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Facial Recognition Based Attendance System Using Machine Learning

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Abstract : In the era of ever-growing innovations, it's time to ditch the mundane and outdated way of recording attendance in the educational sector, and embrace modern solutions. An attendance monitoring system will save both students and teachers a significant amount of time and effort. By differentiating the students' faces from the rest of the objects and labeling them as present, the facial recognition algorithm will keep track of attendance. The system will be pre-loaded with all of the students' photographs, and the algorithm will utilize this data to recognize individuals who are present and match their attributes to previously saved images. In today's rapidly changing technological landscape, there is no need to rely on traditional, tedious methods of attendance monitoring in the educational sector. With the implementation of an attendance monitoring system, both students and teachers can save valuable time and energy. The face recognition algorithm can be used to monitor attendance by accurately identifying each student's face from a crowd and marking them as present. The system will be pre-loaded with the images of all students, enabling the algorithm to instantly detect student presence and match their features with the images stored in the database.

Index Terms - Face Recognition,Lbph, Haar Cascade, Open CV .

1. INTRODUCTION

In the modern world, authentication is crucial for many things, including security. Facial recognition is now a key component of authentication. from the recent. Over the years, the demand for facial recognition has greatly increased. The need for face recognition is currently quite high for both financial and security reasons.

The goal of our system is to identify the face of a student, compare it to data previously stored, and capture all distinguishing features and positioning of the student.Optical character recognition can be used to mark attendance based on handwritten, printed, or typed characters. The generated recognized data may be utilized to update attendance. It takes time because this method of recording attendance requires either handwritten or typed data. Instead, if there was an attendance recognition system that directly captured the features of the face in the camera and translated them into attendance, it would further cut the time.

The haar cascade algorithm is used to put this concept into practice for facial detection and Local binary pattern histogram is used to face recognition. The data utilized to evaluate the algorithm's effectiveness were the faces of students their own age. Every time a face was recognized, the attendance was instantly recorded. When compared to manual attendance, the findings were obtained substantially faster.

2. LITERATURE SURVEY

[1] A paper published by the International Journal of Engineering Research and Technology (IJERT), titled Face Recognition incorporated with Radio Frequency Identification, in which the system keeps records of every registered student and also the details regarding the student's course and provides any information according to the need. But the major limitations of this project are data, time, and ethnic bias.

[2] In a paper published by IEEE, an OV CMOS camera is used to capture the image. A pre-trained neural network is used to get a 128-dimensional encoding representing the face's high-level features. An SM classifier is trained on a set of encoding for a particular face and used for identification / authentication. Noise removal and lighting effects are used to ensure a clear image. Video uploaded by the student in the App is used for feature extraction.

[3] This paper Face recognition technique by combining Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT) published by IEEE shows that Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT) algorithms were used to extract the features of student's face followed by applying Radial Basis Function (RBF) for classifying the facial objects. But a big fault is that this system guarantees greater efficiency when working with large images but not much efficiency with small images.

[4] Another paper was published by IEEE in which Different cameras are installed in the class at different angles.Class scenes are collected at various points in time and forwarded to the computer, where faces are removed. Throughout the presentation, the system checks each student's presence. For face detection, the Viola and Jones face detection method is utilized. PCA, LDA, and LBP are utilized in tandem. The feature is classified using Euclidean distance.Pros: -The whole class is recorded, making it simple to track the attendance of all pupils at the same time. This will also help to monitor how many students remained in the lecture throughout the lecture duration. Cons: -More cameras are needed. System should be active for the whole duration of lecture.

[5] This study is called PCA-based Facial Recognition for Attendance System, and it was presented at the International Conference on Smart Electronics and Communication (ICOSEC 2020). PCA techniques employ Eigenvectors of the convenience matrix that correspond to the biggest Eigenvalues. There is just one image of the student that is utilized and saved. For feature extraction, the Fisher face approach is utilized. These techniques leverage low-dimensional subspace to manipulate high-dimensional picture space. The biggest issue they faced was that From a single image detailed features don't get extracted which affects the success rate.

