5. Every rectangle is either white or black.

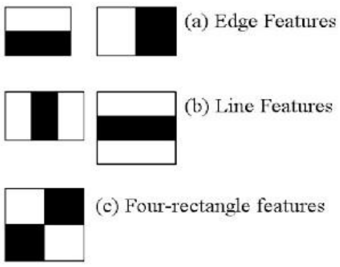

Figure 5: Different possible features of Haar

A Haar cascade needs to be trained with different positive and negative images. The goal is to separate the face from unwanted characteristics. A positive image includes the object to be acknowledged, while a negative image is a photo without the item. i.e., a positive image has a face in the face detection context, and a negative image does not.

Besides, the learning machine needs photos of grayscale. The gray intensity is used to identify which character is depicted. The gray intensity characteristics can be discovered by calculating the dark pixel amount in a region subtracted by the light pixel sum.

To detect faces in an image, the extracted mixture of characteristics from the training portion will be used. The combination of characteristics will be investigated to identify a face in an unknown image. The characteristics are endeavored to match only in a block of pixels defined by a scale. For example, the scale can be a 24x24 pixel square. Each combination function will be attempted to match in the block one by one. If one of the characteristics does not appear in the block, it will stop and the remaining characteristics will not be checked as the machine concludes that this block has no face. Subsequently, it takes a fresh block and repeats the process.

This Haar-Cascade classifier tests all blocks. The Haar-like characteristics used to detect faces with the combination of cascade for effective detection of the face in the image. It is also effective in detecting a faceless image because only a few tests need to be performed to deduce that the image does not contain a face. Consequently, a face is identified when each combination

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function has been properly acknowledged in a block. It can be seen that the eyes are darker than the cheeks and brighter in the center of the nose. All the extracted characteristics are used to discover a pattern representing a face. Block by block, the method will continue until the last one. The scale is improved after inspecting the last block, and the detection method begins again.
With separate scales, the method is repeated several times to detect the faces of distinct sizes. There are only a few pixels between two neighboring blocks. Therefore, the same face is identified in distinct blocks every time a face is identified in an image.
At the end of the whole process, all the detected faces that concern the same person are merged and considered as a single entity. The accumulation of these weak classifiers creates a face detector that can detect faces with an appropriate precision very quickly. The primary advantage of the Haar-cascade classifier is that it is trained only once. Thus, one's own Haar-cascade can be created or one already trained can be used.

4.2 Improving Face Detection

Is there any way to improve the face detection mechanism? The answer is obviously yes. By tuning the detector parameters to produce adequate outcomes, face detection can be enhanced. The following parameters can be tuned to improve face detection.

- Rate of Scale
- Number of Neighbours

4.2.1 Increase in rate of scale

The rate of increase in the scale specifies how fast the face detector feature should improve the face detection speed with each pass made over a picture. Setting the elevated rate of increase on the scale makes the detector run quicker with fewer passes. If set too high, it can quickly jump among the scales and miss faces. OpenCV's default rate of rising is 1.1. This means that each pass raises the scale by a factor of 10 percent. The parameters expect a value of 1.1, 1.2, 1.3 or 1.4.

4.2.2 Limitation on the minimum number of neighbors

The limitation on the minimum number of neighbors establishes the cut-off rate (threshold value) which helps detect the face. The threshold value ranges between zero and four.
When calling the face detector behind the scenes, each positive face region produces many hits from the Haar detector. The face region itself produces a big cluster of rectangles that overlap to a big extent. The detections that are isolated are generally fake and are discarded. The detections of various facial areas are then combined into a single detection. All this is done by the face detection feature before returning the list of faces identified. Rectangles of the merging step groups a large amount of overlaps and then finds the group's average rectangle. It then substitutes the average rectangle for all the rectangles in the group. Fig 6 illustrates the concept of overlapped rectangles.

