A Conceptual Model for Automated Attendance Marking System Using Facial Recognition

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***Abstract*— Attendance marking in a classroom during a lecture is not only burdensome but also a time consuming task. Due to a usual large number of students present in the lecture hall there is always a possibility of proxy attendance. It is extremely difficult for lecturers to manually identify the students who skip their lectures on regular basis. Attendance management of students through the conventional methods had been a challenge in the recent years. The growing need of efficient and automatic techniques of marking attendance is a growing challenge in the area of face recognition. In recent years, the problem of automatic attendance marking has been widely addressed through the use of standard biometrics. However, majority of the previously proposed techniques lack the element of reliability. The focus of this research is to analyze and critically evaluate the recent attendance marking techniques using face recognition methods. Literature review reveals the fact that the intelligent application of iterative facial recognition techniques can make attendance management systems more reliable. In this paper, we propose a conceptual model for automated attendance system through facial recognition. Our proposed model uses an integral validation process which enhances the reliability of your model.**

***Key*words — Biometry, Facial Recognition, Identification, Attendance Management, Attendance Validation**

I. INTRODUCTION

FACE RECOGNITION is a technique replacing biometrics effectively. It is novel of all as it uses the facial features of the person for identification. It can be attributed as a technique with minimum flaws as the facial features of every human being are unique. Gallantly surpassing in various fields, face recognition can effectively be used for security systems but has not been pursued due to evident flaws. Attendance marking through the conventional method i.e. attendance marked manually on a paper by the in charge had its own pros and cons. Method of manual attendance marking in question is vulnerable and time consuming which usually results in a setback to the students. Addressing this issue, innovations have ended up at wide-ranging use of the biometrics. Attendance Management through biometrics had awkward cost of extra effort and personal time at the user end. After the outbreak of face recognition as a useful method, techniques were evolved to incorporate it in attendance management systems. Biometric Attendance Management mainly uses iris recognition or thumb scanning. With passage of time, advancements are also needed to pace up with ever growing technology. As multi tech class rooms are growing,

Attendance Management through biometrics is also being improved and implemented. As marking techniques are advancing, the dire need to remove hindrances, complications of gadgets, delays and a bona fide attendance is the concept under focus. Whereas the conventional attendance marking/management system is sluggish and vulnerable, facial recognition attendance management system uses face recognition to identify and mark the attendance of students. Facial Recognition is done through a camera without any accessory and the attendance is marked. The faces are used to validate the student's presence. The system is very useful in marking attendance and maintaining record for the teacher, students and the management. Algorithms are used to match faces with the database faces of the student. Many have explored this aspect and managed to implement the system successfully. There were some limitations of accuracy and validation of the automatically marked attendance through facial recognition. Some focused upon typical algorithms used for face recognition whereas few used some novel techniques of implement weighted facial masks or data mining techniques to mark attendance of the students. Statistical techniques were also used in the same manner. Systematic implementations were also made such as use of android mobile phone etc. Now to resolve the issues, we ought to propose a conceptual model that addresses all the remaining concerns.

The limitations of some notable works done previously on the subject have been discussed in detail in the next section of literature review. Section three gives a brief but critical evaluation of all the works reviewed and some meaningful deductions have been derived. Fourth section addresses the solution of all the problems and conceptual model of new system is proposed. Last section concludes the study and highlights some future works needed for further refinement of the system.

II. LITERATURE REVIEW

The main purpose of the research is to analyze the solutions given by others and considering the shortcomings of their proposed systems, bring out a better solution. The basic approach taken to tackle the hindrances of attendance marking through facial recognition is to match the images

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taken recently with those images deliberately captured and placed in the central database. The solution to this is as proposed by Naveed et al. in [1] which consists of two databases. One is face database that contains the picture of the students and the other is the attendance database. Attendance database is used to mark attendance of the student when camera takes a picture of the class and then removes the background and noise from the image. Afterwards the skin is classified and the detected face is matched with it the image stored in the face database. After matching and recognition of the image, attendance is marked in the attendance database.

Kawaguchi, Y.et al. in [2] introduced the method of continuous monitoring and fixed seating through which attendance of the students automatically marked by capturing images of the students present in the class. They proposed a system that continuously observes the attendance although video service streaming was also available in many systems but they used face detection technique and capturing images for continuous observation. They also posed that they estimate the seating arrangement of the students by using different mathematical calculations. The architecture of this system is very simple as two cameras are used; one is sensing camera and the other is capturing camera. The picture taking and matching with the database is done again and again for the accurate attendance, which they termed as "continuous observation".

Also, by using fixed seating the Visar et al. in [3] ensured the attendance marking of the students. They proposed real time face detection on an existing learning management system (LMS). They fixed the seating arrangement of the students, to detect the faces of the students and mark the attendance. This was done for all the classes, they marked attendance of all the classrooms students by taking a snap through the fixed camera's one in the front and the other on the roof to take the face image to match with those of in the record to mark attendance. For accuracy, they fixed the seats to mark the attendance if once the system misses or so.