[6] The paper ”Uni stable Spaces:approach to facial recognition under uncontrolled conditions,” by Xin Geng. Most face recognition systems require faces to be entered according to certain rules, such as under controlled lighting, from a specific position, from a specific viewing angle, and without obstructions. Such systems are called facial recognition under controlled conditions. These rules limit the use of facial recognition in many real-time applications because these rules cannot be met. Real-time applications require techniques that don't require strict human control to recognize faces. These types of systems require facial recognition under uncontrolled conditions. Therefore, we propose such a system in this paper, but the system requires one image and one person per image as input.

[7] In the article Anti-Cheating Presence Systems Based on 3WPCA-Dual Vision Face Recognition, Edy Winarno predicts fraud with facial recognition-based systems, such as using a photo of an authorized person or an image resembling an authorized person. They used a dual-vision camera, also called an astereovision camera, that produces an image from each of the two lenses. After acquiring the two images, reused the semi-combining method to combine the left image half of the person withe right image half to create a single person image that can be extracted using the3WPCA method. did. This system has a fraud detection rate of 98.

[8] In this article, the authors designed and described an improvement to an image-based attendance system that captures the faces of many students and could represent the next generation of all currently dominating biometric devices. Faces are differentiated and tend to be highly variable, so there is a need to quickly and accurately recognize the structure of a student's face. The system's processing includes registering students by taking pictures and using it to set attendance. Continuous registrations required to achieve good sharp accuracy in this system. This paper describes the system and finally presents the evidence supporting the system. This project can be used in online exams for certification. Identification of the student taking the test.

3. PROPOSED METHODOLOGY

Each person's face will be photographed once by the technology. This picture will be converted to grayscale. Before sending discovered faces to the face recognition phase, image per-processing is an essential and critical activity that must be performed. The majority of facial recognition algorithms are very sensitive to lighting and a variety of other factors. In certain algorithms, the face should be in fairly constant location within the photos, for example, withe eyes in the same pixel coordinates. [10]Additional requirements include uniform size, rotation angle, hair, and cosmetics, mood (smiling, furious, etc.), and light location(to the left or above, etc.). This is why, before using facial recognition, it is critical to utilize an excellent picture pre treatment filters.

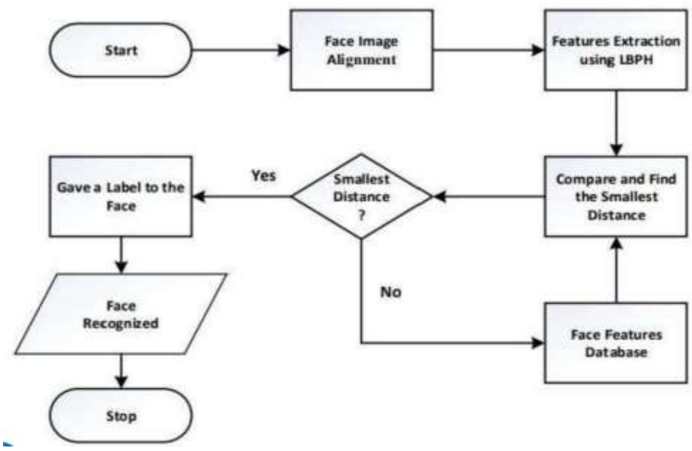


Fig 3.1 Block Diagram

4. ALGORITHM

Quick Object Recognition the Haar Cascade was first introduced as an object detection algorithm in a 2001 research study titled using a Boosted Cascade of Simple Features. It recognizes faces in still images and live video by looking at features like edges and lines. To train the algorithm, a sizable amount of both positive photos with faces and negative photos without faces is needed. . The algorithm uses machine learning to improve its accuracy over time, making it more adept at identifying faces in various lighting conditions and angles. This technology has a wide range of applications, from security systems that use facial recognition to identify potential threats, to social media platforms that use it to tag users in photos. However, there are also concerns about the potential misuse of this technology, particularly in regards to privacy and civil liberties. As such, there are ongoing debates about how best to regulate the use of facial recognition technology and ensure that it is used ethically and responsibly. Despite these challenges, the development of facial recognition algorithms represents a significant breakthrough in computer vision research and has the potential to revolutionize a wide range of industries.