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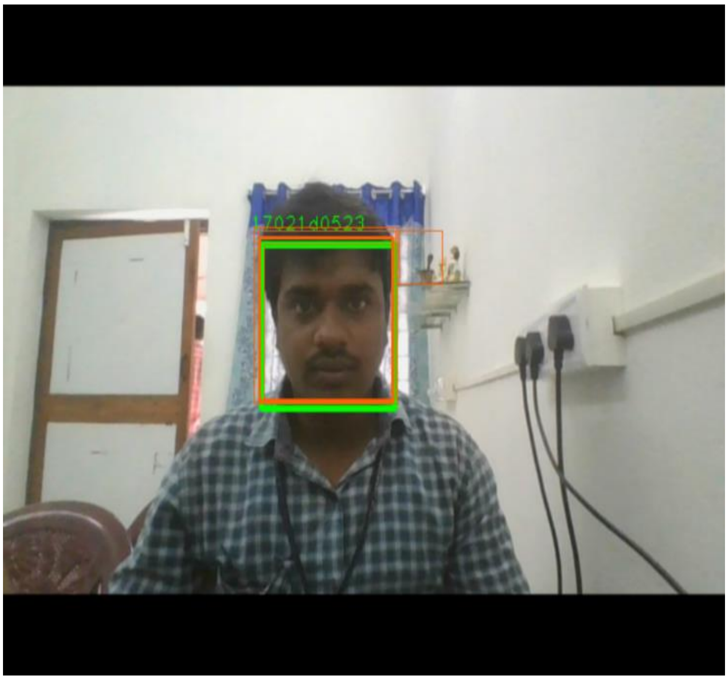

Figure 6: Illustration of overlapped rectangles

4.3 Training Dataset

Any machine learning algorithm needs a database for the training purpose. This is referred to as training data set. This training data set can be a .csv file with different attributes and values or it can be a database of images or it can be a database consisting of various voice files etc., The face recognition algorithms rely on databases/datasets that consist of various images that can vary from few images to huge set of images. The total number of images is application dependant.

4.4 **Training:**

As the first step, the LBPH recognizer must be trained. The training of the LBPH recognizer is based on the Facial Database. An ID is assigned to each picture, so the algorithm will use this data to acknowledge an input picture and provide you with an output [7]. Each person's image must have the same identity. After the training phase, the trained model is used to recognize the face.

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V METHODOLOGY

5.1 Work Flow

Figure 7: Work Flow of IAAS

Fig 7 throws an idea on the workflow that is followed in developing the IAAS. The functioning of this intelligent attendance system is very simple and easy to comprehend. The hardware components that are needed to get this IAAS work is a PC/Laptop and an HD camera. The camera needs to be installed in the classroom at an appropriate place from where the camera can cover the entire class.

Initially, the students get registered to the IAAS by providing the necessary details through a registration form. In the next step, images of the students (around 50-60 images per individual) are captured with the aid of a webcam or any HD camera and are stored in a Facial DataBase (which is referred to as FDB in this paper). The colour images of faces are extracted and converted into grayscale after detecting the faces from the images. The grayscale images are stored into the disk (FDB) and are augmented with the names/IDs of the students (The Registration Number of the students in this case).

After storing the images in the FDB the recognizer needs to be trained with this training set (FDB). After the training phase, verify the model efficiency by providing an input image. The input image (from HD camera which is fixed at an appropriate location in the classroom) will be given to the detecting module. Subsequently, each student's face will be cropped from the image, and all the cropped faces will be compared with the FDB. If the recognized face matches with the FDB image the corresponding student attendance will be automatically posted.

5.2 ALGORITHM

The algorithm described below gives the step by step functioning of the IAAS.

ALGORITHM: INTELLIGENT AUTOMATIC ATTENDANCE SYSTEM (IAAS).

INPUT: Group image captured by the HD camera.

OUTPUT: Attendance marked in the database server.

PROBLEM DESCRIPTION: Acknowledge the presence of students.

Step 1: Begin.

Step 2: **Student Registration:**

Enter the students' details into the Face DataBase (FDB) using a registration form.

Step 3: Set up a camera in the classroom in such a position that the entire classroom is covered.

Step 4: Capture an image that consists of all students (Group Image).

