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A Simple and Efficient Automatic Attendance Management System (SEA^{2}MS)

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ABSTRACT: Student's attendance places an important role in evaluation of their academic performance particularly in the learning strategies that influence the bloom learning outcomes in most of the educational institutions. A high participation rate in the classroom is not only improve their subject knowledge and a motivating factor for teachers and contributes to a suitable environment for more willing and informative teaching. The faculty are finding trouble in both checking and keeping up every understudy's record in the homeroom condition on customary basis using manual attendance system (MAS), especially in a large number of students with distributed branches and leads prone to mistakes / fraud. It is very challenging task to the management of any educational institutions to overcome the above problems. There are various papers are available in the literature, but most of them are concentrated on only face recognition and with their college environment. In this paper, a simple and efficient automatic attendance management system using Principle Component Analysis (PCA) based facial recognition technique is proposed. The authors demonstrate, how face recognition can be used for an effective attendance management system that automatically record the presence of an enrolled students for a section of 47 students in the department of ECE at KL University. The proposed system can maintain a log file to keep records of all the students' attendance and useful for both faculty and management to process without any mistakes and delay. The experimental results show the effectiveness of the proposed algorithm. The results show that the productivity of the proposed work.

Keywords: Automatic attendance system, Euclidian distance classifier, Face recognition, Principal Component Analysis (PCA), Voila-jones Algorithm.

I. INTRODUCTION

In most of the educational institutions, student's attendance places an important role in evaluation of their academic performance particularly in the learning strategies that will influence the Bloom learning out-comes [1]. Student participation in the classroom leads to effective learning and gaining the basic knowledge of core subjects that leads to high success rates in examination and in- turn placements or higher studies. Further, a high participation rate in the classroom is a motivating factor for teachers and contributes to a suitable environment for more willing and informative teaching [2]. The most common practice known to increase attendance in a course is recording the attendance in the attendance registers regularly in the classroom, referred to as manual attendance system (MAS).In practice, by MAS, faculty / staff are finding trouble in both confirming and keeping up every understudy's record in the study hall condition on ordinary premise, regard-less of whether the validated understudies are really reacting or not, especially in a large number of students with distributed branches and leads prone to mistakes/ fraud. Moreover, more than 20% of lecture hours will be wasted in this process. In practice, MAS process consumes more opportunity for recording and figuring the normal participation of each selected understudy to finalize the detention list at the end of the semester. The university / college / school is required to maintain the attendance data of all students up-to date which is more burden and difficult to both faculty and management. In the Modern era, Automated Attendance System (AAS) is emerged in replacing traditional attendance marking activity to overcome the above difficulties. Several popular automatic attendance systems currently in use are smart card system (RFID), iris, fingerprint-based techniques etc. [3-6]. However, the practical implementation of these systems becomes quite complex and time consuming for each period attendance and for each classroom. For example, on the off chance that there is any harm to RFID card, it might bring about an inappropriate participation. Aside from this conveying these frameworks for huge scope isn't cost proficient and consumes more time to post attendance and complicated to maintain.

Since face is individuals' starter plan of individual recognizable proof, facial recognition-based attendance system is an alternate solution that leads to have both time and cost effectiveness without human intervention [7]. The basic idea of face recognition systems is that each person has unique face structure universality and using the facial symmetry, computerized face-matching is possible [8]. The main advantages of the face recognition-based attendance systems are that it is possible to estimate automatically the presence/ absence of each student in their allotted seating place in the classes and the same may be intimated to their parents / guardians time to time. Further, if face images are annotated with the students' name, id number, the time and the place, it is also possible to know whether students are awake or sleeping and whether students are interested or bored in lecture. There are numerous papers are available in the literature and having their own advantages and disadvantages [3,4,5,6]. However, all these algorithms concentrate on the face recognition techniques based on their college or university environment and facilities available, but not concentrated on the attendance management system.