Haar classifier Object detection is based on so-called haar-like properties. Instead of pixel intensity values, these characteristics use the contrast variations between adjacent rectangular groupings of pixels. This contrast comparison aids in locating the image’s borders, lines, and regions with sharp contrast variations. Two or three nearby groups are compared in terms of relative contrast variance to produce a Haar-like characteristic. This results in a straightforward method to recognize objects and features in an image.
There is a technique called integral image that can reduce the load on the system when using Haar-like features, which can total up to 160,000+. An integral image is calculated from the original image such that each pixel is the sum of all the pixels to its left and above in the original image [5].
To select the subset of features from a large set that will perform best while excluding useless ones, a feature selection technique is required. Without this method, the majority of the features are probably either random or have no relation to facial features. In order to create weak learners, the team used an Ada Boost Boosting Technique, applying each of the 160,000 features to the photos separately. Due to their superior ability to distinguish between positive and negative images, some weak learners produced low error rates. As a result, only 6000 features remained in the final feature pool. A random estimate can be outperformed by the Ada Boost Technique. [2]

The Viola-Jones face detection technique works on the premise of scanning the detector numerous times with different diameters across the same picture. Even if the image has numerous faces, many of the analyzed sub-windows will be negative (non-faces). As a result, the algorithm is designed to quickly remove non-faces and spend more time on likely face areas. Due to the computational expense, assessing each window with a single strong classifier generated from a linear combination of all the best features is not viable. Cascade classifiers employ numerous stages, each of which comprises a powerful classifier. Each step consists of a set of attributes that are used to assess whether a given sub-window is definitely not a face or if it may be. The sub-window is instantly eliminated as a face if it fails any of the steps.
Compared to Eigenfaces and Fisher faces, two popular face recognition models that are both impacted by the varying lighting of an image, LBPH is a significant improvement. By comparing each pixel to its surrounding pixels, LBPH takes into account the local structure of an image rather than considering the entire face. To use this model, the algorithm must first be trained on a set of facial image data and each image must be given an ID (e.g., a number or a name). As a result, the algorithm can identify an input image and produce an output. The radius, neighbors, grid x, and grid y are the four training parameters for the LBPH model. The algorithm can process the images and identify the person associated with a given image when these parameters are set.

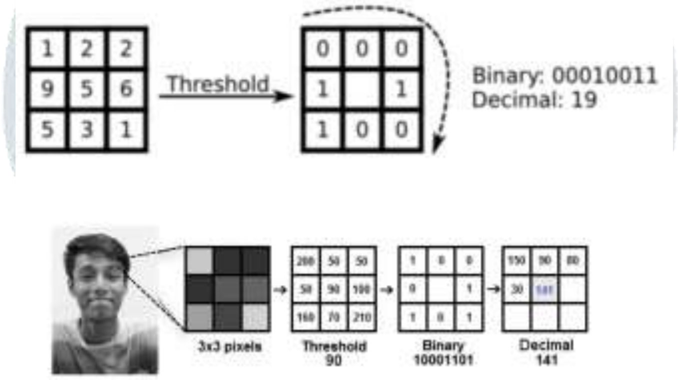


Fig 1–Local Binary Pattern with 3x3 neighbouring pixel

The initial computational phase of the LBPH involves applying the Local Binary Pattern (LBP) operation to the original image using a sliding window based on the parameters of radius and neighbour to generate an intermediate image that better describes the face traits. Let’s take a look at how to create a binary picture from a grayscale photograph of a face. To begin, we must choose a 3x3 pixel window from the grayscale image. This window may be represented as a 3x3 matrix, with each pixel’s intensity ranging from 0 to 255. The next step is to set a limit. We can achieve this by getting the 3x3 matrix’s centre value. This value will be used to calculate the new values produced from the centre value’s eight neighbour. Once we have a limit, we may assign a unique binary value to each of the core value’s neighbour s. We set 1 for values equal to or greater than the threshold and 0 for values less than the limit.

