International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

AUTOMATED ATTENDANCE SYSTEM USING FACE RECOGNITION

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Abstract - *Face recognition is a big research area which takes more attention of many researchers in computer technology. The human face recognition from video sequences is a challenging task, because there are variations present in the background of the images, facial expression and illumination. Our aim to develop an automated attendance management system which can capture and mark presence of students as well as employees using video frames with deep learning method. This system is able to capture real time video and can generate attendance report with improved accuracy.*

Keywords- Video Framing, Video Recognition, Deep Learning, LBPH, Automated Attendance.

1. INTRODUCTION

Face recognition is a major challenge encountered in multidimensional visual model analysis and is a hot area of research. The art of recognizing the human face is quite difficult as it exhibits varying characteristics like expressions, age, change in hairstyle etc. Although many methods have been proposed to detect and recognize human face developing a computational model for a large database is still challenging task. That is why face recognition is considered as high level computer vision task in which techniques can be developed to achieve accurate results. Few popular methods known for face recognition are neural network group based tree, neural nets, artificial neural networks and principal component analysis. The recognition of the face from videos has numerous applications in Video Computer Vision. The main challenge of detecting face image in videos is the pose and the illumination variations and sudden changes in the movement of the object. The main challenges of designing the robust face recognition algorithms are pose variation, self-occlusion of facial feature. The use of Multi view data to handle the pose variation and its challenges. Multi-camera network commonly used for biometric and surveillance system, multiple view point overcome the drawback of single view point. For example multiple view point increases the position of the person in different pose. The proposed system analyzes and recognizes the exact face image from the video even though there are pose variation and illumination variation while the existing systems deals with the recognition of the face images .

2. LITERATURE REVIEW

The objective of this system is to present an automated system for human face recognition in a real time background for an organization to mark the attendance of their employees or student. So automated attendance using real time face recognition is a real world solution which comes with day to day activities of handling employees or student. The task is very difficult as the real time background subtraction in an image is still a challenge. In the past two decades, face detection and recognition has proven to be very interesting research field of image processing. The work carried out describes an automated attendance system using video surveillance. The proposed algorithm is automatic and efficient in intelligent surveillance applications. Video surveillance is used to detect the object movement thereby the captured image undergoes face detection and recognition process and searches the student database and enters the attendance if it is valid in the list.

This paper uses Local Binary Pattern Histogram (LBPH) algorithm for face detection and correlations formulas for face recognition. It was first described in 1994 and has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets. The primary purpose of this paper review is to find the solutions provided by others author and consider the imperfection of the system proposed by them, give the best solutions.

In [4] Kawaguchi introduced a lecture attendance system with a new method called continuous monitoring, and the automatically by the camera which captures the student's attendance marked photo of a student in the class. The architecture of the system is simple since two cameras equipped with the wall of the class. The first one is a capturing camera used to capture the image student in the class and the second camera is sensor camera is used to getting the seat of a student inside the class and the camera capturing will snap the image of the student. The system compares the picture taking from a camera capturing images and faces in the database done much time to perfect the attendance.

Other paper proposed by [5] introduced a real-time computer vision algorithm in automatic attendance management system. The system installed the camera with non-intrusive, which can snap images in the classroom and compared the extracted face from the image of the camera capturing with faces inside the system. This system also used machine learning algorithm which are usually used in computer vision. Also, HAAR CLASSIFIERS used to train the images from the camera capturing. The face snap by the camera capturing will convert to grayscale and do subtraction on the images; then the image is transferred to store on the server and processing later.

In 2012 N. Kar [6] introduced an automated attendance management system using face recognition technique which used the Principal Component Analysis To implementation the system, use two libraries such OpenCV is a computer vision library and FLTK(Light Tool Kit. Both of this libraries helped the development such as OpenCV support algorithm and FLTK used to design the interface. In the system, there are Request Matching and Adding New fact to Database. In Request Matching, the first step is open the camera and snap the photo after the extraction the frontal face. The next step is recognizing the face with the training data and project the extracted face onto the Principal Component Analysis. The final step displays the nearest face with the acquired images. Apart from that, adding a new face into the database is snap the photo after that extract the frontal face images and then perform the Haar cascade Method to find the object in the image in different window size. The next step is to store the image into the database and to learn the face then perform the Principal Component Analysis Algorithm. The final step is storing the information inside the face XML file. The system is focused on the algorithm to improve the face detection from acquired images or videos.