Step 5: Input the Group Image to the recognizer.

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Step 6: **Image Enhancement**.
6.1. Convert the input image into a grayscale image.
6.2. Generate a histogram for the grayscale image.
Step 7: **Detection of the Face**.
7.1. Crop the student faces from the Input Group image
7.2. Choose the area of concern.
Step 8: **Face Recognition**
8.1. Compare the faces that are cropped with the images of the FDB.
8.2. Post the attendance of the student in the database server if the face is recognized by IAAS else go to step 7.2
Step 9: End.

5.3 A detailed explanation of the IAAS

The following are the steps involved in IAAS:

1. Student Registration.
2. Acquisition of group image.
3. Grayscale transformation.
4. Standardization of histogram.
5. Detection of the face and the count of faces.
6. Recognition of the face.
7. Posting the attendance.

5.3.1 Student Registration:

Using their overall data and distinctive biometric characteristics, the student or individual is registered. This data will be saved in the FDB. The registration involves:
• Capturing images of the student (50-60 images per person)
• Image Enhancement.
• Extraction Feature i.e., Faces.
• Maintain Database.
The images of the student will be captured from the camera and enhanced through the equalization of histograms and noise filtering [8]. After this stage, the features will be acquired from the image. Distinctive characteristics of each student are collected in the form of a registration form as depicted in Fig 8.

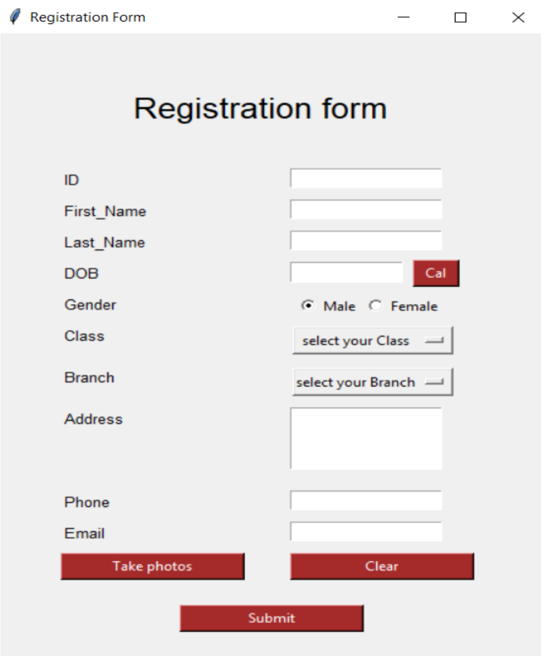

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Figure 8: Student Registration Form

5.3.2 Acquisition of group image:

An HD camera is positioned in the classroom where the entire classroom is covered. The camera captures the entire classroom picture (Group Image). This captured picture is provided to the IAAS as an input. Fig 9 shows the group image captured using an HD camera.

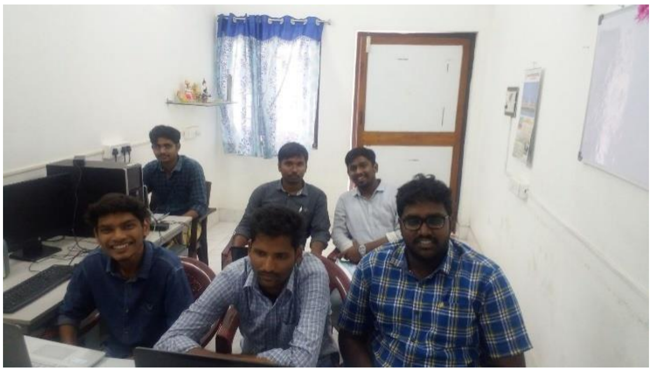

Figure 9: Captured group image through a webcam

5.3.3 Grayscale Transformation:

Sometimes the image captured from the camera may have unwanted brightness and IAAS needs the removal of this unwanted brightness for better accuracy and efficiency [9]. Therefore, the captured image is transformed into grayscale. The transformed grayscale image of Fig 9. is depicted in Fig 10.

