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Online Attendance Management System Using Face Recognition Techniques

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Abstract: Attendance is an important issue for every school and college because it is the primary way to monitor each student's regularity. Currently, attendance in schools and colleges is tracked using an attendance sheet, a time-consuming process that necessitates the storage of data files. We can also do other things within the allotted time for attendance. Using both simultaneously may allow the student to obtain additional information from the instructor. Keeping track of students' attendance during lecture periods has become difficult. Furthermore, because attendance is manually recorded, it is easily manipulated. It is also difficult to verify every student in the class. The standard attendance method is computerized, which provides the foundation for developing an automatic attendance management system. This system can be used to automate existing techniques and methodologies. The attendance monitoring system has simplified management's lives by making attendance marking a breeze. Face detection and image recognition are critical in various applications, including the Attendance Management System. This system detects human faces using a camera and algorithms to detect images. Captured images, face detection, database development, preprocessing, and feature extraction are used to create an automated attendance system. This type of system is applicable in any academic context.

Keywords: — Attendance Management System; Student's Regularity; Schools and Colleges; Sentiment analysis.

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1. Introduction

An attendance system is a system that is used to track the attendance of a particular person and is widely applied in industries, schools, universities, or working places. An attendance management system is an essential part of the management software that uses biometric attendance management systems, access cards, or facial detection to maintain a quick and accurate record of the students' or employees' attendance and provide timely summaries and records when needed. Using a student attendance management module eliminates the need for manual attendance, which is a time-consuming process. It saves extra effort and time that would usually go into manually marking attendance. This system is faster and more accurate than others. It avoids incorrect data entry, duplication, and helps reduce mundane paperwork. Very often, teachers need to access the attendance reports of students—either for disciplinary reasons or for parent-teacher meetings. This system paves the way to generating the reports automatically. While the manual attendance conducted daily by teachers enforces daily attendance, using this smart attendance software ensures that the arrival time of each student is accurately recorded so that the monitors tardiness and teaches students the importance of punctuality. Using an attendance management system makes it easy for parents to get alerts on days that their students are not in class. Though this is possible in a manual attendance system, it takes a lot of manual work. This system might be integrated with a database that stores all the communication data of the parents; it is easier than ever for parents to stay updated on their child's attendance. This also helps parents stay abreast of the number of classes missed by their child.

Today, attendance management is an essential requirement for every school, college and educational institute [1]. Automation of the attendance system frees teachers from doing boring tasks and saves valuable class time that can be used to teach students.

1.1 Importance of Attendance System

Attendance system is crucial for any organization. It allows to track how regular the students are and also to know about the students being absent without any reason. Few of the importance and significance of attendance management system are as below:

Helps to track the performance of students

The numbers of classes attended by a student is necessary information to know. It helps to calculate the classes attended by a student. This helps to know to which students are to be given focus by the faculty

Helps calculate the rate of absenteeism

Rate of absenteeism is necessary to observe the regularity of students. By tracking the attendance of the students, it will be helpful in knowing the students rate of absenteeism that will help the faculty know the regularity of students

Helps in maintaining accurate records

Inaccurate records of attendance, which are seldom in case, can lead to different issues. Attendance management helps with these issues. It tracks the attendance accurately which helps to reduce the excess time spent on rechecking the attendance records.

Helps in maintaining real time attendance

The use of technology enabled us to track attendance more accurately. It provides real time information regarding the attendance of students. This allows the faculty to focus more on other important work.

1.2 Types of Attendance systems

However, there are various types of available software for attendance management system and each one differs a little from the next. The various attendance systems available are:

Manual Attendance System

Manual Attendance systems are still being practiced within a huge number of schools/colleges as shown in Figureure 1.This traditional system requires the faculty to fill in their time sheets manually, for example- On all days of the week the faculty has to take attendance for every class they take [2].

It involves manual entry by the faculty and involves cumbersome work. This takes the valuable classroom time which can otherwise be used for

Figureure 1. Manual attendance system

Biometric attendance software

A biometric attendance system essentially verifies identity and captures one's time of entry and exit using his or her fingerprint. Such systems are hugely popular today and for good reason. This does away with any chances of buddy punching which leads to time leakages that can affect the productivity of a student as a whole.

Biometric systems [3] are commonly integrated with other systems to convert the data into lucid reports. This can be done with ease. Such systems have also found to be extremely cost effective as there are no cost heads apart from the actual biometric machine itself.

Biometric is a security mechanism used for providing access to an individual based on fingerprint recognition which is pre-stored in a biometric security system. Biometric systems are deployed in the workforce is to eliminate time theft.

Figure 2. Biometric attendance system

On-line attendance management software

A time keeping system that offers a web login facility is commonly known as online attendance management software. These function using cloud technology, that ensures one's attendance data can be accessed and log ins and log outs performed from virtually any location with an internet connection.

Figure 3. Online Attendance System

1.3 Advantages of using a Smart Attendance System

Below are some of the benefits of using a smart attendance system

It is a Time-Saving Process

Using software automates and optimizes the entire calculation and disbursement process that saves a significant amount of time compared to manually doing all the calculations.

Avoids making mistakes and Ensures an error free process

Mistakes in the system can be a nightmare as it not only costs the student financially, but it can also demotivate the students and cause them to lose faith in the school. However, with the help of online software, it helps to eliminate the risk of human error and ensures that no risks are being made.

