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Vision-Face Recognition Attendance Monitoring System for Surveillance using Deep Learning Technology and Computer Vision.

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***Abstract*— Nowadays, Artificial Neural networks can be trained over several billion images and can be used to detect and recognize faces with relative ease and flexibility in an instant. This concept is used in the implementation of this real time attendance cum surveillance system that can be prototyped and set into action. Some of the major applications of this innovative method include face attendance using a single snap mode in smartphones for university classes, further real-time facial recognition surveillance of lab facilities and work places which can set this as a first line of defense against intruders from gaining access. The user-friendly graphical user interface provides flexibility and ease in running these powerful face recognition algorithms powered by deep-learning. We have achieved a maximum recognition accuracy of 74 percent while running the real time surveillance algorithm. This work was done as a solution to the absence of a robust and user friendly face recognition attendance system.**

Keywords*— *Face Attendance, Face Detection, Face Recognition, Computer Vision, Deep Learning, Biometric Surveillance.

I. INTRODUCTION

Face Recognition algorithms have many limitations in a real-world scenario like lighting conditions and proxy via pictures and low-quality image processing. In this era of Machine learning and Artificial Intelligence computers have evolved to process huge chunks of data at very high rates with maximum process efficiency and image processing and computer vision powered by Deep learning algorithms have geared up to make face recognition a reality, solving or reducing most of the previous limitations. Vision is a fully isolated system setup on a Raspberry Pi and is modular. The system can be controlled via a network communication to the PI server and also, all the reports and well maintained in the attendance server onboard and online. This module is equipped with a user-friendly GUI (Graphical User Interface) for ease of use. The GUI offer various options for the administrator to operate the system like choose between Realtime surveillance or single snap mode, to train and update the classifier with new face data Fig.4. The backbone of the software is driven by python code with Open source computer vision library and Tkinter library for Graphical user interface.

II. SYSTEM DESCRIPTION

There are 4 main phases for the vision attendance system Fig.1:

- Face Detection and its respective gathering of data.
- Training the recognizer
- Facial Recognition
- Attendance Management in Excel

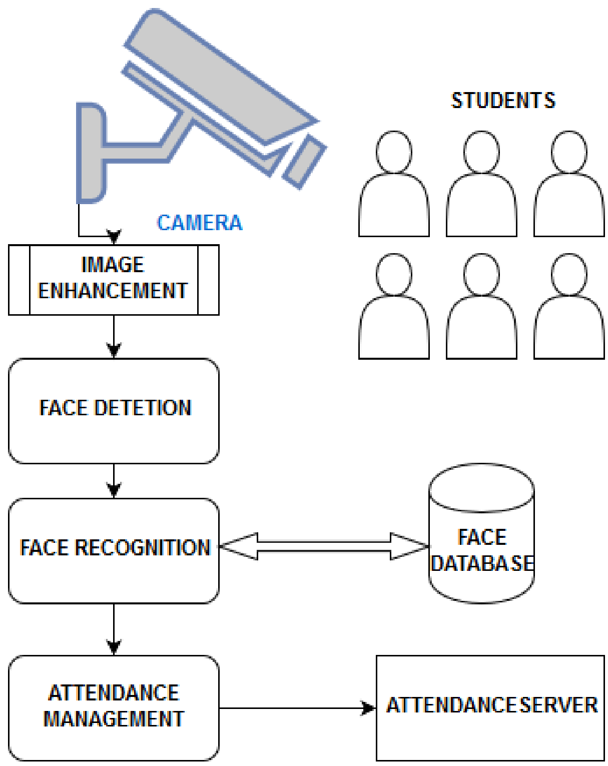


Fig. 1. System depiction and data transfer flow chart.

