# Attendance Management System Using Face Recognition

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***Abstract:*** Attendance recording of a student in an academic organization plays a vital role in judging student's performance. As manual labour involved in this process is time consuming, an automated Attendance Management System (AMS) based on face detection and face recognition techniques is proposed. A Face recognition system is an application of computer vision and image processing which is capable of performing two major tasks of identifying and verifying a person from an image or a video database. The main objective is to automate the attendance system by integrating the face recognition technology using modified Local Binary Pattern (LBP) and Support Vector Machine (SVM) algorithm with Matlab Graphical User Interface (GUI). Once face detection and feature extraction is performed by using viola jones and LBP, then the image is further moved for recognition. If the image is recognised then the attendance of student is marked as present in the data base, else it marked as absent.

***Index Terms*** **- Face detection, face recognition, LBP, SVM, Viola jones algorithm.**

## INTRODUCTION

Traditionally student's attendance is taken manually by using attendance sheet, given by the faculty member in class. The Current attendance marking methods are monotonous & time consuming. Manually recorded attendance can be easily manipulated. Moreover, it is very difficult to verify one by one student in a large classroom environment with distributed branches whether the authenticated students are actually responding or not. The proposed system consists of a high resolution digital camera put on door to monitor the classroom or office room. The data or images/video obtained by the camera are sent to a computer programmed system for further analysis. The obtained images are then compared with a set of reference images of each of the students or employees and mark the corresponding attendance. The system also provides for continuous monitoring of the classroom by an operator if needed. The camera module can be a wireless or wired system. Attendance Management System (AMS) using face recognition based on face detection and feature extraction, which is satisfied with the security and convenience, and plays an important role in the dynamic attendance monitoring, security and other aspects.

## LITERATURE SURVEY

Class participation enrolment system based on face recognition [1] which gives new method of achieving automatic enrolment based on face recognition with the use of android application. Considering the accuracy and speed they have used haar classifier for face detection, Visual Graphic Group (VGG) model for face recognition including illumination preprocessing algorithm. This system can achieve l00% accuracy under good illumination. Under the environment of poor illumination, the accuracy is 85.9%, but the accuracy can reach more than 90% through preprocessing. When the illumination is poorer, the accuracy of the recognition decreases, and the accuracy is slightly improved after preprocessing. This system also has some drawback, such as the attitude and expression of individual changes a lot when take photos which will have a certain effect on the face recognition results. And when the illumination is too poor, the accuracy of this system is not constant.

Attendance management system using hybrid face recognition techniques [2] which uses modified viola-jones algorithm and free partial face recognition algorithm for face recognition for face detection for high accuracy. The method uses Gabor Ternary Pattern (GTP) for robust and discriminative face recognition. This system improves the existing attendance recording system by avoiding manual recording of attendance. The efficiency of face recognition depends upon the number of faces detected. The higher the detected faces the higher the face recognition rate. The percentage of detected faces is 95% and percentage of recognized faces is 47.36% and it keeps changing for each frame.

An efficient automated attendance management system based on Eigen face recognition [3]. Attendance Management System is integrated by the face recognition technology using Eigen face database and Principal Component Analysis (PCA) algorithm with Matlab Graphical User Interface (GUI). By using PCA technique facial characteristics are extracted from the database. By calculating distance between feature vectors, the test image is compared with the training image. The PCA approach requires full frontal image is to be hand over each time else the performance is reduced. Here histogram equalization technique is used to direct the contrast of image depending on the threshold value the accuracy of the image is compared i.e. recognized image and test image

are compared with the resemblance score with respect to threshold score. If matches then face are recognized else the face is not recognized.

The use of asymmetric local binary pattern for facial expression recognition along with the modified convolution techniques [4]. The use of AS-LBP results in high rate of face recognition without the loss of appearance information. The face image is detected with the help of viola and jones face and eye detectors. Support vector machine is used to identify the facial expression which has high accuracy. The face recognition rate increases when the width is greater than the height of the operator and results in maximum of 95.71% for 13x3 and 15x3 sizes with an exception for 5x7 size. When the width and height of the operator is equal (observe diagonally from top left to right bottom) the face recognition rate will not increase, though there is an increase in the operator and 79.46% on FGNET database for the size 15x7. It is inequitable to compare with same work performed using LBP as the face recognition rate is dependent on some parameters such as image size, image sub-region size, databases used, classifier parameters.