In [9] the author also proposed a system which implements automatic attendance using face recognition. The system which can extract the object in the face such nose, mouth by using MATLAB with Principal Component Analysis (PCA). The system [7] designed to resolve the issues of attendance marking system such as time-consuming. As the result of the experiment show that this paper, the system can recognize in case the dark background or difference view of the face in the classroom. Jyotshana Kanti [8] proposed a smart attendance marking system which combines two differencing algorithms such Principal Component Analysis and Artificial Neural Network. The purpose of the author is to solve the traditional attendance marking resolve the time-consuming. In the system implement with Principal Component Analysis, it does an extraction and identify the similarities of the face database and acquire images. Artificial Neural Network is used to solve the problem of the input data or learn from the input data, and the expect value. In the system implemented by the author using back propagation algorithm and combines with mathematical function to perform in that system. As a result, written by the author research, it shows that the system can use to recognize in a different environment.

In [7] Priyanka Thakare proposed a method using Eigenface and Principal Component Analysis which has the architecture as the following step. The camera needs to install in the front which can capture an entire face of the student inside the class. The first phase after the camera has been captured; the captured image was transferred into the system as an input. The image capture from the camera sometimes come with the darkness or brightness which need to do an enhancement on it such as convert to gray image. The next step, Histogram Normalization is used in this system remove the contrast of the image. It is easy to recognize when has the student sit in the back row. The Median filter is used to remove noise from the image in case the camera is high definition camera, but sometimes it still contains the noise. The author also implements with skin classification which changes all the pixel to black except the pixel are close to the skin.

3. PROPOSED WORK

Nowadays Educational institutions are concerned about regularity of student attendance. This is mainly due to students' overall academic performance is affected by his or her attendance in the institute. Mainly there are two conventional methods of marking attendance which are calling out the roll call or by taking student sign on paper. They both were more time consuming and difficult. Hence, there is a requirement of computer-based student attendance management system which will assist the faculty for maintaining attendance record automatically.

In this paper we propose an automated attendance management system. This system, which is based on face detection and recognition algorithms, automatically detects the student when he enters the class room and marks the attendance by recognizing him. Taking attendance using traditional attendance marking system has been a tedious task as it involves a lot of paperwork, and there are chances of redundant attendance, and is highly inefficient. Machine Learning on Facial Recognition The approach we are going to use for facial recognition is very straight forward .Let's see how modern face recognition works.

The goal here is to get deep neural network to output a person's face with identification. This means that the neural network needs to be trained to automatically identify different features of a face and calculate numbers based on that. The output of the neural network can be thought of as an identifier for a particular person's face—if you pass in different images of the same person, the output of the neural network will be very similar or close, whereas if you pass in images of a different person, the output will be very different.

Model and their training

The model is designed to be a GUI based project. To serve the image to the model, the id and the name is entered and then the sample images are taken by "Take image" button. Once you click the take image button the camera of the system opens up and the 60 image samples of a particular person is taken for accuracy of the system. The camera then closes once it is done with 60 image samples and once the samples are been taken then at the Notification text field you'll see the status of the model.

Now the next step will be to train the model of the image sample taken. In this step the "Train Images" button is clicked and internally the algorithm train the model by the image samples taken from the previous step. And then again at the notification text field the status of the model is again shown.

Approach towards solution

The system consists of a camera that records the video of the class captures the images of the person then the image is sent to the image enhancement module. After enhancement the

image comes in the Face Detection and Recognition modules and then the attendance is marked. At the time of enrolment, samples of face images of individual persons are stored in the Face database. Here all the faces are detected from the input image and the algorithm compares them one by one with the face dataset. If any face is recognized the attendance is marked. Human beings perform face recognition automatically every day and practically with no effort. Although it sounds like a very simple task for us, it has proven to be a complex task for a computer, as it has many variables that can impair the accuracy of the methods, for example: illumination variation, low resolution, occlusion, amongst other. In computer science, face recognition is basically the task of recognizing a person based on its facial image. It has become very popular in the last two decades, mainly because of the new methods developed and the high quality of the current videos/cameras.