It is Secure and Ensures Data Confidentiality.

Data security is imperative for all organizations, including in schools and educational institutes. A system protects the internal details of the school and keeps all the personal data such as address, student details etc. safe and secure. This confidentiality is one of the key benefits of a attendance management system as it ensures that only those with administrative rights are only provided to the appropriate users.

It Is A Cost-Effective Approach.

Attendance management system is based on the cloud and this eliminates the need to invest in various hardware such as physical servers or software packages. A smart attendance system ensures that schools/colleges do not have to invest in such laborious process of making attendance registers, thus making it a cost- effective option in the long run.

1.4 Objectives

Attendance is a part of every student's life in any educational institute. It is considered one of the metrics for promoting a student to the next higher class. There are many ways an institute takes attendance of a student. Attendance is required not only of students but also of faculty members at the institute. This attendance system helps in tracking the regularity of students in a classroom and can also be integrated with the leave management system in the institute to keep track of leaves for faculty as well.

Figure 4. Image with different attendance systems

- The main objective of Paper is face detection. It is a type of computer vision technology that is able to identify people's faces within digital images. This is very easy for humans, but computers need precise instructions. The images might contain many objects that aren't human faces, like buildings, cars, animals, and so on. It involves human faces, like facial recognition, analysis, and tracking.
- Facial recognition is the process of identifying the face in an image as belonging to person X rather than person Y.It is often used for biometric purposes, like unlocking your smartphone.
- Facial analysis tries to understand something about people from their facial features, like determining their age, gender, or the emotion they are displaying.
- Facial tracking is mostly present in image analysis and tries to follow a face and its features (eyes, nose, and lips) from frame to frame.

The remainder of the paper is organized as follows: section 2: Discuss the study's related work; section 3: Presents the Study's Background; and section 4: Discuss the Methodology of the proposed work with the proposed algorithm in the study. Section 5 discusses the study's system specification; Section 6 deliberates the study's results and analysis; and Section 7 concludes the paper with the future scope of the research.

2. Related Work

Attendance management is a major part of today's human resource systems, take organization towards better human resource practice, systems and excellence, hence regular attendance and punctuality are expected of all candidates in a work setting. Many works are being conducted in updating and upgrading the process of taking attendance with the technology evolvement. Attendance management is essential criteria to check the regularity of a student in schools, colleges and other institutions. It helps in evaluating the attendance eligibility criteria of the student. Attendance is the record that is maintained from the level of schooling to the organizations that employs an individual. Attendance

Management falls into two categories namely Conventional and Automated methods The paper proposed by Sharma, D explains different techniques used in the iris-based attendance management system. This system possesses the functions of iris recognition verifying, checking on attendances independently, and wireless communication and so on. The performance of this system meets the needs of daily attendance management in various enterprises and institutions. It has good market prospects.[4]

The finger print based attendance system proposed by Kulakarni embeds the finger authentication system based

on minutiae points which is the local characteristic of a fingerprint. [5]

The attendance system proposed by Rizwan Qureshi is based on the RFID technology. It implements RFID cards to replace student ID cards in the university environment. This system is flexible and can be extended.[6]

The QR code-based attendance system proposed by Dhruvil Shah et.al [7] results reduces the manual paper work by using QR codes to give attendance to the students. This system used MySQL database to securely store all the data repositories. The core of the attendance system is to provide a reliable and functional attendance tracking and reporting system which enables administrator to identify and rectify those students who do not meet the minimum attendance as stipulated in the policy and academic regulations.

Attendance is taken by employing an android based application and this application once installed downloads the students list from a designated web server and scan each of the student cards one by one. The device's camera will be used as a sensor that will read the barcode printed on the students' cards.

An RFID based attendance system is built by organizing the data in the database This system is user friendly as the data can be retrieved by the user interface.[8]

3. Background Study

There are different ways in which an attendance of a student can be taken. Since late 1800's, which is the beginning of using attendance management systems, there have been many changes in the design, model, usage, and applications of attendance system [9].

3.1 The first time-and-attendance system [9]

The first ever attendance system was invented in late 1800's, where the purpose was to record the time an employee works in the factory. The workers were given a time card where the time stamp was printed on a thick paper-card. This made the factory owner understand how many hours each employee is working.

Figure 5. Workers punching time for the first ever time

3.2 Manual Attendance System

Conventional method that is followed in the institutions is the manual attendance system. The manual attendance system maintains an attendance register which were physically maintained on the papers or books for seeing the regularity of the student attending the class for any educational institutions. It enables the teachers to maintain the record of students present or absent in their class for a whole academic year.

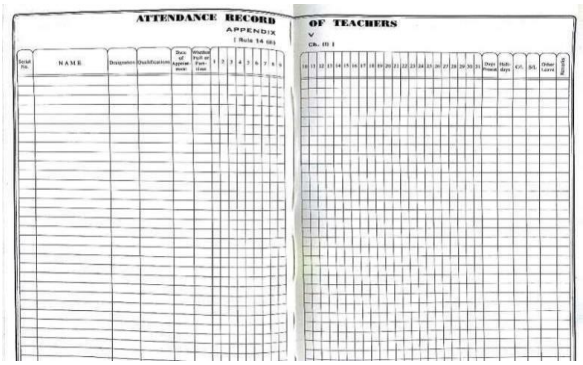

Figure 6. Attendance registers for manual attendance system

3.3 Barcode and RFID based attendance systems

Automated methods include barcode system attendance system, magnetic stripe attendance system, Radio Frequency Identification (RFID) and the finger-print based attendance system [10].

