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Face Recognition Based Smart Attendance System

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***Abstract*- Education institutes today are concerned about the consistency of students ' performance. One cause of this decrease in student performance is the inadequate attendance. There are several ways to mark your attendance, the most common ways to sign or call the students. It took longer and was problematic. From now on, a computer-based student attendance checking system is required that supports the faculty to keep records of attendance. We have used an intelligent attendance system based on face recognition in this project. We have proposed to implement a "Smart Attendance System for Face Recognition" through this large applications are incorporated. The present implementation includes facial identification that is time saving and eradicates the possibilities of proxy attendance due to the facial authorization. This system can now be used in an area in which participation plays an important role. Raspberry Pi, Open CV and Dlib using python are the basic requirements for this system. The system implemented uses LBPH face recognizer to identify the face of the person in real time. Eigen faces and Fisher faces are affected both by light and we cannot ensure perfect light conditions in real life. An improvement in the LBPH faces recognizer to overcome this problem. This system compares the image of the test and the training image and determines who is and is not present. The attendance data is stored in an excel sheet that is automatically updated in the system. If a student is absent**

a message will be automatically sent to their parent's phone number using GSM. Student's can check their attendance using an Android application that we have developed using MIT app Inventor.

Key-words: *Open CV, Face recognition, raspberry pi.*

I. INTRODUCTION

In a classroom, taking attendance is one of the hectic and time consuming things to do for a lecturer, especially in a classroom of 70-80+ students. All these handwritten record of attendance in the form of statistical data is hard to compute and analyse manually. And these methods are more prone to false attendance or proxy. As a solution to this many people came up with various other methods to identify an individual. A few of the best solutions were scanning ID cards, using fingerprint sensors and face recognition systems. Each of these has got its own pros and cons.

Even though fingerprint method is considered the best biometric system for identification of an individual, it is rather more time consuming than the manual method. Hence face recognition system is considered the best possible solution.

By using this face recognition system we can device a dynamic system. This system will mark attendance for students present in class automatically by recognizing their faces. The system is split into multiple steps, but face detection and face recognition are the most major steps. Firstly, we need to database each student's face in order to mark their attendance. Then a camera device is used to take picture of the classroom in such a way that all the faces are captured. This picture serves as a system input. For the best face recognition, the image wishes to boost by means of a few image processing technique like conversion of an image to grayscale and to perform histogram equalization [2]. For the last row students who faces are not clearly visible, a technique called histogram equalization is done to enhance the image.

The image having been enhanced by histogram equalization, it is taken as an input to the face detection algorithm to detectthe face and no face regions. We have several face detection algorithms like Deep Neural Network, Ada-Boost algorithm, support vector machines, etc. among these we have adapted DNN algorithm as it is most efficient.

Now the subsequent task is to recognize these detected faces of students. There are several face recognition algorithms like Eigen Face, Fisher Face, PCA, LBPH algorithms etc. We are going to employ LBPH Algorithm. In the LBPH Algorithm, once the detection of faces is done, the faces are cropped from image. Multiple features are brought out from these cropped images like framework of the face distance between eyes, nose, etc. Now by comparing these faces with the faces in the database, each student will be marked present or absent. Each student has to register their face and identification like roll number, name and phone number, on to a database.

II. LITERATURE SURVEY

The research carried out by the following persons and their published documents has motivated us for our work. Both physiology and information theory and the practical needs of fast-real-time performance and accuracy motivate the computerized approach taken in this system. This approach treats the face recognition problem instead of requiring a recovering of three-dimensional geometry, by taking the benefit of the truth that, faces which are usually upright and therefore a short set of two-dimensional distinctiveness can be identified. This approach is a two-dimensional recognition problem. Their studies indicate that the automatic technique is highly accurate, even if the rejection rate is considerably' unknown' and therefore potentially appropriate for those applications. In order to determine the gender of this topic and to interpret facial expressions, this project also included recognizing the face, using an independent analysis.

Bhattacharya et.al [4], in this paper they have introduced a facial recognition method based on an information theory of facial image coding and decoding approach. The approach is to connect two stages: the extraction of features by using PCA (Principle Component Analysis) and the recognition by the neural network feed forward propagation. 400 pictures (40 classes) have tested the algorithm. By taking into account almost all variants of feature extraction, a recognition score for a test lot is calculated. Olivetti and Oracle Research Laboratory (ORL) tested the proposed methods. The results of the test showed 97.018 percent recognition rate.