Abhishek Jha et al. [4] moved on to a better technique for face recognition by using statistical techniques PCA & LDA plus also matching the image taken and the stored image for attendance marking. They addressed the lengthy and error prone process of attendance making which if compromised may affect the student drastically. They proposed a system computing the images in a certain process so that match scoring can be done. While it can be achieved by using certain algorithms, such as: color detection, PCA and LDA. They extracted the features from the image for example outline of face, nose and eyes etc. The highest match score, the greater chance to get attendance marked. Using PCA and image matching techniques plus calculates the Eigen values to mark the attendance of the students.

Nirmalya et al. [5].fixed the camera in the classroom which took a snap shot and did the face matching at the backend using PCA algorithm and calculating Eigen values and Eigen Vectors. The system when repeatedly captured an unrecognized image, it learned to identify it and added to the database.

Francisco et al. in [6] used another statistical technique known as LBA (local binary algorithm) and weighted mask, which is based upon local or feature based approach of face recognition. In this system they extracted facial features such as nose, eyes and mouth etc. Face recognition was done by local binary patterns were used to build up the masks through which the areas to be matched were separated. These masks were the applied techniques of data mining, from which weighted masks were got. These weighted masks show that the grayest area had the more significance to recognize the face which basically focuses upon the main features of the face such as nose, eyes, lips, cheeks and forehead etc.

Using another statistical technique Gabor Filters to find facial fiducial points Stefano Arca et al. in [7] addressed the orthodox problem of marking attendance. Gabor filters were applied on the colored picture of the student and using the special facial fiducial points that can be from 4 to 64 but the system proposes using 31 points which is easy to compute using less processor power and quite faster. The system eliminated the background matches those predefined spots once the face is recognized attendance is marked.

Other then the literature discussed about the area of research, some other aspects of addressing the same problem are also discussed to just pose a way that how can we tackle the problem by using other techniques.

Using Android based smart phones Muthu Kalyani et al. in [6] proposed a different solution to the problem then the prior solutions. Such as face recognition in the proposed system using a CCTV camera did it by attaching it to an Android based mobile device that was enriched with 3D modeling. Once the picture captured, 3D modeling and canonical technique was applied on the image and then matched it to the student image and stored image. If the image was not recognized it is stored in the stranger database, which helped the administration enhance security.

In another system which is about for the attendance of the employees of a firm Nasser et al. in [8] argued that as the number of employees is large in the companies mostly so to mark their attendance is not an easy job to do. They proposed a system in which the faces are detected then recognized and after that attendance is marked and stored in SQL database. All the employees are gathered first of all to take the picture. The camera captures the image, removes background and noise and after that matches the image with the previously stored image to mark attendance once done the attendance is marked.

J.G. Roshan et al. in [9] proposed a solution to the orthodox problem in their own perspective. Amending the existing systems of attendance management or pointing out a note unattended. they said that in Muslim countries girls mostly use veil to cover their faces and boys have beard, which may change their appearance on regular basis. As the face alignment technique detects the position of nose, eyes, lips and various parts of the face for automatic capture so the system should use a strong algorithm that should be able to mark attendance regardless of veil or changing length and styles of beard.

Table 1 gives an overview of all the papers reviewed in the literature review of the related area respectively. In the table, the keyword Less here depicts that the ratio of the subject under observation is less than 50% whereas the keyword high here clearly stands for the 50% and above performance ratio.

This table covers ten papers that are related to this area and an overview of all the papers discussed is given here we discuss mainly their problems and limitations we rate their system with our own certain set standard key then we also give a summary and conclusion every researcher has proposed in the paper.

Author	Computational Cost	Implementation	Accuracy	Problem	Summary
N Baloch et al.(2012)	High	No	Less	Accuracy of the system to mark the attendance *by matching images only*	Images matching after noised or background removal
Michihiko . M et al .(2007)	High	Yes	Less	Accuracy is the main problem for which continuous observation is needed and validation of student presence lacked	continuous observation of the students for accurate results
Agni Dika et al.(2010)	High	Yes	Less	Fixed placement of the student if the student exchange the seat easily able to mark proxy attendance	Attendance on basis of position
A.jha et al.(2012)	High	No	Less	Accuracy of the system depends on the masks no validation of the attending student	Taking weighted masks and then match scoring is done to mark the student present
A.Saha et al.(2012)	High	No	Less	Repeated image capturing of images and unknown person also added to the DB automatically	Eigen values and Eigen Vectors are used to do face recognition
F.A.Pujol et al.(2012)	High	Yes	High	Heavy computational cost due to usage of data mining techniques	Weighted masks are made by the colors the most greyest area is the most significant to match the images
Stefano Arca et al.(2005)	High	Yes	High	Validation of the students once marked present is not done	Gabor filters or jets are applied to determine facial fiducially pints to match the images of the students
V.Muthu.A et al.(2013)	High	Yes	Less	Less accuracy due to large number of people and the more pictures the heavier the database which SQL is unable to manage so has a very heavy computational cost	Picture taken noise and background removed matched with the stored image and marks attendance
M.A.Nasser et al.(2011)	High	Yes	Less	Less accuracy due to large number of people and the more pictures the heavier the database which SQL is unable to manage so has a very heavy computational cost	Picture taken noise and background removed matched with the stored image and marks attendance
D.Parerea et al.(2013)	High	NO	Less	People with veils and breads are not marked present due to less stronger algorithm	Suggested to use stronger algorithms to recognize faces with veils and breads