Face Detection: It has the objective of finding the faces (location and size) in an image and probably extract them to be used by the face recognition algorithm.

Face Recognition: with the facial images already extracted, cropped, resized and usually converted to grayscale, the face recognition algorithm is responsible for finding characteristics which best describe the image.

The face recognition systems can operate basically in two modes:

Verification or authentication of a facial image: It basically compares the input facial image with the facial image related to the user which is requiring the authentication. It is basically a 1x1 comparison.

Identification or facial recognition: It basically compares the input facial image with all facial images from a dataset with the aim to find the user that matches that face. It is basically a 1xN comparison.

Algorithm Used : Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. It was first described in 1994 (LBP) and has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets. Using the LBP combined with histograms we can represent the face images with a simple data vector. As LBP 1s a visual descriptor it can also be used for face recognition tasks, as can be seen in the following step-by-step explanation.

Steps:

1. Parameters: the LBPH uses 4 parameters:

Radius: the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.

Neighbors: the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.

Grid X: the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.

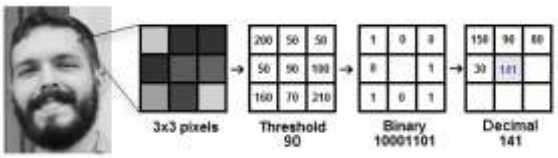
Grid Y: the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.

Don't worry about the parameters right now, you will understand them after reading the next steps.

2.Training the Algorithm: First, we need to train the algorithm. To do so, we need to use a dataset with the facial images of the people we want to recognize. We need to also set an ID (it may be a number or the name of the person) for each image, so the algorithm will use this information to recognize an input image and give you an output. Images of the same person must have the same ID. With the training set already constructed, let's see the LBPH computational steps.

3.Applying the LBP operation: The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. To do so, the algorithm uses a concept of a sliding window, based on the parameters radius and neighbors.

The image below shows this procedure:



Based on the image above, let's break it into several small steps so we can understand it easily: Suppose we have a facial image in grayscale. We can get part of this image as a window of 3x3 pixels.

It can also be represented as a 3x3 matrix containing the intensity of each pixel (0~255). Then, we need to take the central value of the matrix to be used as the threshold. This value will be used to define the new values from the 8 neighbors.

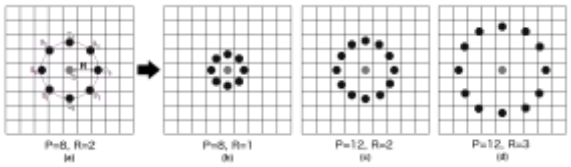
For each neighbor of the central value (threshold), we set a new binary value. We set 1 for values equal or higher than the threshold and 0 for values lower than the threshold.

Now, the matrix will contain only binary values (ignoring the central value). We need to concatenate each binary value from each position from the matrix line by line into a new binary value (e.g. 10001101). Note: some authors use other

approaches to concatenate the binary values (e.g. clockwise direction), but the final result will be the same.

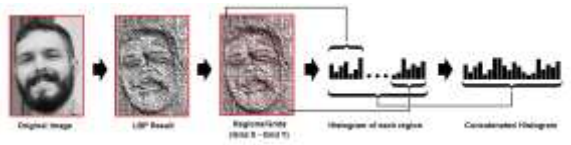
Then, we convert this binary value to a decimal value and set it to the central value of the matrix, which is actually a pixel from the original image. At the end of this procedure (LBP procedure), we have a new image which represents better the characteristics of the original image.

Note: The LBP procedure was expanded to use a different number of radius and neighbors, it is called Circular LBP.



It can be done by using bilinear interpolation. If some data point is between the pixels, it uses the values from the 4 nearest pixels (2x2) to estimate the value of the new data point.