Therefore, we understood that the literary examination prepared for face detection is a two-stage facial detection and facial detection process. When the image is captured, the image space is classified as "face" and "non-facial" areas for face detection. A holistic approach, a functional approach and appearance are the various methods for facial detection. The complete region of face is seen as an input to the facial recognition system in a holistic way. The characteristic approach is the segmentation of facial features, such as the nose and eyes, and the insertion in the face recognition method.

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For face detection, we should search for the algorithms like LBPH, Eigen faces and Fisher faces. Eigen faces and Fisher faces are both exaggerated by light and, in daily life, we can't assure ideal lighting circumstances. LBPH face recognizer is an enhancement to defeat this inadequacy.

Table 1. Comparison of various algorithms for face recognition

Method	No. of Images	Success Rate	Reference no.
Principal Component Analysis (PCA)	400	79.65%	10
Principal Component Analysis + Relevant Component Analysis	400	92.34%	10
Independent Component function Analysis	40	Gauss function 81.35%	11
Support Vector Machines	-	85-92.1%	12
Neural Networks	-	93.7%	13
Eigenfaces Method	70	92-100%	14
Eigenfaces with PCA method	-	92.30%	15
LBPH method	20	98.5	16

Table 2. Advantages and limitations of other approaches on face recognition

Publication & Year	Authors name	Advantages	Limitations
Face recognition with symmetric local graph, Year: (Elsevier)2014	Mohd Fikri Azli Abdullah,Md hohel Sayeed,Kalaiarasi Sonai Muthu,Housam Khalifa Bashier,Afizan Azman,Siti Zainab Ibrahim	In this approach, the graph structure of a pixel in an image has better representation with its neighbour's pixel	Done only with frontal face Lower performance for rotated face
Human face recognition using PCA based genetic algorithm. Year: (IEEE)2014	Firoz Mahmud,Md Enamul Haque,Syed Tauhid Zuhori, Biprodi Pal	In this paper, tried to explain basic concept of face recognition using PCA based genetic algorithm Reduces the computational time	Feature extraction is not accurate because of which the efficiency is low Problems in data processing
Face recognition with liveness detection using eye and mouth movement Year: (IEEE) 2014	Avinash Kumar Singh,Piyush Joshi,G.C.Nandi	The system has shown a good accuracy ratio. Highly secured.	Approach is tested only on 40 people. Not used large databases for experiment.

III. PROPOSED METHODOLOGY

A. ARCHITECTURE

The architecture of a smart attendance system used in our work is a simple and easy to understand. To commence, we need a Model B Raspberry Pi 3. Then we need a camera and a servo motor for Raspberry pi in order to control various directions. It must be fastened to a suitable place in a classroom from where it can cover the whole classroom with the camera.

The image is improved for further use when the camera pictures all students. Here the image is transformed into a gray image and then equalized with histogram method.

Following improvement, the picture will be given to detect students ' faces by means of an algorithm for face detection. The face of each student is then cropped from this picture after facial detection and all of these cropped faces are matched to a face database. In this database, the image of all students is preserved. The presence of students on the server is marked by matching face by person. If the student is not able to attend, a message will automatically be sent to their parents/ Guardians by GSM, so students can use our Android app developed via the MIT app inventor to check their attendance.

B. HARDWARE COMPONENTS REQUIRED:

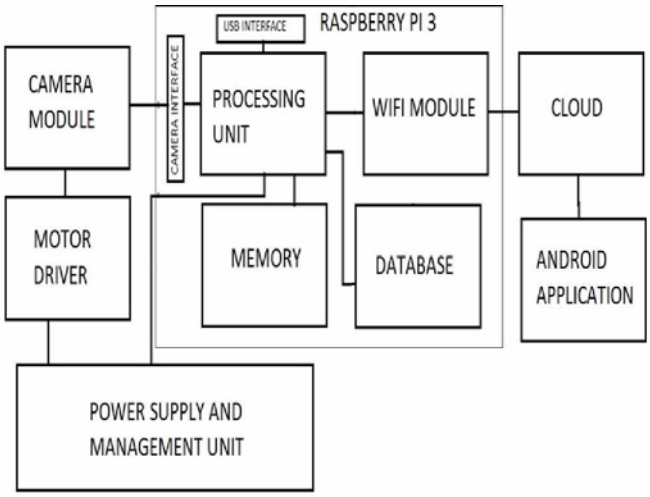

Fig 1. Block diagram.

1. Raspberry pi3 model B module.

"Raspbian is a Debian-based computer operating system for Raspberry Pi".