The barcode system is a common type of time and attendance system through which the efficiency of measuring and the tracking the time can be increased. With the barcode technology, the errors in manual attendance system can be eliminated.

In this system, every student is given a barcode to check in or out of the session or class. When the card is swiped on time clock, the data is captured by the clock and it is stored in the attendance records which can be managed by the administrator.

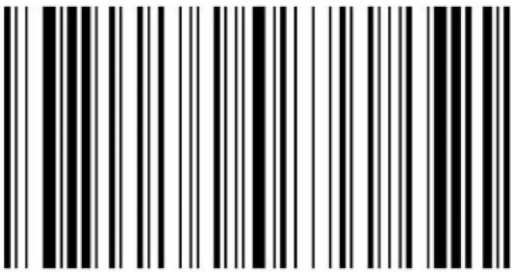

Figure 7. Barcode

RFID based Attendance System uses RFID reader to get the student information through student matrix card [11]. After getting the student information, it will send it to the computer in that class or lab. After that, the individual in charge (Professor, staff, and student) must connect to the

PC using Bluetooth to make his/her see the student attendance in that particular class.

RFID based attendance system is very time consuming and it also requires sufficient distance to read the RFID chip for marking attendance of object. RFID system also takes help of manual efforts because one person is always required for manually counting for head count of all the attendants of a system.

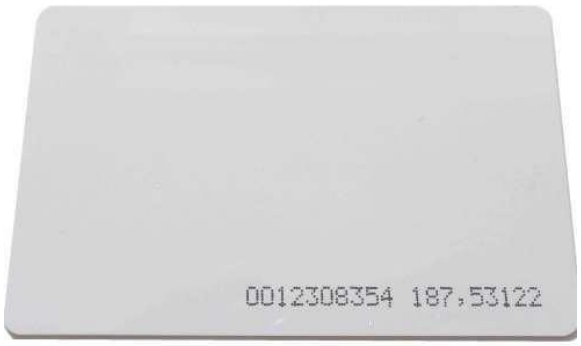

Figure 8. RFID card

3.4 Biometric attendance system

Biometric attendance systems are presently the most widely used attendance system to maintain the record of attendance. A Fingerprint Attendance System uses an enrolled finger or thumbprint to track student attendance with a high degree of non- repudiation (unlike timecard or badge systems that can be exploited by a friend swiping).

They typically use specialized hardware installations near doorways or common access points. They can also be incorporated to provide a relatively secure form of building or department access control. This system will restrict the users to clock in for other user (buddy punching).

Figure 9. Biometric attendance System

3.5 Limitations

- The manual writing of attendance on a card can be manipulated and thus the manual process has been converted into a software in recent days
- The manual attendance system enhances the punctuality of the students but there is a chance for data inconsistency and proxies and also requires manual work
- The barcode and RFID attendance systems are not secure because the system is prone to manipulation and also the cost of RFID module is more for large number of students in an institution
- Although the finger print attendance system is easy and convenient to use, it is pretty time consuming as it is placed in a common accessible place and everyone trying to give the attendance at the same time .

4. Methodology

4.1 Data set creation and Procurement:

A dataset of students is created before the recognition process. The dataset was created only to train this system. We have created a dataset of five students which involves their names and roll numbers. For better accuracy, a minimum of approximately 75 images of each student should be captured. Whenever we register a student’s data and images in our system to create a dataset, the Haar algorithm applies to each face to compute facial features and store them in the student's face data file to recall that face in the recognition process. This process is applied to each image taken during registration. An image is acquired using a high-definition camera which is placed in the classroom. This image is given as an input to the system. For storing student data, we have used OpenCV.

4.2 Proposed Work

This paper aims to use face recognition technology to identify a student and mark his or her attendance. In this paper, the author generates a report on the attendance record of the students who are present in the class. It helps by utilizing more time for teaching than for taking attendance. The image of the class is captured during the session such that there are no students missing.

The proposed system involves different steps, namely, face detection, facial feature extraction, face recognition, attendance marking and report generation .

4.2.1 Face detection

Face Detection is the first and essential step for face recognition, and it is used to detect faces in the images. It is a part of object detection and can use in many areas such as security, biometrics, etc. Faces are detected by the Haar - like features or by the circular object of some predefined radius. It is used to detect faces in real time for surveillance and tracking of person or objects. It is widely used in cameras to identify multiple appearances in the frame.

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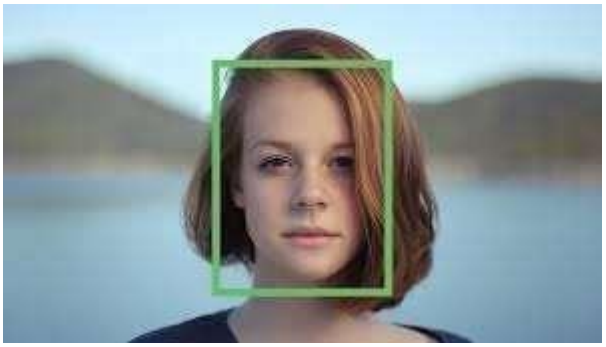

Figure 10.Bounding box over a detected face

4.2.2 Facial Feature Extraction

Detection of facial features is an essential step in applications that involve facial animation, facial expression, and face image database management. This involves identifying exact location of different features of face such as eyes, eye brows, nose bridge, mouth, chin and face edge.