Face Detection and Recognition Using Skin Color [5]. The performance of face detection, which uses skin color division with thresholding skin color model combined with AdaBoost algorithm. The facial properties extraction is obtained with the help of Principal Component Analysis (PCA) and K-Nearest Neighbor (KNN) based classification. Additionally, they have used Morphological Operators to improve the face detection performance. Some images for which the expected results have not been reached are no proper orientation of faces, image illumination is not good and if the distance of faces from the camera is different. For very few images that vary in the high level of orientation are not detected and recognized properly. This gives around 96% recognition rate for the available database.

## SYSTEM DESIGN

AMS undergoes mainly three processes such as face detection, feature extraction and face recognition. modified viola-jones algorithm detects the face. Face detection uses haar classifier with high accuracy, features extraction is obtained using LBP followed by SVM for the classification of features. The flow of the system design is as shown in the figure 1.

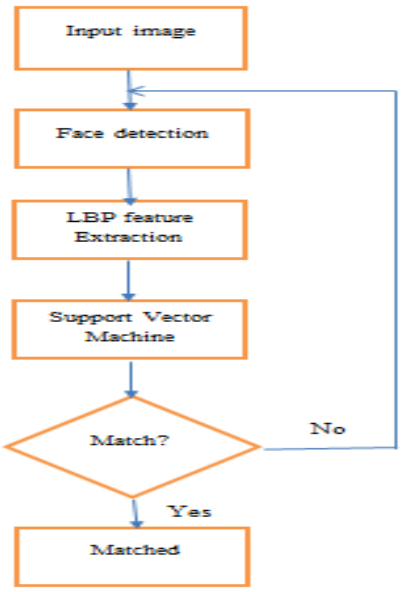


Figure 1: Flow diagram of Attendance Management System using face recognition.

### A. Face detection

Haar classifier based method is chosen for face detection owing to its high detection accuracy and real time performance. Haar like features encodes the difference in average intensity in the different parts of the image and consists of black and white connected rectangles in which the value of the feature is the difference of sum of pixel values in black and white regions. Haar like features can be found out at different scales and positions which are robust for detection purpose. The computational speed of the feature calculation is increased with the use of Integral image. The number of Haar features available from a small image is very large. The optimal set of features to be used and their corresponding thresholds to be used for classification is obtained from AdaBoost algorithm.

**B. Feature Extraction**

Selection of the feature vector is the most important part in a pattern classification problem. The inherent problems related to image classification include the scale, pose, translation and variations in illumination level. The feature vector extracted should be invariant to these problems to achieve better accuracy in classification. LBP based feature extraction method is used owing to its excellent light invariance property and low computational complexity. The neighbourhood values are threshold by the centre value and the result is treated as a binary number. In this way, it encodes the neighbourhood information very efficiently.

**C. Classification**

To classify the feature obtained from the LBP technique, multi class Support Vector Machines (SVMs) are used. SVM have developed from Statistical Learning Theory. They have been widely applied to fields such as character, handwriting digit and text recognition, and more recently to satellite image classification. SVMs, like ASVM and other nonparametric classifiers have a reputation for being robust. SVMs function by nonlinearly projecting the training data in the input space to a feature space of higher dimension by use of a kernel function.

**IV. VIOLA JONES ALGORITHM**

The Viola-Jones face detector contains three main ideas that make it possible to build a successful face detector that can run in real time.

There are four main parts in this method:

1. Integral images

2. Haar-like features

3. AdaBoost

4. Cascading classifier

**A. Integral images**

The first step of the Viola-Jones face detection algorithm is to turn the input image into an integral image. This is done by making each pixel equal to the entire sum of all pixels above and to the left of the concerned pixel. This allows for the calculation of the sum of all pixels inside any given rectangle using only four values. These values are the pixels in the integral image that coincide with the corners of the rectangle in the input image.