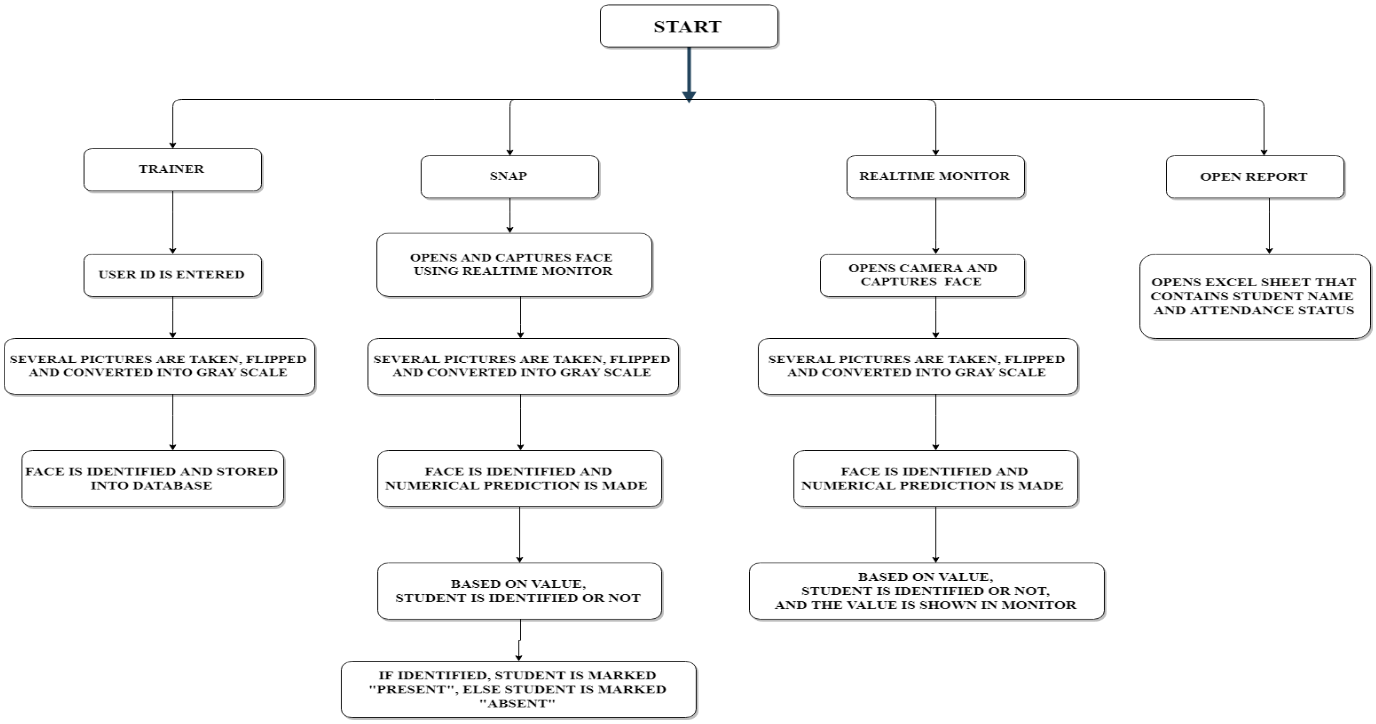


Fig. 2. Program workflow and breakdown.

III. IMAGE PRE-PROCESSING

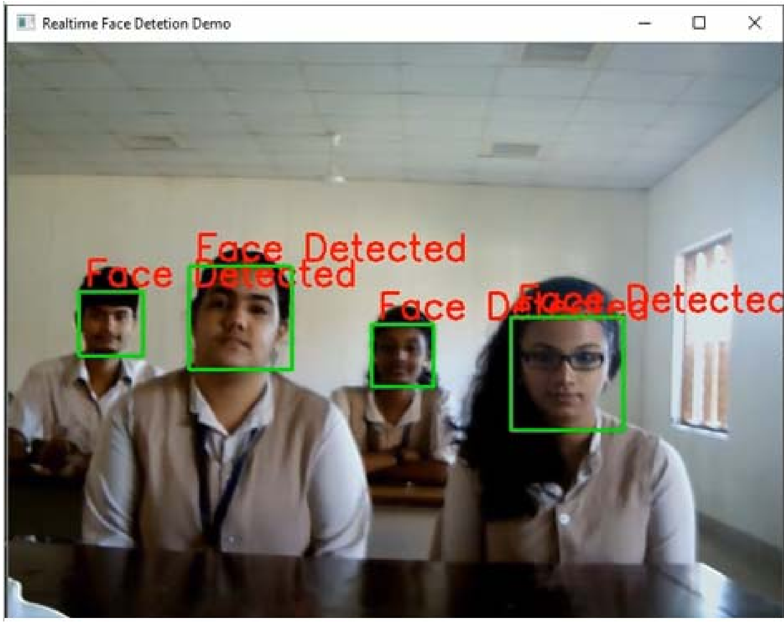
The input image is read and is converted into grayscale image of 8 bits. The image is flipped along the vertical axis and is resized using Bicubic Interpolation over 4x4 pixel neighborhood method. Bicubic Interpolation is used to find the position of two nearby points and getting the orientation or gradients at those positions, which gets connected by a piece wise cubic spline to get a smoother and image with a fewer interpolation artefacts. It is also used to calculate the positions of the points between the two end points and there by getting the new resized pixels value. For the facial recognition it is necessary to enhance the facial features. The method used here is thresholding using Tozero, which is performed on to the image where the pixels at the thresholding value is converted to black and the other to subsequent lighter shades. Morphological transformation is performed on the image in order to remove the noise and isolate individual elements. Morphological closing which is used here will first dilate the image that is, remove the noise of the object image and close the disjoint areas. It is followed by erosion which removes the white noise by discarding the pixels near the boundary depending on the kernel used Fig.2.