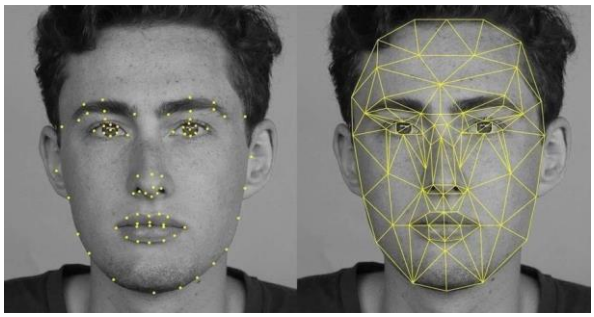

Figure 11. Feature points that are ideally considered on a face

4.2.3 Face recognition

Face recognition is a method of identifying the identity of individual using their face. These are being used in real-time systems in recent times. It is also said that the face recognition can be prone to error, if the data is not accurate while training the system. The system uses computer algorithms to pick out distinct details about a person’s face. The data collected about a face is called its template.

4.2.4 Report Generation

The process of report generation involves a tool for creating reports for its end users. In order to generate any report, you need information about what is the definition of report, report layout, what is the purpose of that report etc. Reports help in analyzing the data in a better way in statistical manner. Reports help people who are not part of the Paper understand the results of the Paper.

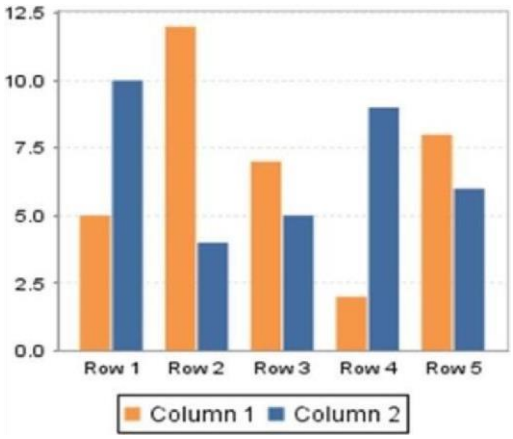

Figure 12. showing a bar graph report

4.2.5 Classification method

4.2.5.1 Cascade Classifier

Cascading classifiers are trained with several hundred "positive" sample views of a particular object and arbitrary "negative" images of the same size. After the classifier is trained it can be applied to a region of an image and detect the object in question. To search for the object in the entire frame, the search window can be moved across the image and check every location for the classifier. This process is most commonly used in image processing for object detection and tracking, primarily facial detection and recognition. The first cascading classifier was the face detector of Viola and Jones (2001). The requirement for this classifier was to be fast in order to be implemented on low-power CPUs, such as cameras and phones.

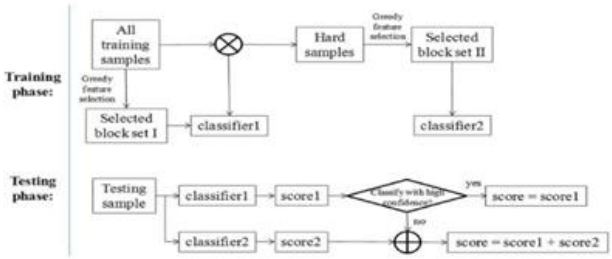

Figure 13. Picture representing cascade classifier

The main objective of the *Online Attendance Evaluation System* is to take the attendance of the students present in classroom environment. In order to capture the attendance during classroom environment, a camera has to be installed at the entrance of the classroom at a place where each student face is captured individually.

The process of working of the system follows the steps mentioned based on the architecture. The process involves in collecting the dataset of the students of the class and training the system with it, followed by testing with the image taken during the classroom environment.