We propose a simple and efficient automatic attendance management framework dependent on the facial recognition. The proposed algorithm is unique and developed based on available facilities and environment of our Koneru Lakshmaiah Education Foundation (KLEF) deemed to be university. The paper is organized as follows: Section II introduces the proposed system. The implementation and results are explored in Section-III. Finally the conclusions are given at the end last, the ends are given toward the end.

II. PROPOSED SIMPLEAND EFFICIENT AUTOMATIC ATTENDANCE MANAGEMENT SYSTEM

In this paper, we propose a simple and efficient automatic attendance management system based facial recognition algorithm using Principle Component Analysis (PCA) [7,8]. The authors demonstrate that how face recognition can be used for an effective attendance management system that automatically record the presence of an enrolled individual within the respective venue. It is also maintain a log file to keep records of the entry of every individual with respect to a universal system time. The proposed system is also useful to both the faculty and the management to process without any mistakes and delay. Moreover, the attendance is forwarded to their parents / guardians from time to time which leads more attendance in the classrooms and improve the learning strategies that will influence the Bloom learning outcomes. Further, the proposed algorithm can be integrated with learning management system (LMS) / Enterprise Resource Planning (ERP) systems and hence, much burden will be reduced, and time will be saved for both management and faculty. The proposed algorithm consists of (i) Training phase, (ii) Detection phase (iii) Recognition and classification phase as illustrated in the Fig. 1.

A. Training Phase

In the Training phase consists of acquiring the enrolled students image database, pre-processing, face space generation and feature extraction steps (Fig.1).

***A*1. Acquiring database of enrolled students:** The database of the enrolled or registered students is established for a section of 47 students for our experimental purpose. Ten images of each student cropped to face part, with different poses such as sorrow, smile and laugh, turning head with left, right, top and bottom, different lighting conditions with and without spectacles, different dresses and hair styles etc. are collected and stored in a separate sub-folder. All the 47 students' sub-folders are stored in a main folder referred to as database of enrolled students' images.

***A*2. Pre-processing Module:** The pre-processing module is divided into three sub-modules, low pass filter (LPF), normalization and reshaping. The function of each module is illustrated as below:

LPF: A low-pass filter may be used to remove high frequency noise.

Normalization: The face standardization is utilized to lessen picture varieties, the impact of undesirable, interferential and excess data, for example, foundation, hair, material and so on., thusly upgrade the acknowledgment procedure. As a rule, to standardize the face picture, the essential component focuses are ordinarily chosen by utilizing the middle purposes of the eyes.

Reshape: All 2D images of the enrolled students face images database are reshaped into 1D column vectors i.e., NM ×1 (or 36000 × 1 since N × M = 200 × 180.

Then, all these 1D column vectors of 470 images are stacked a 2D matrix of size NM × 470 = 36000 × 470.

***A*3. Face space generation:** The central part investigation (PCA) is a factual dimensionality decrease technique, which creates an ideal straight least-squares disintegration of a preparation set in (P-1) dimensional space, that preserve the variance [9,10]. The PCA representation is characterized by a set of (P-1) Eigenvectors (e_1, e_2,... e_{P-1}) and Eigenvalues $(\lambda_1, \lambda_2, \ldots, \lambda_{P-1})$. The faces are represented by their projection onto a subset of K ≤ (P-1) Eigen vectors (corresponding to the K largest Eigenvalues, are referred to as face space. In our experiment, we consider K = 10.

***A*4. Features extraction:** Facial element extraction is the way toward removing face part includes like eyes, nose, mouth, and so forth from human face picture that initiates face recognition processing. The Eigen vectors computed from PCA is referred to as a lot of highlights that together describe the variety between the face pictures. Each image location contributes to more less to each eigen vector is a kind of ghost face usually called an eigenface in the face-recognition literature.

