Face Detection and Recognition for Smart Attendance System using Raspberry Pi

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ABSTRACT

Security is the major threat to an organization or institute that is why there is a need of several specially trained person to attain the desired security to overcome the declining security condition in the country. The person as human being makes mistake that might affect the security, hence there is a need for facial recognition system which is fast, accurate and highly secured real time system which reduces the human errors while taking attendance. Face recognition is one of the most important biometric pattern recognition which is used in broad spectra applications. The main purpose of this paper is to develop face detection and recognition for smart attendance system. This system will eliminate the proxy attendance, saves the time and reduces mistakes while taking attendance. It maintains the student documents and reduces the human errors. Since the inception of Pattern Recognition & Image processing researchers across the globe continue to propose newer facial recognition algorithms. Each of the facial algorithms has its own pros and cons, hence in this paper we intend to select a best algorithm to propose a new face detection and recognition model.

Key words:- *RFID - Radio Frequency Identification and Detection, MATLAB - Matrix laboratory, Open-CV - Open Command Visualization*

1. INTRODUCTION

Attendance of each students are being maintained by every school, college and university. The manual attendance record system is not efficient and also it requires more time to arrange record and to calculate the average attendance of each student. The automated attendance system uses electronic tags, barcodes, magnetic stripe cards, biometrics, vein reader, hand geometry, RFID, fingerprint, facial, touch screens, thumb impressions, access card consumes more time. Students to identify themselves will have to touch or swipe and record their attendance throughout the day. The recorded information is then automatically transferred to the institute server. Some-times these systems require an operator to physically transfer the data from the electronic system to the computer through a memory device. All earlier systems lead high amounts of manual labour. Data cannot be precisely relied upon duplication of data there will be a possibility of faulty attendance parameters. Hence there is a requirement of a system that will solve the problem of students record arrangement and students average attendance calculation. One alternative to make student attendance system automatic is provided by facial recognition. The face detection and recognition method for smart attendance system using raspberry pi helps to maintain the student documents automatically. Its efficiency is more, less time consuming and easy to use.

The goal of this paper is to develop smart attendance system for colleges, industries and for security system using Raspberry Pi. A camera based system will be used to detect and recognize the presence of the person in the working area. The manual method of taking attendance is time-consuming process. Hence it is important to construct an efficient method for managing attendance automatically. Currently, industries, organizations are using personal identification strategies such as RFID, iris recognition, bio-metric, MATLAB, fingerprint identification is used for taking attendance. Among of all these personal identification strategies including face recognition is the highly accurate, less time consuming and high efficient, despite being difficult to implement, a continuous observation for overcoming it increases accuracy and maximizes the output. It has

several applications in attendance management systems and security systems. It takes attendance of students during lecture. Another advantage of this type is inclusion of fake attendance can be avoided.

It involves face detection and recognition technology. A facial recognition system is a technology capable of identifying or verifying a person from a digital image or a video frame from a video source and face detection is a computer technology being used in a variety of applications that identifies human faces in digital images. A time period is set for taking attendance and that database is automatically transferred in to the excel sheet or uploaded into the web server through the internet connectivity. This process is done without any human intervention. In this a Raspberry Pi installed with Open-CV library and a Raspberry Pi Camera module is connected for facial detection and Recognition. Open-CV is an open source library in which the source code is open and it is useful in visual field such as image processing. The main aim of this paper is to take and manage attendance using face recognition. The data is stored in the memory card connected to Raspberry Pi and it can be accessed through the internet.