formal definition:

$$ii(x,y) = \sum_{x' \le x, y' \le y} i(x',y')$$

Recursive definition:

$$s(x,y) = s(x,y-1) + i(x,y)$$

$$ii(x,y) = ii(x-1,y) + s(x,y)$$

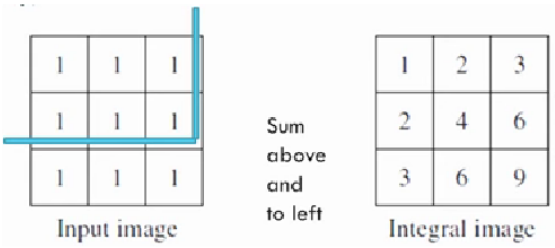


Figure 6: Example of integral image [1]

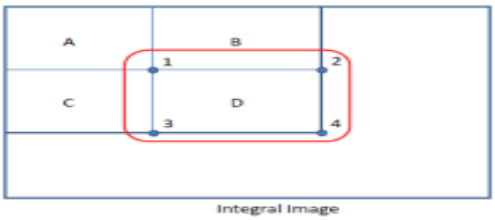


Figure 7: Example of integral images calculation for inside pixels [3]

**B. Haar-like features**

Haar features are similar to convolution kernels which are used to detect the presence of that feature in the given image. Feature set is obtained by subtracting sum of all the pixels present below black area from sum of all the pixels present below white area.

Value = Σ (Pixels in White area) –

Σ (Pixels in Black area)

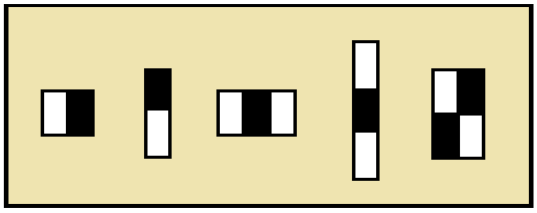

Figure 8: Some of haar like feature

**C. AdaBoost**

Viola jones algorithm uses 24x24 windows as the base window size to start evaluating these features in any given image. If it is considered all possible parameters of the haar features like position, scale and type it end up calculating about 160,000+ features in this window.

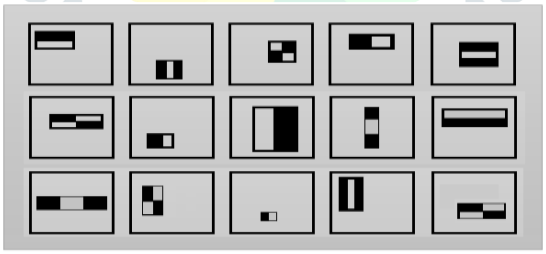

Figure 9: AdaBoost feature selection

As stated before there can be nearly 160,000+ feature values within a detector at 24x24 base resolutions which is to be identified. But it is to be understood that only few set of features will be useful among all these features to identify a face which is as shown in figure 9.

**D. Cascading classifier**

The basic principle of the Viola-Jones face detection algorithm is to scan the whole image by consecutively increasing the scanning window size so that the whole image will be covered. Even in an image there is a probability that it may contain one or more faces due to an excessive large amount of the evaluated sub-windows would still be negatives (non-faces).So the algorithm should concentrate on discarding non-faces quickly and spend more on time on probable face regions. Hence a single strong classifier formed out of linear combination of all best features is not a good to evaluate on each window because of computation cost. A cascade classifier is composed of stages where each stage has certain no of features grouped each containing a strong classifier which is as shown in figure 10. The job of each stage is used to determine whether a given sub window is definitely not a face or may be a face. A given sub window is immediately discarded as not a face if it fails in any of the stage.

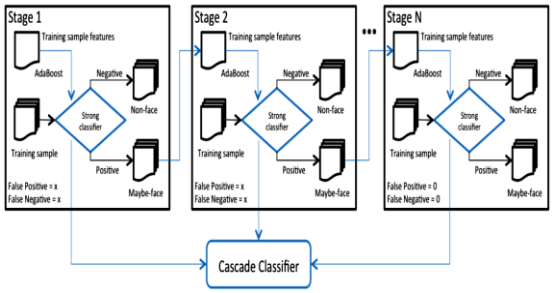


Figure 10: Cascade work flow

## V. LBP FEATURE EXTRACTION

In recent years, LBP features analysis has been extensively used across various different fields and for establishing classification groups based on age/gender for detection and recognition applications. Different advancements of the original LBP have been established for improved high performance feature selection, i.e. it overcomes the most discriminative and complex problems effectively. LBP, a non-parametric method providing tolerance against the monotonic illumination changes has been used in retrieval of audio/video content. It represents the local structures of an image by calculating the histogram efficiently, and has the ability to summarize the histograms across various different blocks of an image increasing interest for facial representation recently in aerial analysis and inspection fields. The LBP operator was originally designed for texture description. The operator assigns a label to every pixel of an image by thresholding the 3x3-neighborhood of each pixel with the centre pixel value and considering the result as a binary number. Then the histogram of the labels can be used as a texture descriptor.