IV. DETECTION

Face detection is done using Haar Cascade Method (feature-based) which uses machine learning algorithms to classify images into two categories- images containing faces and images of objects [1]. In this method we use cv2.CascadeClassifier() to classify the input images. Further, feature wise extraction is performed on the images. Features are selected in such a way that it could effectively classify images. For instance, the area of the eyes is compared to the areas near the nose. As the region near the eyes are lighter than that of region of the nose, this can classify the samples [7]. All such features are applied on all training images. And for each feature, there is a threshold value, which identifies the face and nonface images and classify them accordingly. Since there is high chance for errors, we consider the features with minimum error rate. During each classification, the misclassified images are given more weight and the process is repeated. New error rates and weights are calculated until the requirements are met. To ease the process, the features are grouped into different sets of classifiers and then applied to the window one at a time Fig.2. If a window fails the first stage, it is discarded. If it succeeds, then the next set of features are applied. If a window passes all the stages, it is considered as a face region.

V. TRAINING

In the training phase, the entire user data within the database is selected, accompanied by the OpenCV recognizer, “Trainer”. This operation is performed by a function contained in OpenCV, which will result in a .yml file placed on a “trainer/” directory. The recognizer, that is used here, is the LOCAL BINARY PATTERNS HISTOGRAMS (abbreviated as LBPH), which is implemented using the following line of code: **cv2.face.LBPHFaceRecognizer-create().** To select all the photos from the directory : “dataset/”, “getImagesAndLabels (path)” function is used, which when implemented, will return two arrays “Ids” and “faces”. These two arrays are then provided as inputs to the recognizer.train() function which trains our recognizer and results in a file named “trainer.yml” that will be saved in the trainer directory[2].



	A	B	C	D
1	NAME	ATTENDANCE	DATE	TIME TAKEN
2				
3	Hari	Present	23-02-2019	09:50 AM
4	Namitha	Present	23-02-2019	09:50 AM
5	Pranav	Absent	23-02-2019	09:50 AM
6	Vaishnavi	Present	23-02-2019	09:50 AM
7	Saurab	Absent	23-02-2019	09:50 AM
8	Varshini	Present	23-02-2019	09:50 AM

Fig. 3. Working demo with database results and Hardware Prototype.

VI. RECOGNITION

Image recognition is done using Local Binary Pattern Histogram (LBPH) in which a 3x3 matrix window is moved along the image and the pixel value at the central location of the matrix is calculated. The pixel value at the center is compared with the neighboring pixel values. If the values measured are greater than or equal to the central pixel value then that pixel value is read as 1 and the rest as 0. The values are read in clockwise order, forming a binary value which is the local binary pattern of that specific area. This is done to the entire image and LBPs are obtained [3].

The obtained LBPs are converted to its corresponding binary values and histograms are plotted against each value. Each face will have a histogram in the training dataset. When a new face is detected, its histogram is compared with the training dataset and the best matching histogram is returned with the label of the person it belongs to. After that, when a face is captured on the camera, the recognizer tries to identify the face and make a prediction. It checks if the face data is already available in the training dataset. If the data is available, it returns the histogram ID and an index. A portion of the face is taken as a parameter by the recognizer. predict () and it will output the ID of the owner and the accuracy of the recognizer. The confident index will output zero if it is a perfect match. When a successful prediction is made, the probable id and the probability of a right match is displayed over the image. Otherwise, an unknown label is displayed Fig.3.

VII. SINGLE SNAP MODE

For the purpose of using the single snap mode, the backend consists of a function, snap() : This function is used to capture the face of a student, identify him/her and if identified, marks him/her as present in the excel sheet of attendances[5]. It consists of several variables which are initialized first, and also contains a list of names of the trained faces. Then it initializes and starts real time video capture. The image of the student is captured, flipped and converted into grayscale. Within a for loop, a rectangular box is created to outline the face and using a function called recognizer.predict(), a numerical value on the closeness or similarity of the face is found by comparing with the trained faces. Using the “If” and “Else” conditions, if the confidence value is within a certain threshold, it will show the name of the face on the window, else it will show “unknown face”. It prints the name of the student and confidence level, and using above entry function, the name and status record is then entered into the excel sheet and the loop is exited.

VIII. REALTIME SURVEILLANCE

Realtime surveillance can be obtained using the backend function, realtime() : This function gives produces a real time monitor which can be used for surveillance in lab facilities and classrooms for real-time surveillance. Its implemented to show that the system works by showing a live feed Fig.3. The variables are initialized and uses Videocapture() function. Within an infinite loop, the images are captured using read() function, flipped and converted into grayscale[4]. A rectangular box is made to show that it identified the face using predict() function, the confidence levels are predicted[6]. If the predicted confidence levels are within a certain threshold, the name of the student is displayed. Using the escape key, the real time monitor can be exited.