4.Extracting the Histograms: Now, using the image generated in the last step, we can use the Grid X and Grid Y parameters to divide the image into multiple grids, as can be seen in the following image:



Based on the image above, we can extract the histogram of each region as follows:

As we have an image in grayscale, each histogram (from each grid) will contain only 256 positions (0~255) representing the occurrences of each pixel intensity. Then, we need to concatenate each histogram to create a new and bigger histogram. Supposing we have 8x8 grids, we will have 8x8x256=16.384 positions in the final histogram. The final histogram represents the characteristics of the image original image.

The LBPH algorithm is pretty much it.

5.Performing the face recognition: In this step, the algorithm is already trained. Each histogram created is used to represent each image from the training dataset. So, given an input image, we perform the steps again for this new image and creates a histogram which represents the image. So to find the image that matches the input image we just need to compare two histograms and return the image with the closest histogram.

We can use various approaches to compare the histograms (calculate the distance between two histograms), for example: Euclidean distance, chi-square, absolute value, etc.

So the algorithm output is the ID from the image with the closest histogram. The algorithm should also return the calculated distance, which can be used as a 'confidence' measurement. Note: don't be fooled about the 'confidence' name, as lower confidences are better because it means the distance between the two histograms is closer.

We can then use a threshold and the 'confidence' to automatically estimate if the algorithm has correctly recognized the image. We can assume that the algorithm has successfully recognized if the confidence is lower than the threshold defined.

4. RESULT

Attendance System is the advancement that has taken place in the field of automation replacing traditional attendance marking activity. We have projected our ideas to implement "Automated Attendance System Based on Face Recognition', in which it imbibes large applications. The application includes face identification, which saves time and eliminates chances of proxy attendance because of the face authorization. Hence, this system can be implemented in a field where attendance plays an important role.