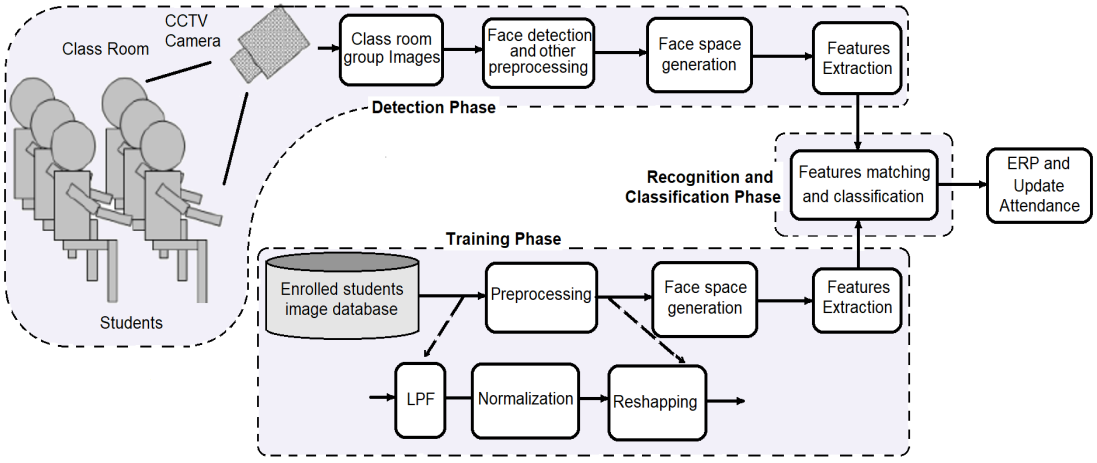


Fig. 1. The architecture of the proposed simple and efficient automatic attendance management system.

B. Detection Phase

The discovery stage comprises of obtaining the study hall bunch pictures for participation, face location and other pre-processing steps, face space age and high-light extraction steps, refer Fig.1. The preprocessing steps, face space age and highlight extraction steps are examined in the abovementioned, we investigate just securing the homeroom bunch pictures and Face location modules.

(i) Acquisition of the classroom group images: Each classroom in KLEF deemed to be university is equipped with two CCTV cameras and one sophisticated public address system and monitored every classroom by higher authorities in their cabins. Hence, the group images of students are acquired through using two CCTV cameras by a coordinator from his cabin for attendance purpose.

(ii) Face detection: After acquiring the group images, it is desired to identify or detect each student to post the attendance. In this experiment, we selected a famous face detection algorithm proposed by Paul Viola and Michael J. Jones [10,11]. This algorithm is relatively simple, fast in execution and provide remarkable performance that becomes a standard for solving face detection tasks. The algorithm is briefly outlined in the following four stages:

Stage1: Haar Feature Selection: All human faces share some comparable properties. These regularities might be coordinated utilizing Haar Features. There are 3 kinds of Haar-like highlights that Viola and Jones distinguished in their research: Edge highlights, Line-highlights and Four-sided includes as appeared in Fig. 2. For face detection, the flat and the vertical highlights are broadly utilized.

Stage2: Creating an Integral Image: Detection of intensity-based images are quite difficult in nature. Hence, another picture portrayal called a necessary picture is shaped utilizing the arrangement of Haar like highlights, that takes into consideration extremely quick component assessment.

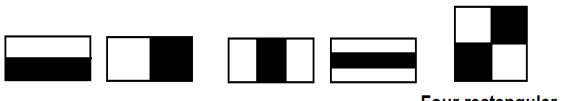


Fig. 2. Haar like features.

Stage3: Ada-boost Training: Ada-Boost select the best features and provides an effective learning algorithm for effective detection process.

Stage4: Cascading Classifiers: Falling is another kind of "hack" to support the speed and exactness of the discovery model. The solid classifiers are masterminded in a course arranged by multifaceted nature, where each progressive classifier is prepared uniquely on those chose tests which go through the first classifiers [12,13, 14].