### E. LBP Calculation and facial representation

The idea behind using the LBP features is that the face images can be seen as composition small patterns which are invariant to grey scale transformation. Combining these small patterns, a whole description of the face image is obtained. The original LBP operator labels the pixels of an image by thresholding the 3-by-3 neighbourhood of each pixel with the centre pixel value and considering the result as a binary number figure 11 shows an example of LBP calculation.

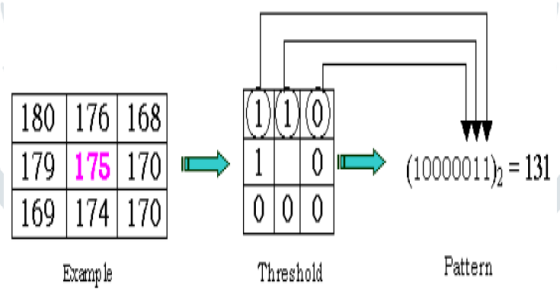


Figure 11: Example of LBP calculation

Each face image can be considered as a composition of micro-patterns which can be effectively detected by the LBP operator. The histogram of LBP calculated over the whole face image encodes only the occurrences of the micro-patterns without any indication about their locations. To also consider the shape information of faces divide face images into M local regions to extract LBP histograms. The face images are divided into M small non-overlapping regions R0,R1,...,RM in order to collect the shape information. The LBP histograms extracted from each sub-region are used for calculation and combined into a single, histogram with spatial advanced features defined as:

$$H_{i,j} = \sum_{x,y} I(f_l(x,y) = i) I((x,y) \in R_j)$$

Where i=0,...,L-1,j=0,...,M-1.

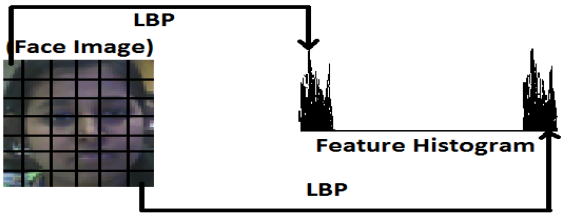


Figure 12: LBP based facial representation

In the figure 12, it is observed that the description of the face on three disparate levels of locality, the labels for the histogram contain information about the patterns on a pixel-level, the labels are added over a local region to produce information on a local regional level and the regional histograms are combined to build a global description output of the face.

## VI. SVM CLASSIFIER

Support Vector Machine is a machine learning method which is widely used for data analysing and pattern recognition. The main idea of SVM is to classify the data by drawing line called hyper line. This line separates the data sets to indicate which class it belongs to.

A binary class supervised classification problem is usually formulated in the following way: given n training samples (< xi >,yi) where < xi > =(xi1,xi2,.....,xim) is an input feature vector and yi ∈ {−1,+1} is the target label, the task of the discriminant function or a classifier is to learn the patterns in the training samples in such a way that at a later stage it can predict reliably a yi for an unknown xi . SVM is fundamentally developed for such binary classification case and is extendable for multi-class situation. Like other linear classifiers, it attempts to evaluate a linear decision boundary (assuming that the data is linearly separable) or a linear hyperplane between the 2-classes. Theoretically, when the data is linearly separable, there exist possibly an infinite number of hyperplanes which can correctly classify the training data. SVM, unlike other classifiers of its kind, strives to find out an optimal hyperplane. It is commonly believed that points belonging to the two data classes often lie in such a way that there is always some margin" between them. SVM attempts to maximize this margin by considering it as a quadratic programming problem, see [4], [5] for mathematical formulation and derivation of the solution.