2. LITERATURE REVIEW

T.S. Lim et al [1] have proposed about the Radio Frequency Identification (RFID) based attendance system. This system can be used to take attendance of the students in school, college, and university. It can also be used to take attendance of workers in working places. Its ability is to uniquely identify each person based on their RFID tag (type of ID card) to make the process of taking the attendance easier, faster and secure as compared to conventional method. Students or workers only need to place their ID card on the reader and their attendance will be taken immediately with the real time clock capability of the system, attendance taken will be more accurate since the time for the attendance taken will be recorded. The radio frequency wave is used to identify and track the tag implanted into an object or a living thing, it is a wireless mean of communication which uses electromagnetic and electrostatic coupling in radio frequency portion of the spectrum to communicate between reader and tag through a variety of modulation and encoding scheme. It can be done quickly, it usually takes less than a second, but it has a problem that there is a chance of proxy attendance by misusing the id card, if he or she is absent.

Kennedy O et al [2] have proposed a iris based recognition for attendance system. Attendance taking is a standard practice in every educational institution. The methods used to take attendance are quite numerous but emphasis keeps shifting towards automating the process. The use of biometrics in taking class attendance is fast gaining ground and the traditional way of taking attendance is fast losing ground especially when the class is very large and time is of great essence the iris was used as the biometric. In this paper, it is explained that after enrolling the information of all the students by storing their particulars along with their unique iris template, the designed system automatically takes attendance by capturing the eye image of each student, recognizing their iris, and searching for a match in the created database. But the disadvantage is that the system is not accurate for large volume.

Nur Izzati Zainal et al [3] have proposed the design and development of a portable classroom attendance system based on fingerprint biometric. The aim of implementing a biometric feature into a portable attendance system is to improve security and portability. The circuit of this device is strategically constructed to have an independent source of energy to be operated, as well as its miniature design which made it more efficient in term of its portable capability. Rather than recording the attendance in writing or queuing in front of class equipped with fixed fingerprint or smart card reader it is more easier to use portable attendance system. But it has certain drawbacks were each and every one has to do it individually which consumes more time.

Diachok et al [4] have proposed a method for face detection and recognition using raspberry pi and barcodes. Bar code is a sequence of black and white stripes containing certain information in a suitable form for reading by technical equipment. Requirements of introducing bar codes dictated by the extremely high volume of deliveries, territorial dispersion of interdependent organizations and enterprises lack information about product features on the packaging and accompanying. The most commonly used technique are linear bar codes for reading information, the disadvantage of which is that they can submit only small volume of relational data. To represent larger volumes of information, it is necessary to construct bar code with a two-dimensional structure, for reading it is necessary to apply a two-axis scan horizontally and vertically, when working with linear bar codes a computer database is needed. The use of two-dimensional barcode allows us to abandon such a base, since the code capacity is sufficient to store complete information about the object, but it has a great limitation like insufficient timely information on the properties of the product on its packaging and in the accompanying documentation.

Rao et al [5] have explained about the smart phone based attendance system. The issues of taking attendance each and every period by the teacher is very time consuming and tiring, hence designed an application for android smart phones which helps in capturing the image of all the students in the class and then marks the attendance   accordingly to their respective faces if present. The image processing will internally be done by the application so as to detect the faces of the students by computing the various features of the face. This application has intend to reduce the pressure of teachers taking the attendance and saving time as well. The probability that there would be wrong attendance marked for students will be reduced.

Zhen et al [6] have explained about the image registration, it is the process of estimating the relative translation rotation of two or more images of the same scene taken at different times, from different viewpoints, or by various sensors. It can place multiple images into a coordinate system to facilitate the information extraction and subsequent process, which is a necessary and fundamental step for many image processing processes, such as image fusion, image super-resolution reconstruction, computer vision, medical field etc. The majority of image registration methods consist of the following four steps—feature detection, feature matching, transform model estimation and image re-sampling and transformation. According to the four steps, image registration methods can be classified into the area-based method and feature-based method. We can also classify image registration methods into spatial registration method and frequency domain registration method simply. For the spatial registration method, the gray scale is processed as image feature and block-matching algorithm is the major method in spatial registration method. There are two types of domain methods: full search and local search. The full search matches all the pixels one by one with higher accuracy but it takes more time.