C. Recognition and classification Phase

The Face recognition is a system that integrates three nodules, Principal Component Analysis (PCA) for include extraction, presto jones for face location and Euclidian distance classifier [12]. Once the features are extracted from training module and detection modules, it is desired to match these features and classify the image for recognition [6, 7, 8]. In our case, it is desired to mark the attendance. A simple Euclidean distance classifier is used to deciding the Euclidean separation between the two vectors of the pictures of the preparation informational index and the test picture (for our situation study hall pictures). On the off chance that the base separation between the test face and preparing face is not exactly a predefined edge, it is known and belong to the person in the database, the student is marked as present otherwise the student is marked as absent.

Fig. 3. Examples of both female and male student's database collection.

Fig. 4. A snap shot of class room students' group image and corresponding students' face detection.

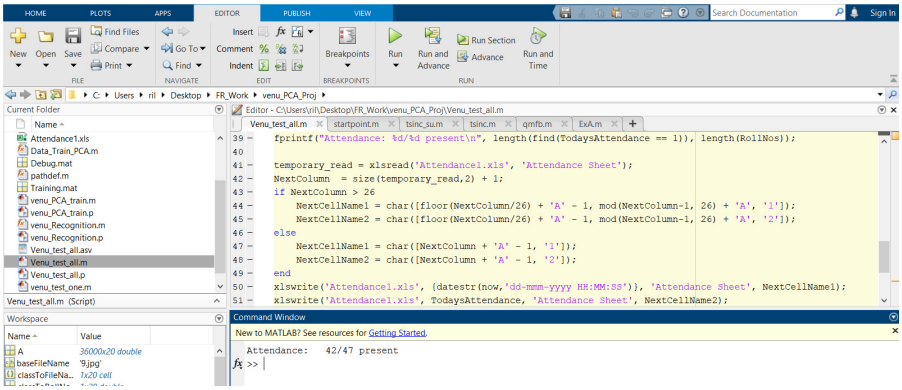
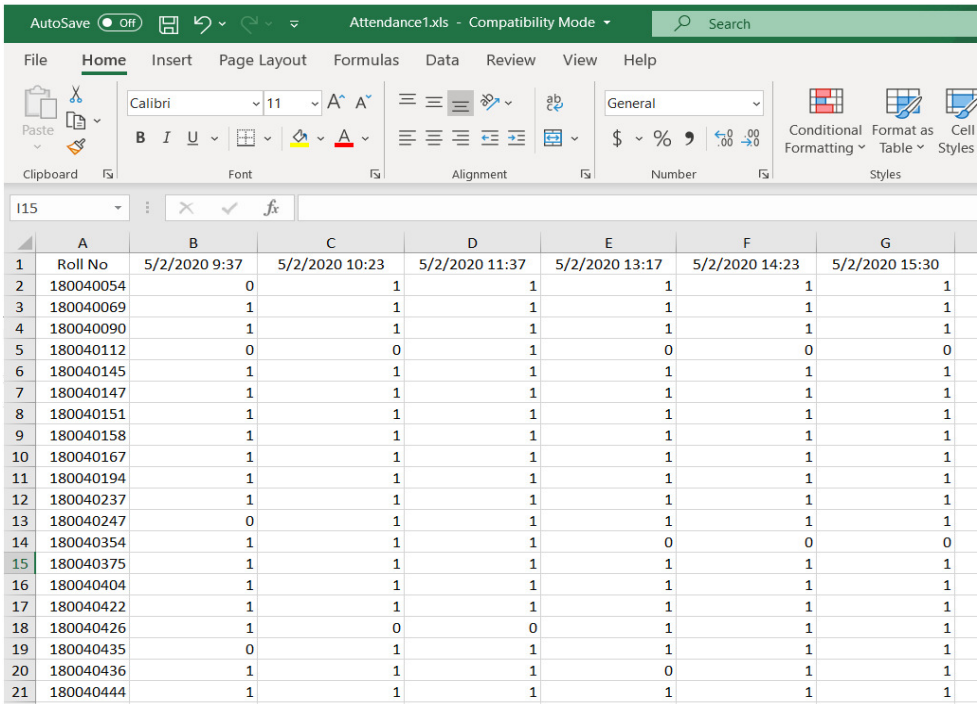


Fig. 5. Absentee statement through face recognition technique included in the part of the Matlab code.