However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi . We have used built-in python version 3.

We are using this model for our processing and has the features are

SOC: Broadcom BCM2837 CPU: 1.2 GHZ quad-core ARM Cortex A53 (ARMv8 Instruction Set)

GPU: Broadcom VideoCore IV @ 400 MHz
Memory: 1 GB LPDDR2-900 SDRAM
USB ports: 4
Network: 10/100 MBPS Ethernet, 802.11n Wireless LAN, Bluetooth 4.0
2. Raspberry Pi Camera modules 8MP.
3. Servo Motors and motor driver's circuits.
4. SD memory card.

C. METHODOLOGY

Face Detection: The aim is to locate and probably extract the faces (locations and size) from the picture to be used with the facial recognition algorithm. It then sees for:

- Face Verification
- Face or No Face decision

Face Recognition: The algorithm for face recognition is used to find the characteristics which best describe an picture with face images that are already extracted, cut, scaled down and usually converted into grayscale.
Face Recognition is a biometric method for the identification of a person through a comparison oflive or digital image data and the record stored for him. Face recognition involves:

- Face Verification: Identify whose image it is among all the images
- Face identification

Verification or authentication of the image of the face: Essentially it compares the face image insert to the face image of the user requiring authentication. This comparison is basically 1x1.
Facial identification: Basically it compares the input facial image to all face images from a dataset in order to find the user that matches that face. It's a 1xN comparison basically.
LBPH Algorithm for Face Recognition
"Local binary pattern" (LBP) is an easy yet effective texture operator, where it identifies the pixels of images and consider the outcome to be a binary number through the threshold of each pixel's area.
The LBPH algorithm uses 4 parameter:
Radius: It is used to build the local circular binary prototype and the central pixel radius is represented. It is normally set to 1.
Neighbors: The sample amount of the binary pattern circular to build. Please note that the higher the cost of the computation the more sample points you include. Normally it is set to eight.
X grid: Horizontally oriented number of cells. The thinner the grid the more cells, the greater the dimension of the resulting vector. Normally it's set to 8.
Y grid: Here vertically oriented number of cells. The thinner the grid, the more cells, the greater the dimensionality. Normally it is set to 8.
Training the Algorithm: First, it is necessary to train the algorithm. We need to use a dataset of the facial photos of the people we want to know. We must also set an ID for each picture to identify the output of an image (this may be a number or the person's name). Photos must be identical from the same person.

LBP operation: The first computation step of LBPH is to better describe the original picture by emphasizing its face properties to create an intermediate image. The algorithm use the theory of sliding windows relies on the radius and neighboring parameters.

We can use many techniques to compare histograms, for example: Euclidean distance, chi-square, absolute, etc. (Calculate a distance of two histograms). Based on the following formula, the Euclidean distance is computed by the formula,

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

The output of the algorithm is therefore the ID with the nearest histogram from the picture. The algorithm is supposed to provide a distance that is already calculated, so that it can be used as a measure of confidence. Later a confidence and threshold are used to evaluate the algorithm if it recognizes the image appropriately.

D. ALGORITHM

The algorithms show the step by step functioning of a system. In this method, we have to follow the below algorithm.
INPUT: Images of the classroom at different angles.
OUTPUT: Updating the attendance on android app.
PROBLEM STATEMENT: Identify the students present in the class.
1: Start
2: Create face database by enrolling students.
3: Mount the device with raspberry pi camera in classroom.
4: Take the images captured by the camera as input.
5: Image enhancement.
i. Conversion of RGB to grayscale image.
ii. Generation of histograms for the grayscale image.
iii. Equalizing the image.
iv. Create histogram of the equalized image.
v. Eliminate noise present in the image.
6: Face Detection.
i. The detected faces are cropped from the image.
ii. The ROI is selected.
7: Face Recognition
i. Use the LBPH algorithm match the cropped images with face database images
ii. Mark the presence on the attendance server.
a. If some other face is found, Then
b. Go to ii) of 6

8: End.

IV.CONCLUSION

The Face recognition based smart attendance system can be established as an effective system in classrooms, laboratories, workplace and for security purposes. This method overcomes the drawbacks of the traditional attendance marking system and among all other biometric system face recognition has the most excellent performance. The probability of proxy attendance can be reduced by this method. To device this system we just need a "raspberry pi 3 model b module", "raspberrypi camera", servo motor and database servers. By using LBPH face recognition algorithm we can overcome the problem of different head orientations and substantial occlusion.

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