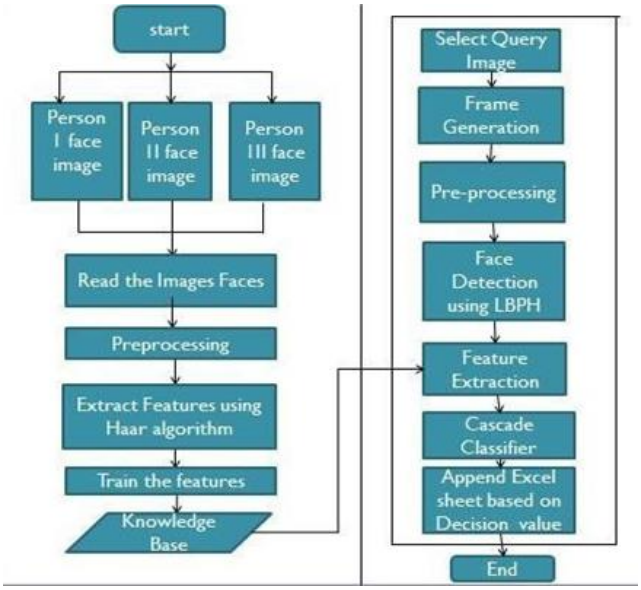

Figure 14. Architecture of the Proposed System

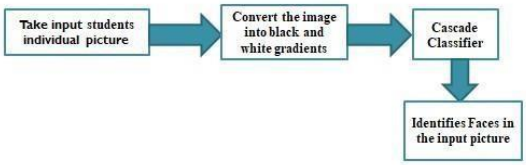

Figure 15. Face Detection Module

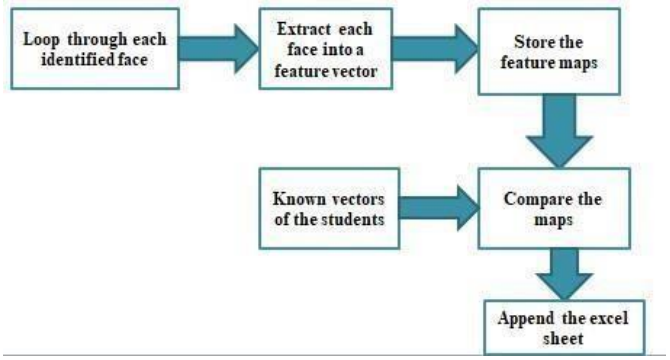

Figure 16. Feature Extraction and Recognize Module

4.3 Algorithm used

Face recognition is a technique which is used to detect the faces of students with the help of images in dataset. There are different methods that can be used for face recognition. There are Geometric based, Piecemeal based, Appearance based, Model based, Template based, Neural Network based methods, Distance Correlation based methods for face recognition [17]. The Paper has been built using different algorithms at different stages. The face detection step has used Haar Cascade Classifier for detecting the faces. The face identification and recognition are built using a Local Binary Patterns Histogram.

4.3.1 Haar Cascade Classifier (Used in Face Detection)

Paul Viola and Michael Jones are proposed the effective object detection method Haar cascade classifier. This is used machine learning based approach. From this, a cascade method analyzes from the positive and negative images. Then it will use in other images to detect objects. In here, without faces to analyze the classifier, face detection algorithm will use in that need a lot of positive and negative face images.

The haar-like algorithm is also used for feature selection or feature extraction for an object in an image, with the help of edge detection, line detection, center detection for detecting eyes, nose, mouth, etc. in the picture. It is used to select the essential features in an image and extract these features for face detection.

The next step is to give the coordinates of x, y, w, h which makes a rectangle box in the picture to show the location of the face or we can say that to show the region of interest in the image. After this, it can make a rectangle box in the area of interest where it detects the face. There are also many other detection techniques that are used together for detection such as smile detection, eye detection, blink detection, etc.

Here we will work with face detection. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. For this, Haar features shown in the below image are used. They are just like our convolutional kernel. Each feature is a single value obtained by subtracting sum of pixels under the white rectangle from sum of pixels under the black rectangle.

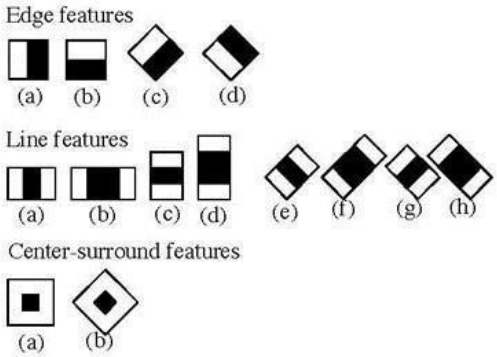

Figure 17 Features required for image processing

Now, all possible sizes and locations of each kernel are used to calculate lots of features. For each feature calculation, we need to find the sum of the pixels under white and black rectangles. To solve this, they introduced the integral image. However large your image, it reduces the calculations for a given pixel to an operation involving just four pixels.

4.3.2 Local Binary Patterns Histogram (Used in Face Identification and Recognition)

Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. It was first

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described in 1994 (LBP) and has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets. Using the LBP combined with histograms we can represent the face images with a simple data vector.

LBPH algorithm work step by step: LBPH algorithm work in 5 steps.

Parameters: the LBPH uses 4 parameters:

- Radius: the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.

Neighbors: the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.

Grid X: the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.

Grid Y: the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.

4.3.3 Training the Algorithm:

First, we need to train the algorithm. To do so, we need to use a dataset with the facial images of the people we want to recognize. We need to also set an ID (it may be a number or the name of the person) for each image, so the algorithm will use this information to recognize an input image and give you an output. Images of the same person must have the same ID.

With the training set already constructed, let’s see the LBPH computational steps.

4.3.4 Applying the LBP operation:

The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. To do so, the algorithm uses a concept of a sliding window, based on the parameters radius and neighbors.

The image below shows this procedure:

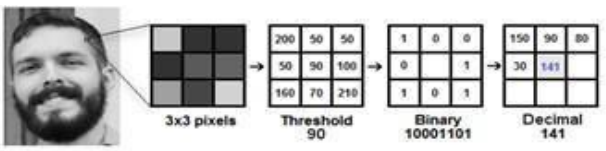


Figure 18. LBP Operation

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

- Suppose we have a facial image in gray scale.
- We can get part of this image as a window of 3x3 pixels.
- It can also be represented as a 3x3 matrix containing the intensity of each pixel

(0~255). • Then, we need to take the central value of the matrix to be used as the threshold.