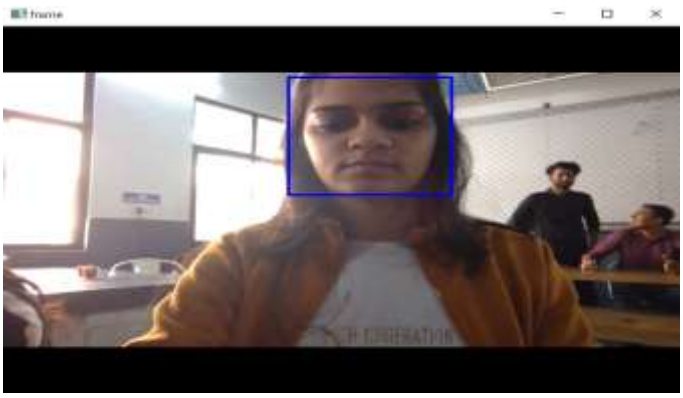


Figure 4.1: Face Detection

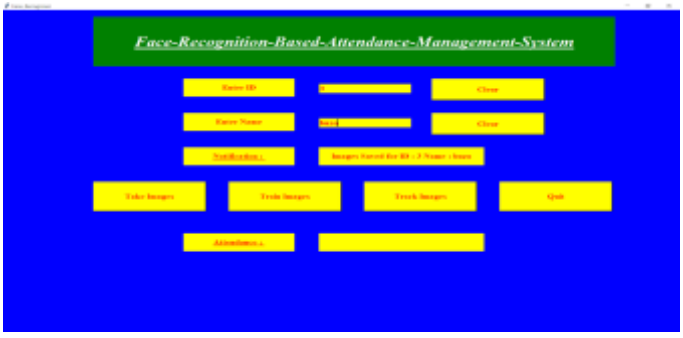


Figure 4.2: Data Saved

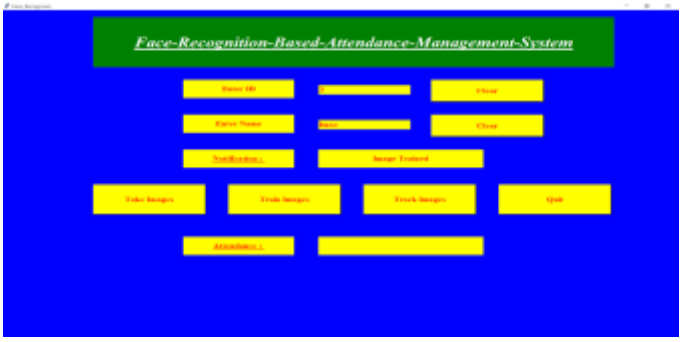


Figure 4.3: Model Trained

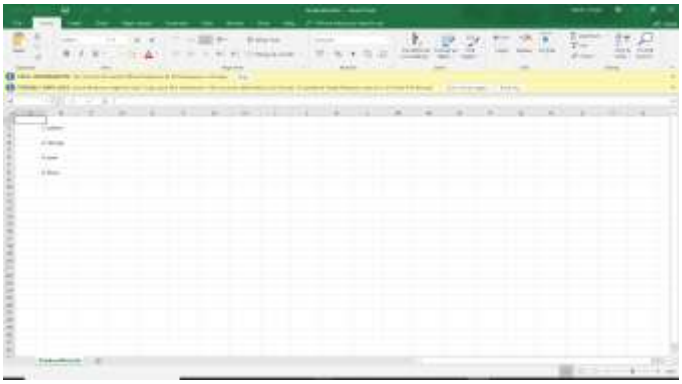


Figure 4.4: Records

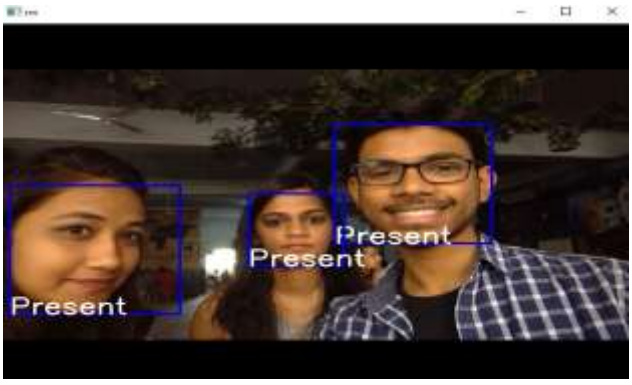


Figure 4.5: Face Recognition

5. CONCLUSIONS

This system has been proposed for maintaining the attendance record. The main motive behind developing this system is to eliminate all the drawbacks which were associated with manual attendance system.

The drawbacks ranging from wastage of time and paper, till the proxy issues arising in a class, will completely be eliminated.

Hence, desired results with user friendly interface is expected in the future, from the system. The efficiency of the system could also be increased by integrating various steps and techniques in the future developing stages of the system used for face detection. Where it is used in both creating database and face recognition process. Where in case creating database it takes input image through a web camera continuously. Captured image undergoes face detection. Detected face will be cropped and stored in database. Where in case of face recognition if there is any movement video surveillance will be used to detect the moving object. The captured image undergoes face detection and further processed later by face Cross-Correlation and Normalized-Correlation are used to extract the Coordinates of peak with the target images. The peak of the cross-correlation matrix occurs where the sub images are best correlated. Find the total offset between the images. The total offset or translation between images depends on the location of the peak in the cross correlation matrix, and on the size and position of the sub images. Check if the face is extracted from the target Image. Figure out where face exactly matches inside of target image.

ACKNOWLEDGEMENT

It gives us great pleasure in presenting this project synopsis report titled: " Automated Attendance System using Face detection". We express our gratitude to our project guide Mrs. Abhilasha Varshney (Assistant Professor), who provided us with all the guidance and encouragement. We also would like to deeply express our sincere gratitude to the Head of the Information Technology Department Dr. Pooja Tripathi, for her approval to this project. We are also thankful to her for providing us the needed assistance, detailed suggestions and also encouragement to this project. We would like to deeply express our sincere gratitude to our respected director Dr.B.C.Sharma and the management of Inderprastha Engineering College for providing such an ideal atmosphere to build up this project with well-equipped and up to date IT Laboratories. We are extremely thankful to all the staff and the management of the college for providing us all the facilities and resources required.

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