Figure 10: Transformed Gray Scale Image

5.3.4 Standardization of Histogram:

Histogram standardization is a method used to enhance contrast. The grayscale image obtained above will be equalized to remove the contrast. This is done to make the task of identifying the learners from the backbenches easy. The resultant of this step will be an equalized histogram image as depicted in Fig 11.

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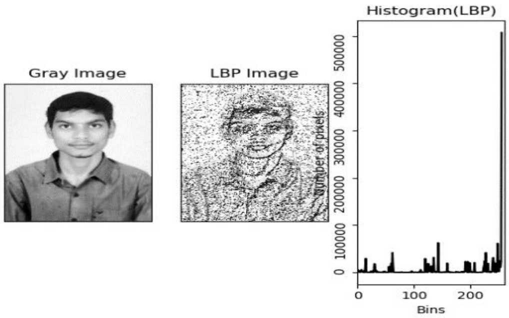

Figure 11: Grayscale image into a Histogram

5.3.5 Face Detection and count of faces detected

The picture goes to the face detection and counting module. This module detects student's faces from the picture and shows the number of faces detected. OpenCV offers a Haar cascade classifier, that can be used to detect faces. The cascade uses the AdaBoost algorithm to detect various facial features including the eye, nose, and mouth which is used for face detection purposes. Fig 12 depicts the output of the face detection module with rectangular boxes on the detected faces.

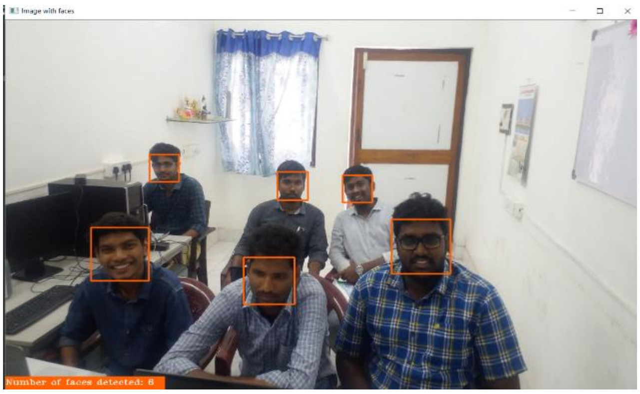

Figure 12: Output of Face Detection module

5.3.6 Recognition of Face:

The next stage after face detection is face recognition [10]. By cropping the faces from the group image and comparing them with the registered pictures in the Face DataBase (FDB), the face recognition can be accomplished. The selection of the region of interest is used for face recognition, and one by one the faces are checked using the LBPH technique. The output of the face recognition phase is depicted in Fig 13. One can observe that the detected faces are recognized with their IDs that were mapped in the first phase of registration.

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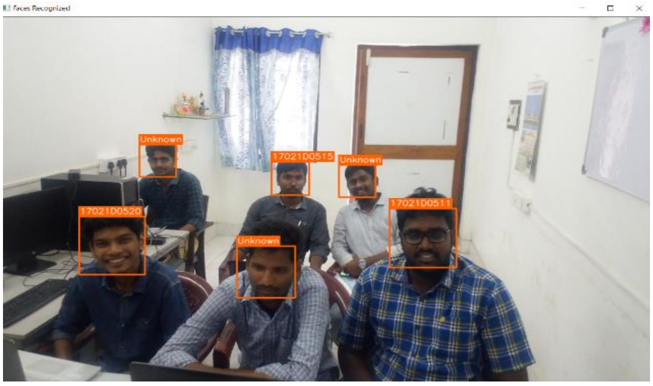

Figure 13: Output of Face Recognition Module

5.3.7 Posting the Attendance:
The attendance is marked on the database server after face verification and effective recognition has been achieved. The sample screenshot of the IAAS attendance posting page is shown in Fig 14. The rows represent the student registration IDs and the columns represent the calendar dates. It can also be observed that the number of days present and the percentage of attendance for a particular student is automatically calculated with the IAAS.