- This value will be used to define the new values from the 8 neighbors.
- For each neighbor of the central value (threshold), we set a new binary value. We set 1 for values equal or higher than the threshold and 0 for values lower than the threshold.
- Now, the matrix will contain only binary values (ignoring the central value). We need to concatenate each binary value from each position from the matrix line by line into a new binary value (e.g. 10001101). Note: some authors use other approaches to concatenate the binary values (e.g. clockwise direction), but the final result will be the same.
- Then, we convert this binary value to a decimal value and set it to the central value of the matrix, which is actually a pixel from the original image.
- At the end of this procedure (LBP procedure), we have a new image which represents better the characteristics of the original image.

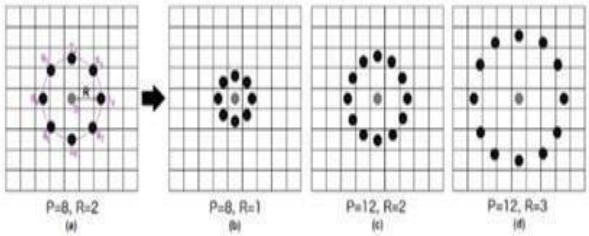
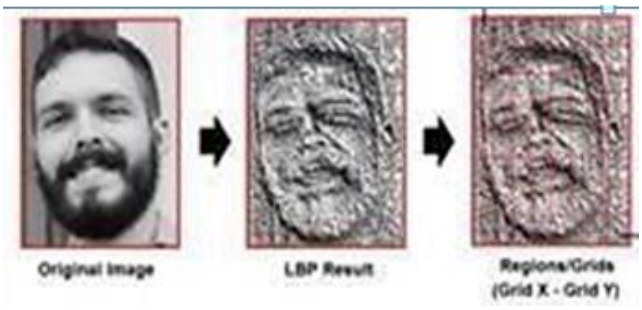


Figure 19. LBP Operation Radius Change

It can be done by using bilinear interpolation. If some data point is between the pixels, it uses the values from the 4 nearest pixels (2x2) to estimate the value of the new data point.

4.4 Extracting the Histograms:

Now, using the image generated in the last step, we can use the Grid X and Grid Y parameters to divide the image into multiple grids, as can be seen in the following image:



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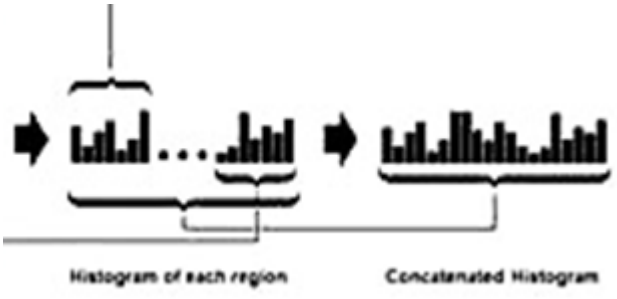

Figure 20. Extracting the Histograms

Based on the image above, we can extract the histogram of each region as follows:

- As we have an image in gray scale, each histogram (from each grid) will contain only 256 positions (0~255) representing the occurrences of each pixel intensity.
- Then, we need to concatenate each histogram to create a new and bigger histogram. Supposing we have 8x8 grids, we will have 8x8x256=16.384 positions in the final histogram. The final histogram represents the characteristics of the image original image.

4.5 Performing the face recognition: In this step, the algorithm is already trained. Each histogram created is used to represent each image from the training dataset. So, given an input image, we perform the steps again for this new image and create a histogram which represents the image.

- So to find the image that matches the input image we just need to compare two histograms and return the image with the closest histogram.
- We can use various approaches to compare the histograms (calculate the distance between two histograms), for example: Euclidean distance, chi-square, absolute value, etc. In this example, we can use the Euclidean distance (which is quite known) based on the following formula:

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

- So the algorithm output is the ID from the image with the closest histogram. The algorithm should also return the calculated distance, which can be used as a ‘confidence’ measurement. Note: don’t be fooled about the ‘confidence’ name, as lower confidences are better because it means the distance between the two histograms is closer.
- We can then use a threshold and the ‘confidence’ to automatically estimate if the algorithm has correctly recognized the image. We can assume that the algorithm has successfully recognized if the confidence is lower than the threshold defined.

5. Implementation

For Implementation Image is acquired using a high definition camera which is placed in the classroom. This image is given as an input to the system. Dataset was created only to train this system. We have created a dataset of 5 students which involves their name, roll number. For better accuracy minimum approx.75 images of each student should be captured. Whenever we register student’s data and images in our system to create dataset, Haar algorithm applies to each face to compute facial features and store in student face data file to recall that face in recognition process. This process is applies to each image taken during registration.

5.1 Training Model: After the dataset is formed, each student image is sent to extracting the facial information feature vector using Haar algorithm and store it as a known face of that particular student. This facial information is further used while testing for comparing with the unknown faces detected.