IX. REPORT GENERATION

The Back end of the program consist of a function, Openreport() : This function is to open the excel report which contains the attendance record of the students for a particular day. The frontend consists of the tkinter program which includes the necessary widgets, labels etc to create the visual output of the GUI. Within the frontend script, the

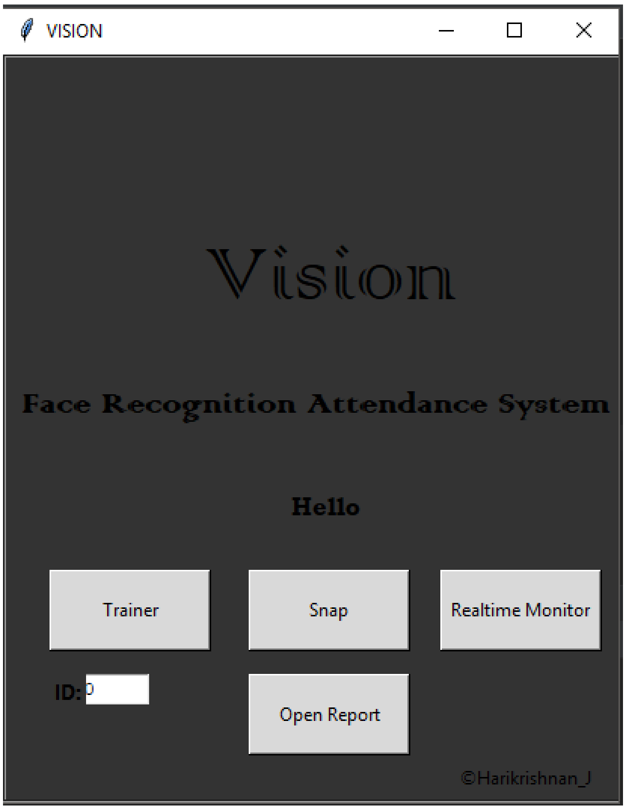


Fig.4. Graphical User Inferface of Vision.

functions are called from the backend script using the import module which allows the use of functions in the frontend script and using the button, function is used via command to indicate that when the button for the required function is pressed, the command accesses the function and does the required functionality to obtain the desired result. In this case if it recognizes the student, it marks him/her as present in the attendance record for the current day Fig.3.

X. FUTURE WORKS

On the basis of the present research works carried out, the following are the scope of future work for the detection and recognition [8]. To increase the efficiency of detection and recognition to above 90 percent. Expanding the domain of attendance system from colleges to office and enterprises. Monitoring the arrival and departure of the employees accurately and reliably without any proxy attendance [16].
Using of superior algorithms like Fisher face algorithm for facial recognition and classification to maximize the separation between classes in the training data process.
To develop this system into a simple portable hardware system. The proposed methods can be applied for Active student tracking, law enforcement, Information Security,
Voter verification, Access control, Surveillance and banking.

XI. RESULTS

Vision has been trained and tested over several situations of a classroom environment and has achieved a maximum recognition accuracy of 74 per cent and above. The entire Graphical user inter face is robust and easy to use and has been configured to be used with a pocket-sized computer like a Raspberry Pi Fig.3. The entire system can be run on a raspberry pi along with a surveillance camera which are the only requirements. The modularity of the system enables it to be implemented or applied in classrooms and lab facilities for real-time surveillance or regular attendance even under poor lighting conditions due to the Image Pre-processing techniques which are being used in the system.
The system enables the user to store the data (attendance) automatically to the attendance server onboard and also online which saves time and is also user friendly. Vision can be used in Single Snap mode or Real time surveillance mode according to the convenience of the user. Due to the efficient onboard data storage mechanism and real time surveillance Proxy via pictures is impossible, resolving major limitation of Face recognition systems. In comparison to reference [2], the haar cascade classifier used in this system is way easier to implement as it only requires a smaller dataset in contrast to the Deep Semi-NMF feature used in the cited reference. In comparison to reference [7], our current system is much simpler, quicker and provides a very high detection success rate of over 70 per cent in contrast to the cited reference. In comparison to reference [8], the Haar features based cascade classifier is better at detecting edges and lines than the viola jones algorithm that is used in the cited reference. In comparison to reference [13], the haar cascade classifier used in our current algorithm only requires a comparatively smaller dataset to the cited reference and provides a higher face detection accuracy of over 70 per cent. In comparison to reference [10], the current model of vision uses LBPH along with haar cascade classifier to provide high face detection accuracy using a smaller dataset along with faster processing speeds and is able to detect all types of faces with a high accuracy.

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