ID	01_03_19	05_03_19	11_03_19	19_03_19	20_03_19	10_04_19	05_06_19	06_06_19	07_06_19	23_06_19	PRESENT_DAYS	PERCENTAGE
17021D0520	0	1	1	1	0	1	1	1	0	1	9	69
17021D0511	0	0	0	0	0	0	0	0	0	1	1	8
17021D0515	0	0	1	0	0	1	0	1	0	1	5	38
17021D0514	1	1	1	0	0	1	0	1	0	0	8	62
18025A0562	0	0	0	0	0	0	0	0	0	0	0	0

Figure 14: Screenshot of Attendance posted by IAAS

5.3.8 Facial Dataset

The IAAS makes use of a Facial DataBase (FDB) for training purposes. To achieve more accuracy and perfection in face recognition a huge FDB is built with thousands of images that vary in pose and light illuminate from different individual persons. The IAAS FDB is created with 25000 images which are taken from 50 individual persons (i.e., each person has 50 images). Each person's images are stored in a folder with a unique folder name (i.e., the registration ID of the student). The face images of different individuals are taken in such a way that the set of snaps of each individual includes all possible facial expressions, posture and light circumstances that may be sufficient at the time of recognition. It should be possible for the camera to generate high-quality images to be stored in the FDB as a directory. A sample image set of an individual in FDB is shown in Fig 15.

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Figure 15: Sample image set of an individual in FDB

5.3.9 Performance Analysis

Fig 16 shows the Performance Analysis of EigenFace, FisherFace, and LBPH faces recognition algorithms in terms of accuracy (correct predictions). The system is tested with the sample set (500 images) of FDB created at the time of IAAS implementation. From the obtained results, it can be observed that the accuracy of Eigenface, Fisherface, and LBPH as 60%, 80%, and 90% respectively. It can also be observed that LBPH wins the race in terms of accurate predictions.

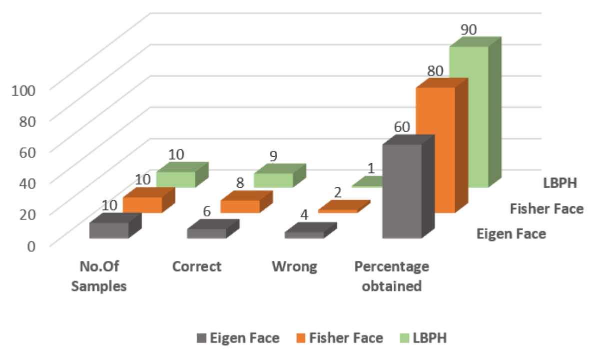

Figure 16: Performance Analysis of EigenFace, FisherFace, and LBPH

VI Conclusion

In this work, a reliable, cost-effective and Intelligent Automatic Attendance System (IAAS) was developed for automating the process of marking attendance of the participants in the classroom or any organization. The LBPH face recognizer model was used for the implementation purpose to achieve a more accurate and effective attendance system. Compared to other algorithms like EigenFace and FisherFace, LBPH is one of the simplest face recognition algorithms with the highest accuracy rate. By using IAAS it is possible to reduce the likelihood of false attendance and proxies. This Automated system had an upper hand when compared to traditional attendance systems that are currently in use as it is accurate and intelligent (automatically posts the attendance at a single click). IAAS reduces manpower and consumes less time to track the student's participation. The primary advantage of IAAS is that there is no need for any advanced hardware. The entire system was developed with one PC augmented with an HD camera.

VII FUTURE SCOPE

The current recognition system has been designed for anterior views of face images. In the future, it can be extended in such a way that it can recognize posterior faces (i.e., side faces). Also, it can be eventually improved to increase the recognition rate of algorithms when there are unintentional changes in a person's facial features like a tonsured head, using a scarf, beard, etc., The system can be enhanced in such a way that the accuracy, detection rate, and recognition rate can be increased so that a greater number of students/employees can be detected and recognized for those who are present in the class/organization. It can further be improved by embedding the capability to generate monthly attendance reports and automatically email them to the appropriate staff for review.

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