5.2 Testing Model: The testing of the system is done by capturing the image of the student during class. This image if too large is segmented into multiple images and then given to the face detection module of the system. After the unknown faces are detected, the facial information is extracted through LBPH algorithm. This is compared with the already known facial information of the students and maps with the similar face-vector. All the faces that are identified are marked present. The Testing model of the system consists of different modules, namely:

5.3 Registration Module: It takes the enrollment id and name of the student.

5.4 Face Detection Module:

After registering the images are being captured and the faces are detected. The detected face in the image is being trained and saved with the given name.

5.5 Attendance Module:

Here the system takes the subject name and recognizes the face of the person with given id and name. Attendance is being marked in the excel sheet for that subject with time and date.

5.6 Admin Module:

In this module attendance can be checked and only by authorized users. System specification for the experimental implementations is to carry out with the following requirements such as programming language Python, Spyder IDE with Open CV and Pandas Packages

6. Results and Analysis

 https://doi.org/10.22362/ijcert/2022/v9/i8/v9i801

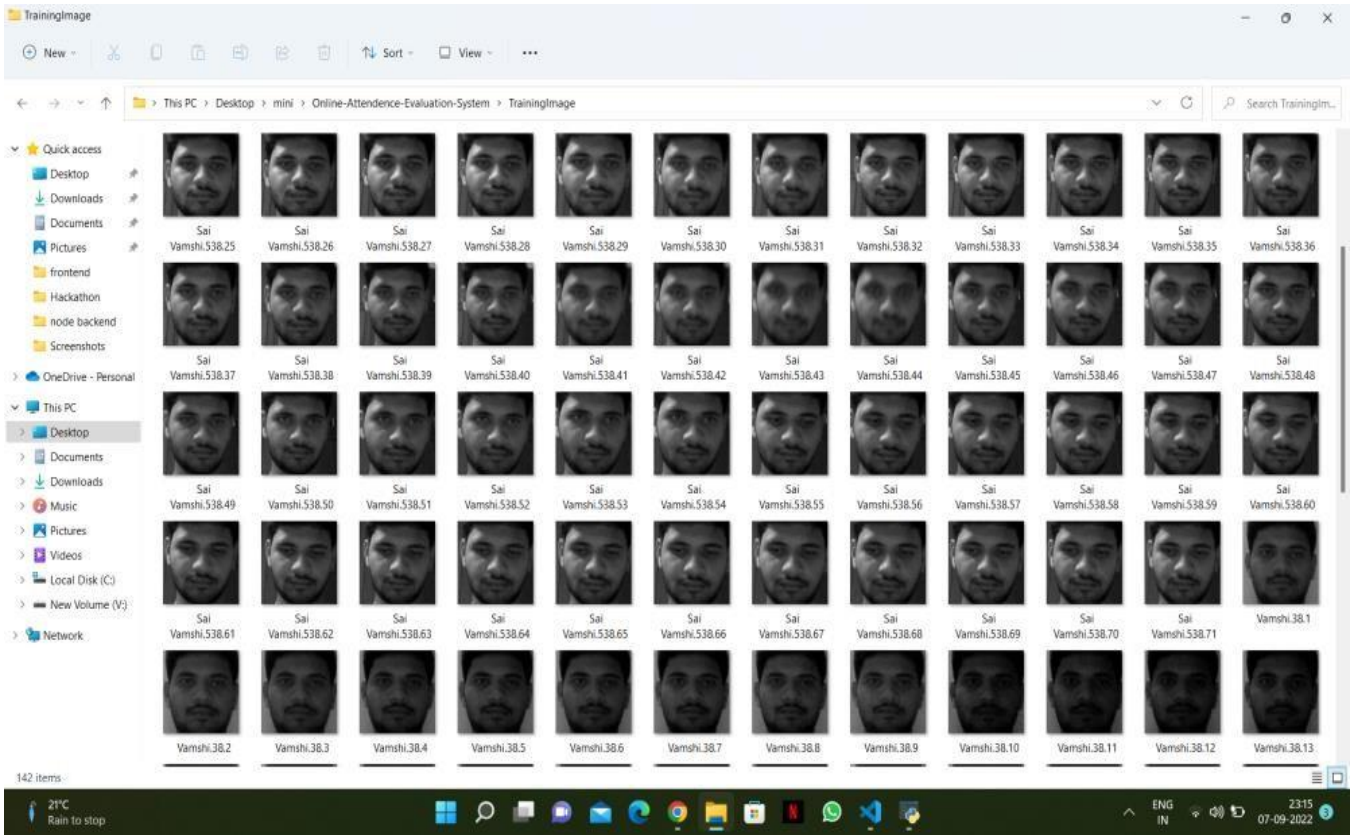

Figure 21. Outlook of a dataset folder of a single person

The database is formed by collecting images of students in a class. Each student images are stored in folder representing their roll numbers and consists of three images of a student in three different angles. One in frontal position and other two facing different directions, one slightly facing right and other slightly facing left. This window contains the list of menu items. This menu form includes Take image, Train image, Automatic Attendance and close as shown in figure 22 to 26.