Table 1: Face detection rate and face recognition rate.

Face Orientation	Detection rate	Recognition rate
0º (Frontal face)	98%	95%
20º	79.6%	78%
54º	59.4%	59%
72º	7%	6%
90º	5%	4%



	A	B	C	D	E	F	G
1	Roll No	5/2/2020 9:37	5/2/2020 10:23	5/2/2020 11:37	5/2/2020 13:17	5/2/2020 14:23	5/2/2020 15:30
2	180040054	0	1	1	1	1	1
3	180040069	1	1	1	1	1	1
4	180040090	1	1	1	1	1	1
5	180040112	0	0	1	0	0	0
6	180040145	1	1	1	1	1	1
7	180040147	1	1	1	1	1	1
8	180040151	1	1	1	1	1	1
9	180040158	1	1	1	1	1	1
10	180040167	1	1	1	1	1	1
11	180040194	1	1	1	1	1	1
12	180040237	1	1	1	1	1	1
13	180040247	0	1	1	1	1	1
14	180040354	1	1	1	0	0	0
15	180040375	1	1	1	1	1	1
16	180040404	1	1	1	1	1	1
17	180040422	1	1	1	1	1	1
18	180040426	1	0	0	1	1	1
19	180040435	0	1	1	1	1	1
20	180040436	1	1	1	0	1	1
21	180040444	1	1	1	1	1	1

Fig. 6. Automatic attendance recording in the xl-sheet.

III IMPLEMENTATION, RESULTS AND DISCUSSION

A undergraduate B. Tech ECE 2nd year class section consists of 47 students is selected for our experimental purpose. We collected ten images of each student with different poses, styles, and lighting environment. Fig. 3 illustrate a male and a female student with different poses and styles with different environment conditions. The Id numbers are saved as names of these 10 images. All the images are cropped to an arbitrarily chosen to the size of $N \times M = 200 \times 180$. For example, a student with Id. No. 160040421 named for these 10 images are as 160040421a, 160040421b,....160040421j and stored in a separate sub-folder named S1.Similarly, all the other student's id numbers are stored in a separate sub-folder named as S2 to S47. All these 47 sub-folders are stored in a separate folder referred to as database of enrolled students' images. Hence, total $P = 47 \times 10 = 470$ images with each image of size 200×180 are available for training purpose. These images are filtered to remove the noise, normalized, so that increases the chance of the recognition process. Each enrolled student 2D face image of size 200×180 in the database are reshaped into 1D column vector i.e., $NM \times 1 = 36000 \times 1$. Then, all these 1D column vectors of 470 images are stacked as a 2D matrix of size $NM \times 470 = 36000 \times 470$. All the required and important face image features such as Eigen vectors and Eigen values are extracted from this 2D matrix using PCA. This is the preliminary experimental set up as background.

In the live class, the group students' images are acquired by the course coordinator as illustrated in Fig. 4. A face detector detects all the faces of the students from the group image and extracted the image features using PCA [11,15,16]. These features are compared with the enrolled database image features and classified using Euclidean distance measure. Fig. 5 and Fig. 6, illustrate the part of Matlab code that registering the students' roll numbers and corresponding posting the attendance in an excel sheet after identifying the students. The face detection and face recognition rate observed in the experiment as illustrated in Table 1.

IV. CONCLUSION AND FUTURE SCOPE

A simple and efficient automatic attendance management system using Principle Component Analysis (PCA) based facial recognition technique is presented. The authors demonstrated, how face recognition can be used for an effective attendance management system that automatically record the presence of an enrolled students for a section of 47 students in the Department of ECE at K L University. The proposed system can maintain a log document to keep records of all the students' attendance and useful for both faculty and management to process without any mistakes and delay.

There is a tot of scope for improvement over the current work focused on a single classroom of 47 students. For improving detection rate and recognition rate, machine- or deep-learning based methods may be incorporated. Further it should be extended to all the section of the department and in-turn the whole university by integration with LMS and or ERP.

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