Once we have a limit, we may assign a new binary value to each of the core value’s neighbour. We set 1 for values equal to or greater than the threshold and 0 for values less than the limit. To better reflect the attributes of an original picture, the Local Binary Pattern (LBP) approach is applied. This approach entails constructing a binary value matrix (while disregarding the centre value) and concatenating each binary value from each point in the matrix line by line into a new binary value (e.g., 10001101). Different writers may concatenate the binary values in different ways (e.g., clockwise), but the ultimate result is the same. This binary value is then converted to a decimal integer and allocated to the matrix’s centre value, which is an image pixel. When the procedure is finished, a new picture is formed that better represents the qualities of the original image. [6] We can divide the image into 8x8 grids by using the Grid X and Grid Y parameters, as seen in the figure below. Each histogram will only contain 256 spots, one for each pixel intensity occurrence. By dividing the image into smaller grids, we can analyse the distribution of pixel intensities more accurately. This method is particularly useful when dealing with images that have a wide range of pixel intensities, as it allows us to identify areas of high and low contrast. Additionally, we can use this technique to compare different images and identify similarities or differences in their pixel intensity distributions. Overall, dividing an image into smaller grids and 104nalyzing its histograms is a powerful tool for image processing and analysis. It allows us to gain a deeper understanding of the underlying qualities of an image and make more informed decisions about how to manipulate or enhance it.

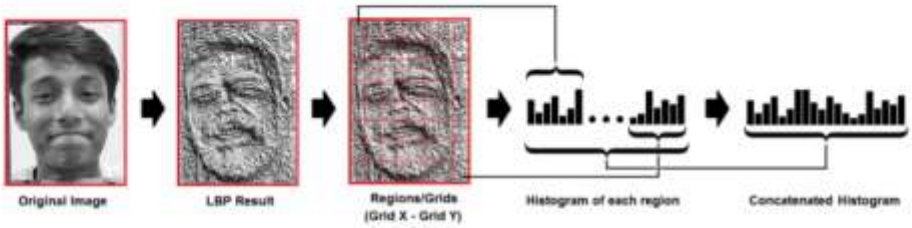


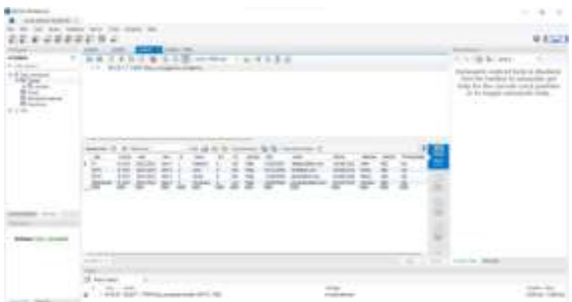
Fig 2

When we concatenate these histograms, the final histogram will contain 16,384 places, which reflects the original properties of the image. [6] At this point, the face recognition algorithm has already been trained, which means that a histogram has been generated to represent each image in the training datasets. To find the image that corresponds to a given input image, we compare the histogram of that input image to the histograms of the images in the training dateset and return the image with the closest histogram. [8] We may use a variety of approaches to compute the distance between two histograms, including Euclidean distance, chi-square, absolute value, and others. The following formula may be used to compute the Euclidean distance between two histograms:

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

The method returns the calculated distance between the images as well as the ID of the image with the closest histogram. Lower distances signify a closer similarity between the two histograms, even though the distance is sometimes referred to as "confidence." Therefore, the system can be used to automatically determine whether the algorithm successfully detected the image by setting a threshold for confidence. It can be assumed that the algorithm correctly identified the image if the confidence is lower than the threshold. [9]

5. RESULT



An accuracy of 93% was achieved and the proposed approach can be further improvised through cooperating weakly trained algorithms that can identify the faces with minimum training data and also self-learning algorithms would aid in enhancing the accuracy of the algorithm and reduce the computational time.

6. CONCLLUSION

The Attendance Management System's development makes use of machine learning to aid in target achievement. All bugs have been eradicated and the system has attained equilibrium. The system is run with excellent efficiency. The issue is resolved by the system. It was created as a need specification to solve.The system can recognize and identify the face well with an accuracy of 85% at a face distance of 40 cm from the camera with decent lighting. The results we concluded are above expectations and the system is well functioning.

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