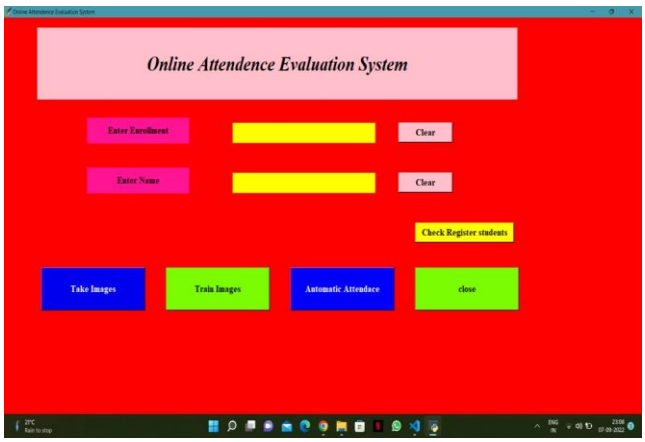

Figure 22. The menu form

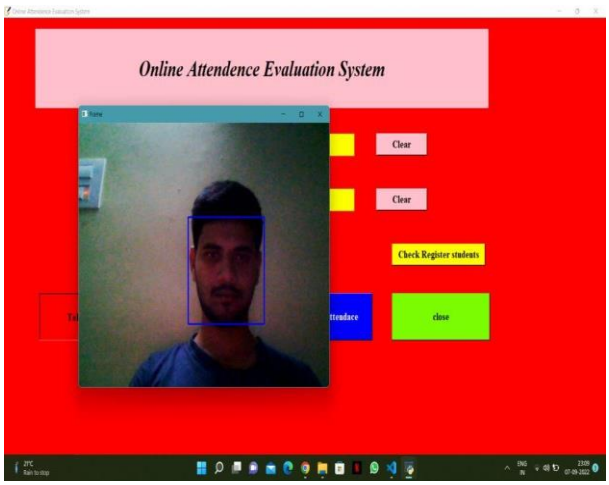

Figure 23. The face is being detected here

Face Recognition Window:

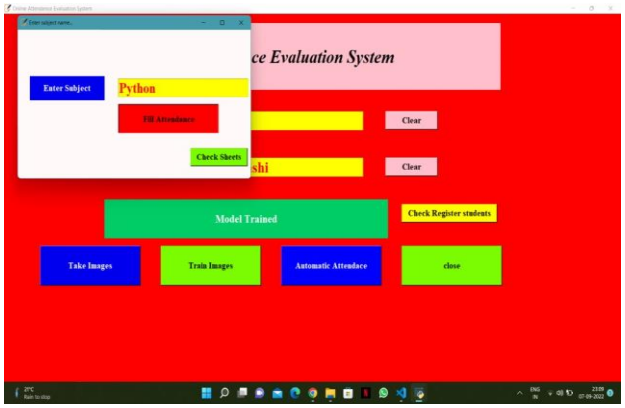

Figure 24. The window showing the details entered by the student

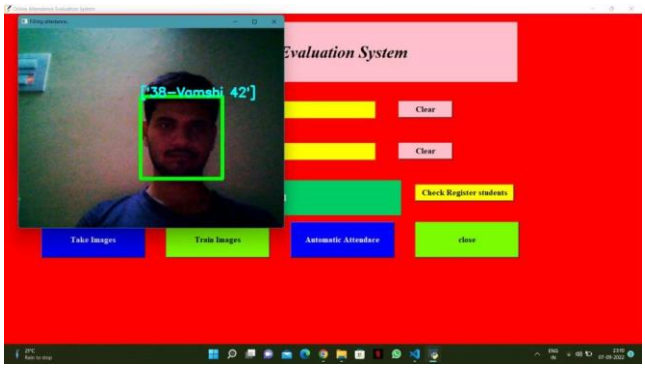

Figure 25. The face is being recognized here based on the name given by the person

Figure 26. The excel sheet generated for mention subject by the student

7. Conclusion

This paper creates a report sheet for student attendance in the classroom by taking pictures of the students in the classroom. Many experiments are being carried out in this domain to improve the accuracy as well as the image resolution for better image processing.

Many researchers have conducted various studies using face recognition for attendance systems. Face recognition algorithms can be used in a variety of ways. The way we use the algorithm depends on the area where we want to use face recognition. The primary goal of the system and basic work flow is to record attendance for students who are present in class during image capture in a classroom setting. The position of the camera is also important for this to happen smoothly. The camera should be positioned so that it can capture an image while covering the entire class. If this is not possible, it becomes necessary for the camera to rotate and picture the students.

The rotation and placement of the camera are entirely dependent on the height, width, and proximity of light-emitting sources in the classroom, such as tube lights, etc. The accuracy of the system can be increased by upholding the classifier threshold by training the system with a sufficient number of datasets of the students in the class. This increase in the threshold of the classifier might increase the precision of the system, but it might not affect the recall much.

The system, since it was built over dlib, doesn’t support the non-frontal faces of the students in a class room environment. The system might also return low precision if the threshold of the classifier is fixed too low or too low.

The Paper's future enhancement will include a classifier that is far more powerful than almost any algorithm, such as DeCNN (Deep Convolutional Neural Networks) with the dlib package or OpenCV. It allows the image to be processed by running it through a series of neural networks, which produces much more accurate results. Neural networks can effectively solve problems such as no frontal faces, brightness issues, and dynamic bounding box problems. The dynamic bounding box can also be solved with DNN and dlib (Deep Neural Network). The dlib package is preferred over OpenCV because it is entirely written in C++ and is easier to use in general.

Though CNN works on CPUs (Computer Processing Units), it gives better results when used on GPUs (Graphical Processor Units).

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