Viola et al [7] have proposed the paper on Eigen face detection, it is one of the useful technique which detects and recognizes the face. Eigen faces are the components that divide the face into feature vectors. These vectors are further used to distinguish various faces. Each face can be treated as a linear combination Eigen values. The face images can be reconstructed using a few weights for each of the Eigen faces. The processing speed of this algorithm is efficient and less time consumption. The accuracy of Eigen face detection depends on light intensity as it was pixel dependent. It means that it can be highly focused in the conditions where light is good enough. The limitation of this method is sensitive for lighting conditions. This algorithm is also highly used for face recognition. It uses principal component analysis and linear discriminate analysis by which subspace projection matrix will be constructed. Unlike Eigen face construction process, the fisher face technique takes the matrix and further, it converts into a vector. It is as similar as eigen face but, found better results in the case of low light. The problem with this technique is the difficulty while constructing projection matrix. Therefore, it needs more storage space .

Tokas and Agarawal [8] have stated about the Principal Component Analysis (PCA). The face images are faced onto a space that encodes best difference among known face images. The face space is created by eigen face methods which are eigen vectors of the set of faces, which may not link to general facial features such as eyes, nose, and lips. The eigen face method uses the PCA for recognition of the images. The system performs by facing pre-extracted face image onto a set of face space that shows significant difference among known face images. Face will be categorized as known or unknown face after imitating it with the present database. From the obtained results, it was concluded that, for recognition, it is sufficient to take about 10% eigen faces with the highest eigenvalues. It is also clear that the recognition rate increases with the number of training images. Hence it requires more time.

Balcoh et al [9] have stated that maintaining the attendance is very important in all the institutes for checking the performance of students. Every institute has its own method in this regard. Some are taking attendance manually using the old paper or file based approach and some have adopted methods of automatic attendance using some biometric techniques. But in these methods students have to wait for long time in making a queue at time they enter the classroom. Many biometric systems are available but the key authentication are same. Every biometric system consists of enrolment process in which unique features of a person is stored in the database and then there are processes of identification and verification. These two processes compare the biometric feature of a person with previously stored template captured at the time of enrollment. Biometric templates can be of many types like Fingerprints, Eye Iris, Face, Hand Geometry, Signature, Gait and voice. But all these methods have some drawbacks, hence face recognition approach is done for the automatic attendance of students in the classroom without students intervention. Face recognition consists of two steps, in the first step faces are detected in the image and then these detected faces are compared with the database for verification.

Soetedjo et al [10] have proposed a method for face detection and tracking, it illustrates the fusion techniques for detecting and tracking the face. The proposed method combines the Viola-Jones method, the Cam shift tracking and the Kalman filter tracking. The objective is to increase the face detection rate, while reduce the computation cost. The proposed method is implemented on a low cost embedded system based-on the

Raspberry Pi module. The experimental results show that the average detection rate of 98.3% is achieved and it is superior compared to the existing techniques. It achieves the frame rate of 7.09 fps in the real-time face detection. Face detection and tracking is an important and popular research topic in the image processing area. An example of the real application that employs the technique is a system for detecting the driver fatigue using the camera systems. In the system, the driver fatigue is examined from the facial features, such as the eye closure, eye blinking, and mouth openness. The face detection technique is a crucial task for localizing the face area for further process, especially for finding the eyes precisely. Usually, the face tracking is performed after the face detection to improve the performance. By tracking the face, the search area on the next image frame is limited. This technique consumes more time, hence it cannot be implemented in the large volume applications.