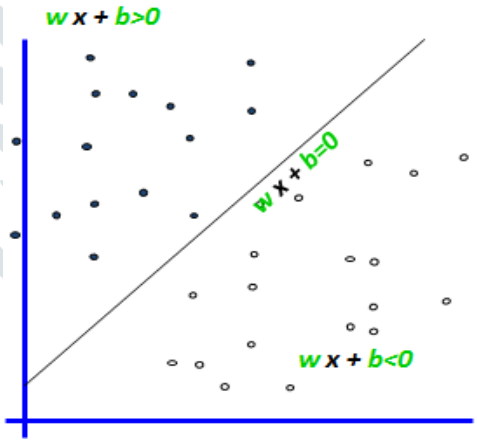


Figure 13: SVM representation

## VII. IMPLEMENTATION

To implement his system a high definition camera is to be placed in a classroom such that it covers entire class. Their exist two cases to implement this system that is, train case and test case. In the train case, first the camera should be initialised by matching IP address of the system and the camera through Wi-Fi. Then capture the image and algorithm detects the face and the details of student is to be entered and update to the database. In the test case, f or every session the attendance of the students is to be cleared before taking the attendance. Care must be taken about IP address of the camera and the system. Start the camera it will detect the faces and recognise the respective students and automatically attendance is updated in the database. This can be viewed in the view log This is as shown in figure 14.

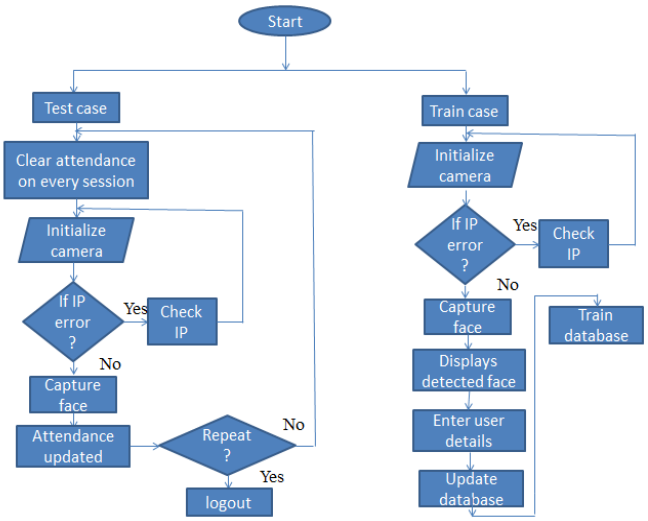


Figure 14: Implementation flow of AMS

## VIII. RESULT

Face detection and face recognition is the most challenging task and it is successfully achieved in this system. The usage of the viola jones algorithm successfully detects the faces, LBP performed feature extraction which helped in extracting the features of the detected faces. The extracted features are completely utilised by the SVM for the recognition of the respective faces. All these are combined and designed the AMS which successfully marked the attendance of the students by recognising the detected face. This system completely replaces the current attendance marking system. In the figure 15 shows the attendance of all the students. In figure 15 the number of registered students is 2 and for each hour the attendance of the students is marked and it also gives the individual attendance information for each session.

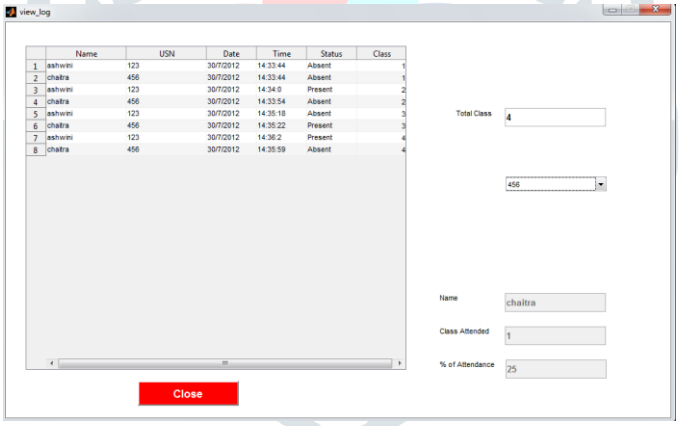


Figure 15: Screenshot of the Attendance marked in AMS

## CONCLUSION

Attendance of the students is marked successfully with the help of face recognition. Along with the challenges such as bad illumination and image orientation faces are detected, recognized and attendance is updated. This system detects and recognizes all the faces which is given as input without the loss of information.

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