III. CRITICAL EVALUATION:

The use of image matching for marking the attendance of the students rather than that of the real time face recognition is done once the image is captured. Then it is matched with the already stored image in a database to mark the attendance using some statistical techniques such as that of PCA, LDA and LBA. Whereas LBA or local binary algorithm feature based approach is one of the most effective algorithms used for face detection. Facial fiducial points for matching the faces to mark the attendance all the systems mark the attendance of the students once. No system validated or verified the attendance of the student whether the student was present during the lecture or not. It means that all the systems proposed are vulnerable by not providing the solution to the problem wholly but leaving out loop holes if the student comes in the class, shows up and marks his attendance once after image is captured the student can leave the class and be marked as present. This is a critical point that needs to be addressed in the system proposed. So we propose a system covering the problem of validation plus automated facial recognized attendance marking.

It is evident that all the previous works done have not fully incorporated all the relevant factors, hence they could not pose a meaningful solution. Everyone opted out from Validation process which as per the re addressable of problem stamen has been incorporated by the present author to make a better solution.

Orange: Hardware Used Green: Algorithm Blue:Systematic Techniques
Red: Limitation of systems reviewed

Sr. No.	Attribute	Considered by Others	Considered by Author
1	Sensing Camera	80%	Yes
2	Capturing Camera	100%	Yes
3	LDA	30%	Yes
4	PCA	40%	Yes
5	RFID	20%	No
6	LBA	10%	Yes
7	Noise Removal	40%	Yes
8	Android	10%	No
9	3D	10%	Yes
10	DB	100%	Yes
11	***Validation***	***Zero***	***Yes***

IV. Proposed Conceptual Model

We propose a model in Figure 1 for attendance management system in which we have two databases one is storage database and the other is known as student database. The storage database contains the already stored images and the masks calculated by the facial fiducial points of the students such that of nose, eyes and lips mainly. The other database known as attendance database will be used to mark the attendance of the students. A camera will be fixed in the class in the front, at such an angle where the picture of the whole class can be taken. Once the image is captured, noise will be removed and background will also be minimized. Gabor Filters or Jets will be applied after that through which every individual student's 31 facial Fiducial points will be calculated. It will calculate the measurements of the facial features and then they will be matched to the image information stored in the storage database. This all computation will be headed on the server. Once the matches are done, the student's attendance is marked to solve the issue of validation of the student present in the class or not. we pose a solution that is to take the attendance randomly three times in a lecture so that it could be made sure that the student attends the particular lecture and is present in the class actually rather than being marked as present.

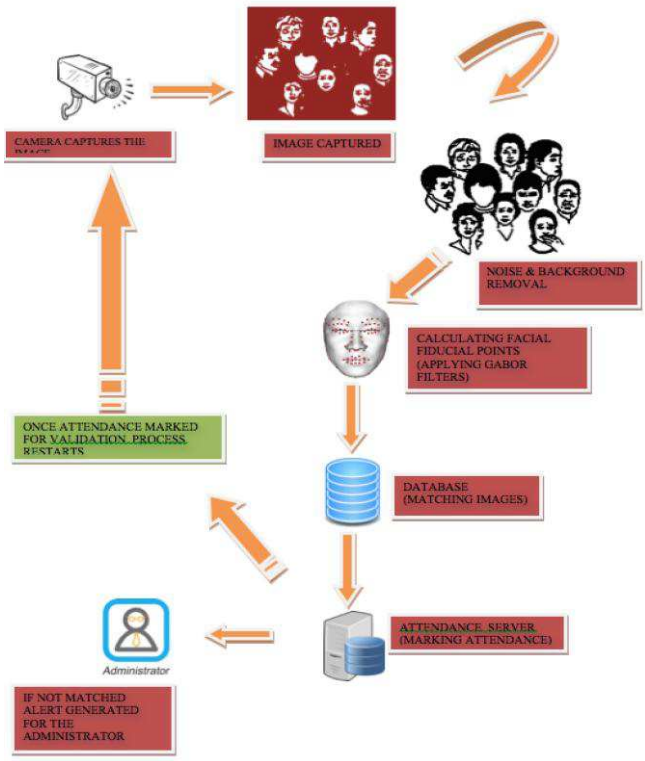

Figure 1. Proposed Conceptual Model

V. Conclusion

In a Muslim country, girls generally wear veil and boys have beard which may change length posture shape and size. If face recognition is to be done to mark attendance, face detection and verification would be a challenge for the system. As the girls in veil cannot be identified, this issue can be solved by having facial fiducial points of the student's faces through which attendance can be marked. It will be done on the basis of the statistics gained about the eyes of girls in veils and boys. With the similarity of eyes and nose etc. we can easily facially recognize the student. It is established that the problem exists so in future work on this should also be done to solve the problem.

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