Ali Akbar Shah et al [11] have proposed about the real time face detection and recognition using raspberry pi and mat lab. Face detection and tracking has been used for the purpose of surveillance, security, human computer interaction, etc. Various methods of face detection are reported in literature, they include Viola Jones, Haris corner, principle component analysis, Haar classifier. In this research, Haar classifier extracted from Viola Jones algorithm is used for the face detection. The Eigen features of the face for tracking its position are detected using MATLAB and Raspberry pi. Computational models of face detections and face recognition have been traditionally used mostly for the purposes of criminal detection and recognition. These basic principles of image processing can be used for entertainment and gaming purposes as well. It can play an important and key role in helping us communicate between virtual and real world. This paper proposes gesture based tracking while using just a camera, the LED on the array of LEDs will glow to the exact position, where your face is located and not only this, it will follow and track your face within its prescribed limit. Methods like Principle Component Analysis (PCA), Independent Component Analysis (ICA), Local Binary Pattern (LBP), Linear Displacement Analysis (LDA), Sparse Representation based methods and Support Vector Machines are used for facial recognition and its features. Some face recognition methods analyze the geometric features of facial images, such as location and distance between nose, eyes, and mouth. Some of the above mentioned methods are not so effective because of the illumination and facial expressions. To avoid this, a holistic image may be created to extract all features of the face. Hence, Viola Jones developed Haar classifier, which is a real time face detection algorithm. Some parallel versions of face detection algorithm use Haar-like features.The major flaw in this algorithm was that it was not able to process a stream resolution of 640x480

Arva and fryza [12] have proposed a system on embedded video processing using raspberry pi .This paper presents a study of existing methods for motion and face detection and their application to the on-board miniature Raspberry Pi computer. The algorithms realized by Open CV+ functions were modified to optimize their operation on the mentioned platform, which could be used as an embedded surveillance system. The paper also mentions the training of a custom classifier for hand detection, the paper deals with the design of an embedded surveillance system realized on a Raspberry Pi 3B minicomputer. The main part focuses on the study of selected functions used by modern surveillance systems, like motion detection methods and issues and algorithms used for detecting human faces. After selecting the proper methods, they are developed in the programming language C/C++ in order to exploit the computational power of the embedded minicomputer. An external web-camera captures static scenes which are used as input data for the image processing algorithms. These algorithms analyze the images in real time, yielding information about the moving objects and saving the video sequence if a motion has occurred. To automatize these tasks, basic Computer Vision approaches are modified and applied to the real-time camera feed. The functions are provided by Open CV, An open source library containing over 500 optimized algorithms for image and video analysis and manipulation. It also has C++, C, Python, Java and MATLAB interfaces and supports windows, Linux, Android and Mac OS. The functions are completely designed with the help of Open CV libraries and are optimized to operate effectively on the Raspberry Pi platform.
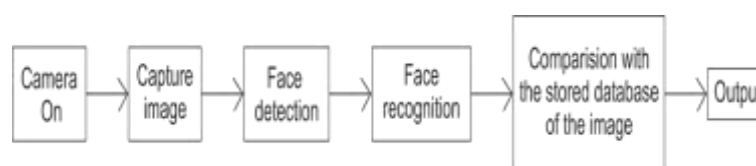
3. METHODOLOGY

Fig-1: Proposed design

In general, face recognition system has three important stages namely face detection, training of detected faces and face recognition. This is to record the attendance through image using face detection and face recognition. The proposed approach has been implemented in four steps such as face detection, labelling the

detected faces, training a classifier based on labelled dataset, and face recognition. The database has been constructed with the positive images and negative images. The complete database has been divided into training and testing set and further processed by a classifier to recognize the faces in a classroom. The final step is to take the attendance using face recognition technique in which the input image of a classroom is given and faces of the given image will be detected along with their ID's. The frames of a video taken for a minute is taken into consideration to avoid the missed ones due to rotational issues.

4. CONCLUSION

From the knowledge af all the 12 papers, the method of face detection and face recognition is the best among all other techniques. When comparing with the efficiency and the performance, there are many algorithms but to do the face detection efficiently both in the dark and the bright light the Haar classifiers technique extracted from Viola-Jones method and LBPH algorithms are used to do the efficient face detection and recognition.

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